1. Fluid and water balance

Name	Organization	General comments	Detailed comments	Comment from authors
Johanna Kaipiainen (M.Sc) **Charlotta Hyttinen (M.Sc)**	Finnish Vegan Association		Side 7: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	changed

2. Energy

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Janne Lauk	NIHD Estonia	-	Page 8 table 7a - energy recommendations for the 10 y.o boys are higher than for the 11 y.o boys. As a general principle, the energy requirements in teenage years increase with age. When giving specific recommendation, this principle should be followed.	Thank you for your comments. We are aware of this numbers, and this is valid for both Table 7a and 7b. We have added a sentence to the paragraph that the energy values calculated for ages around the borderline values (ie 9-11y) should be interpreted with caution.
Ellen Ulleberg	Norwegian Dairy Council	We thank the NNR committee for the opportunity to respond to the draft of the chapter on energy. The chapter is well written and an interesting and important update on factors related to energy expenditure and requirements. Regarding the sections of the article covering energy requirements in pregnant- and lactating women, we propose that different energy sources are more thoroughly discussed. As is well established, pregnant- and lactating women have increased energy requirements. In addition, pregnant and lactating women have an increased daily recommended intake of several micronutrients. Examples of such nutrients are iodine and calcium. In Norway, around half of all pregnant women have a lower intake of iodine than the recommendation (1). It should be stressed that for pregnant- and lactating women it is important that the extra energy requirements are met through foods that are also nutrient dense	None	Thank you for your commment. We agree that iodine and calcium are important for pregnant and lactating women. However, this will disucussed in the specific micronutrient chapters "iodine" and "calcium".

		and a source of micronutrients important for pregnant and lactating women. Fish (white) and dairy products are the main sources to iodine in the Norwegian diet and are examples of foods important for pregnant- and lactating women. These foods are rich in other important nutrients as well (such as e.g. vitamin D for white fish, and calcium, B-vitamins and phosphorus for dairy). In addition, intake of dairy products may prevent weight gain, as stated earlier in the chapter. Many pregnant- and lactating are not aware of the sources of important micronutrients in- and after pregnancy (2) and this should be emphasized in the NNR 2022. References: 1. Meltzer HM, Torheim LE, Brantsæter AL, et al. Risiko for jodmangel i Norge - Identifisering av et akutt behov for tiltak. Oslo: Nasjonalt råd for ernæring; 2016 2. Garnweidner-Holme, L.; Aakre, I.; Lilleengen, A.M.; Brantsæter, A.L.; Henjum, S. Knowledge about Iodine in Pregnant and Lactating Women in the Oslo Area, Norway. Nutrients 2017, 9, 493		
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Energy draft. Here are the comments from LRF. Page 5: Determinants of obesity and weight control, row 5: It is stated that "Meat predicted more weight gain." However, accordingly to the reference (52), Fogelholm et al (2012) that is used in this draft, the following can be found:	.	Thank you for this comments. We have added the following sentences: "Furthermore, the consumption of meat, in general, shows an increase in weight gain. However, it is important to mention that the intake of lean meat with a higher protein content and less saturated fatty acids, as part of a healthy diet, could contribute to weight loss and weight maintenance" + references

		- Meat, general, 3 studies, strength of evidence: probable. - Meat, processed, 1 study, strength of evidence: no conclusion - Meat, red meat (unprocessed): 2 studies, strength of evidence: no conclusion - Hamburgers, pizza, sausage, 1 study, strength of evidence: no conclusion Further, there are three studies in Fogelholm et al (2012) reporting a positive association between weight change and meat intake. However, Fogelholm themselves state that two of those studies "are not totally independent: the former was based on a subpopulation of the EPIC cohort, while the latter used the entire cohort for analyses." Fogelholm also state that one of their references found "a higher intake of red meat protected against an increase in weight change, adjusted for BMI". Based on this, we urge the authors to reconsider their conclusion regarding meat and weight gain, or provide the readers with more scientific evidence to support their conclusion.		
L.M. Granskog	concerned citizen	The rise in non-communicable diseases (NCDs) parallels the increased consumption of processed foods, including sugar, refined flour, rice, and vegetable oils, while the consumption of saturated fats from animal sources was inversely correlated with NCDs (https://doi.org/10.3389/fnut.2021.748847). This raises doubts about the dietary guidelines. The well known article by Hall,	Articles discussing satiety and the protein leverage hypothesis should be included in the reference list and discussed.	Thank you for your comments. Indeed, the intake of UPF plays a role in weigh gain and weight maintenance. This will be discussed in the chapter "UPF".

		K.D. et.al. https://doi.org/10.1016/j.cmet.2019.05.008 mentions that a possible partial explanation for the weight gain with ultra-processed food is the protein leverage hypothesis, and these references are cited in that article: https://doi.org/10.1017/S1368980017001574 https://doi.org/10.1111/j.1467-789X.2005.00178.x Animals that don't get enough protein will apparently keep eating until they do. https://doi.org/10.1038/508S66a This an important point which deserves discussion in this chapter.		
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	No general comments.	Page 11. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Page 14. As seen in table 5 in the following WHO's publication, processing of plant-based proteins improves their absorption. For example, absorption of wheat gluten is 99 % white wheat flour 96 % and soy protein isolate 95 %. Reference: Protein and amino acids requirements in human nutrition: report of a join FAO/WHO/UNU expert consultation (WHO technical report series; no 939) Word Health Organization 2007. Available: https://apps.who.int/iris/handle/10665/43411	Thank you for your comments. We have changed IOM into National Academy of Medicine. We have added that protein digestibility is depending on the processing and the reference to the paragraph about protein energy content and digestion, page 14.

Puk Holm	Danish Agriculture & Food Council	Thank you for the opportunity to comment on the NNR chapter on Energy.	Page 5: The reference used to support the statement in line 5 under the specific paragraph Determinants of obesity and weight control: "Meat predicted more weight gain" repeated in lines above figure 1: Fogelholm et al (2012) reference no 52, has the highest strength of evidence "probable" when it comes to meat in general. Other categories are inconclusive or dismissed. This is very weak and belated scientific evidence (so is reference no 46 Jeffery RW (1996)) for the stated conclusion on meat in the chapter. Later published evidence shows that lean meat, and as part of healthy diets, provides good basis for weight loss and maintenance. We recommend further revision of the statement with more recent and sound evidence.	Thank you for this comment. We have added the following sentences: "Furthermore, the consumption of meat, in general, shows an increase in weight gain. However, it is important to mention that the intake of lean meat with a higher protein content and less saturated fatty acids, as part of a healthy diet, could contribute to weight loss and weight maintenance" + references
Swedish food agency	Swedish food agency	No general comments.	Could be good to add that BMI could be higher in well trained athletes, not only in body builders. Good with the combination of measuring the waist circumference to circumvent this issue.	Thank you for your comment. We have added well-trained athletes to the sentence.

3. Fat and fatty acids

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Nina Teicholz	Nutrition Coalition	There is insufficient evidence to show that saturated fat cause CVD or total mortality. More than 20+ review papers over the past 15 years have reached this conclusion. These papers have concluded that the evidence is lacking to support the continuation of numeric caps on saturated fats. Further, when recommending vegetable oils instead of saturated fats, the harms of omega-6 vegetable oils, such as the their clear effects on inflammation and cancer, have not been considered. Thus, recommending that polyunsaturated vegetable oils replace saturated fats is also a recommendation unsupported by the totality of the evidence. Among the many reviews and umbrella reviews that have been published on this topic over the past 15 years are the following, whose authors include 5 members of former US Dietary Guidelines Advisory Committees: Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? https://www.mdpi.com/2072-6643/13/10/3305 Astrup, A.; Teicholz, N.; Magkos, F.; Bier, D.M.; Brenna, J.T.; King, J.C.; Mente, A.; Ordovas, J.M.; Volek, J.S.; Yusuf, S.; Krauss, R.M. Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? Nutrients 2021, 13, 3305.	There is insufficient evidence to show that saturated fat cause CVD or total mortality. More than 20+ review papers over the past 15 years have reached this conclusion. These papers have concluded that the evidence is lacking to support the continuation of numeric caps on saturated fats. Further, when recommending vegetable oils instead of saturated fats, the harms of omega-6 vegetable oils, such as the their clear effects on inflammation and cancer, have not been considered. Thus, recommending that polyunsaturated vegetable oils replace saturated fats is also a recommendation unsupported by the totality of the evidence. Among the many reviews and umbrella reviews that have been published on this topic over the past 15 years are the following, whose authors include 5 members of former US Dietary Guidelines Advisory Committees: Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? https://www.mdpi.com/2072-6643/13/10/3305 Astrup, A.; Teicholz, N.; Magkos, F.; Bier, D.M.; Brenna, J.T.; King, J.C.; Mente, A.; Ordovas, J.M.; Volek, J.S.; Yusuf, S.; Krauss, R.M. Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? Nutrients 2021, 13, 3305. https://doi.org/10.3390/nu13103305	Considered

		https://doi.org/10.3390/nu13103305 JACC State-Of-The-Art Review: Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations https://www.jacc.org/doi/abs/10.1016/j.jacc.2020.05.077 Astrup A, Magkos F, Bier D, et al. Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations. J Am Coll Cardiol. 2020 Aug, 76 (7) 844–857. https://doi.org/10.1016/j.jacc.2020.05.077 A short history of saturated fat: the making and unmaking of a scientific consensus Teicholz, Nina Teicholz, Nina. A short history of saturated fat: the making and unmaking of a scientific consensus. Current Opinion in Endocrinology & Diabetes and Obesity: December 09, 2022 - Volume - Issue - 10.1097/MED.0000000000000791 doi: 10.1097/MED.0000000000000791 https://journals.lww.com/co-endocrinology/Fulltext/9900/A_short_history_of_saturated_fat__the_making_and.42.aspx	JACC State-Of-The-Art Review: Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations https://www.jacc.org/doi/abs/10.1016/j.jacc.2020.05.077 Astrup A, Magkos F, Bier D, et al. Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations. J Am Coll Cardiol. 2020 Aug, 76 (7) 844–857. https://doi.org/10.1016/j.jacc.2020.05.077 A short history of saturated fat: the making and unmaking of a scientific consensus Teicholz, Nina Teicholz, Nina. A short history of saturated fat: the making and unmaking of a scientific consensus. Current Opinion in Endocrinology & Diabetes and Obesity: December 09, 2022 - Volume - Issue - 10.1097/MED.0000000000000791 doi: 10.1097/MED.0000000000000791 https://journals.lww.com/co-endocrinology/Fulltext/9900/A_short_history_of_saturated_fat__the_making_and.42.aspx	

Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc),	Finnish Vegan Association	No general comments.	Page 36. It remains unanswered, how do pregnant and lactating vegans (and vegetarians) get their 200 mg/day DHA. Findings from studies are consistent: vegans have lower blood DHA status than people who eat fish (see references 1-4). In one study no differences were seen in breast milk DHA content between vegan and other mothers, although the prevalence of low DHA concentrations was common in all dietary patterns. But it is noteworthy, that in this study 27 % of vegan mothers used DHA supplement (5). The Finnish Vegan Association recommends a supplement of 200 mg/day of DHA for pregnant and lactating vegans. DHA supplementation for vegan mothers is also suggested in NNR chapter “Infant feeding”. It would be preferable if all chapters were in line with other chapters regarding DHA supplementation, as well as with a recommendation set by the Finnish Vegan Association. So far, the Finnish Vegan Association haven’t had a DHA recommendation for vegan children. References: 1. Elorinne A-L, Alfthan G, Erlund I, Kivimäki H, Paju A, Salminen I et al. Food and nutrient intake and nutritional status of Finnish vegans and non-vegetarians. PLoS One 2016;11(2):e0148235.doi:10.1371/journal.pone.0148235 Available: https://pubmed.ncbi.nlm.nih.gov/26840251/ 2. Sarter B, Kelsey KS, Schwartz TA, Harris WS. Blood docosahexaenoic acid and	Based on the chapter 'Infant feeding' we have included the following sentences "Pregnant and breastfeeding mothers who eat a vegan or vegetarian diet should be advised to take a daily DHA supplement. When the breastfed child of a vegan mother begins with solid foods, they should also be given DHA supplement. "

			eicosapentaenoic acid in vegans: associations with age and gender and effects of an algal-derived omega-3 fatty acid supplement. Clinical Nutrition 2015;34:212-218. Available: https://pubmed.ncbi.nlm.nih.gov/24679552/ 3. Rosell MS, Lloyd-Wrigth Z, Appleby PN, Sanders TAB, Allen NE, Key TJ. Long-chain n-3 polyunsaturated fatty acids in plasma in British meat-eating, vegetarian, and vegan men. Am J Clin Nutr 2005;82:327-34. Available: https://pubmed.ncbi.nlm.nih.gov/16087975/ 4. Sanders T. DHA status of vegetarians. Prostaglandis, Leukot Essent Fatty Acids 2009;81:137-41. Available: https://pubmed.ncbi.nlm.nih.gov/19500961/ 5. Perrin MT, Pawlak R, Dean LL, Christis A, Friend L. A cross-sectional study of fatty acids and brain-derived neurotrophic factor (BDNF) in human milk from lactating women following vegan, vegetarian, and omnivore diets. Eur J Clin Nutr 2019;58(6):2401-2410. Available: https://pubmed.ncbi.nlm.nih.gov/30051170/ Page 36. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	

Anna-Lena Klapp	ProVeg International	-	On page 1, the authors write: “Ruminant TFA, as well as biomarker levels of oddchain fatty acids, are associated with lower risk of T2D.” Please replace the word "are" with the words “might be” here as the evidence states that it is uncertain whether this a true biological difference between “industrial” or “ruminant” TFA or a function of the lower levels of intake from ruminant TFA during the periods of study. Please also state here that there is need for further research on this topic (as stated in the conclusion). On p. 35, the authors address the requirements and recommended intakes of fat and fatty acids. Please add information on what foods these fats can be found in. Like the example of WHO: “Less than 30% of total energy intake from fats (1, 2, 3). Unsaturated fats (found in fish, avocado and nuts, and in sunflower, soybean, canola and olive oils) are preferable to saturated fats (found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard) and trans-fats of all kinds, including both industrially-produced trans-fats (found in baked and fried foods, and pre-packaged snacks and foods, such as frozen pizza, pies, cookies, biscuits, wafers, and cooking oils and spreads) and ruminant trans-fats (found in meat and dairy foods from ruminant animals, such as cows, sheep, goats and camels). It is suggested that the intake of saturated fats	We have modified the abstract accordingly. We have provided examples of foods where SFA and MUFA/PUFA can be found

			be reduced to less than 10% of total energy intake and trans-fats to less than 1% of total energy intake (5). In particular, industrially-produced trans-fats are not part of a healthy diet and should be avoided (4, 6)." https://www.who.int/news-room/fact-sheets/detail/healthy-diet	
Ellen Ulleberg	Norwegian Dairy Council	We thank the NNR committee for the opportunity to comment on the draft of the chapter "Fat and fatty acids". In the chapter it is mentioned that trans fatty acids (TFA) are negative for blood lipid profiles irrespective of the source, compared to unsaturated fat. In dairy foods there is an inherent content of TFA, but the levels are low. As an example, the content of TFA in milk is about 4 g per 100 g which means that one serving (2 dl) of milk with 1 % fat contains 0,08 g TFA (1). Milk and dairy products play a key role in human nutrition by contributing many nutrients to diets globally (2) and a recommendation to reduce ruminant TFA should be seen in connection with this. While the relative contribution of ruminant TFA to the total TFA intake has	-	Considered

		become higher because the consumption of industrial TFA is reduced in the Nordic countries, the normal intake of ruminant TFA is well below the maximum recommended intake of 1 E%. In 2021 the intake of TFA in Norway on a food-supply level was about 0,5 E% (3) and consumption of ruminant TFA at doses achievable by the diet alone has no adverse effect on coronary heart disease risk (4,5). References 1. Johansson L et al. (2006) Transfettsyrer i norsk kosthold (Trans fatty acids in the Norwegian diet). Tidsskr Nor Lægeforen 126, 760–763 2. FAO. 2013 Milk and dairy products in human nutrition (accessed on 10 october 2019: http://www.fao.org/3/i3396e/i3396e.pdf) 3. Utviklingen i Norsk Kosthold 2022. Matforsyningsstatistikk. 4. Uauy R et al., (2009). WHO Scientific update on trans fatty acids: summary and conclusions. EJCN 63, S68-75 5. Gayet-Boyer C et al. (2014) Is there a linear relationship between the dose of ruminant trans-fatty acids and cardiovascular risk markers in healthy subjects: results from a systematic review and meta-regression of randomised clinical trials. Br J Nutr.;112(12):1914-1922		

Aina Marie Lien	NorgesGruppen	1. The main purpose of this manuscript (ms) is to give an updated background paper in the NNR about the role of fat og fatty acids on health outcomes. The authors describe data gaps and future research and the need for more research to investigate the potential food source-specific effects of SFA, and the limitation in the search for scientific literature within the inclusion criteria. When reading this, we wonder if it is relevant to include the review: A short history of saturated fat: the making and unmaking of a scientific consensus. It seems to be a debate that needs more knowledge; One part relates to the variation in specific food sources of SFAs and CVD, and another part relates to interindividual variation in the biologic and clinical effects of these SFAs. Are there genetic factors underlying the interindividual differences in response to different dietary fats? Is it possible that a more personalized and food- based approach in recommending levels of total and saturated fat in the diet may be beneficial? A short history of saturated fat: the making and unmaking of a scientific consensus. Teicholz N. Curr Opin Endocrinol Diabetes Obes. 2023 Feb 1;30(1):65-71. 2. Evidence was identified in the scientific literature only since 2011, therefore there might be some relevant older studies which is not included. We want to mention that for the topic	no comments	Considered

		mother and child health and neurodevelopment there are relevant studies from Norway. Similar effects on infants of n-3 and n-6 fatty acids supplementation to pregnant and lactating women. Helland IB, Saugstad OD, Smith L, Saarem K, Solvoll K, Ganes T, Drevon CA. Pediatrics. 2001 Nov;108(5):E82. doi: 10.1542/peds.108.5.e82. Maternal supplementation with very-long-chain n-3 fatty acids during pregnancy and lactation augments children's IQ at 4 years of age. Helland IB, Smith L, Saarem K, Saugstad OD, Drevon CA. Pediatrics. 2003 Jan;111(1):e39-44. doi: 10.1542/peds.111.1.e39. Effect of supplementing pregnant and lactating mothers with n-3 very-long-chain fatty acids on children's IQ and body mass index at 7 years of age. Helland IB, Smith L, Blomén B, Saarem K, Saugstad OD, Drevon CA. Pediatrics. 2008 Aug;122(2):e472-9. doi: 10.1542/peds.2007-2762.		

Karianne Spetaas Henriksen	Animalia AS	Regarding trans fatty acids: In the abstract, it is stated (page 1, line 18) that « TFA, regardless of source, impairs blood lipid profile compared to unsaturated fat. In observational studies, TFA is positively associated with CVD but whether associations differ by source is incloclusive. » TFAs are naturally present in meat and milk. Since the contribution of industrial TFA was reduced due to new regulations in 2014, the contribution of TFA from meat and milk is increased. However, the total intake of TFA in the Norwegian diet is below the maximum recommendation of ≤1 E% (1). On a food-supply level, it is estimated to 0,5 E% in 2021 (2). We suggest adding the food-supply intake of TFA to the section «Diet Intake in the Nordic and Baltic Countries» as TFA intake was not covered in the last dietary survey in Norway (3). Although the intake of TFA is mentioned in the section « Cadiovascular diseases and blood lipids », it should also be mentioned under the diet intake section that TFA intake in the Norwegian diet today is within the recommendations . Regarding saturated fatty acids: We believe there should be a thorough discussion on different types of saturated fatty acids and how the matrix of foods, meals and diets affect the associations	No comments	To highlight the role of the food matrix we have added the following text to the section Data gaps "Interactions between nutrients, other compounds and the physical structure of a food may influence the effect of SFA on risk markers, so-called food-matrix effects. This has been clearly demonstrated for dairy products (142, 143). However, although some types of dairy products may not exert as negative health effects as would be expected due to their content of SFA, both short-term randomized trials and observational cohort studies favor sources of unsaturated fat in direct comparisons (144, 145). More research is needed to understand the role of fermented full-fat dairy products such as cheese and yoghurt in healthy dietary patterns. "

		between intake of different saturated fatty acids and the risk of NCD. As we do not eat nutrients in isolation, and dietary components have interactive, synergistic, and potentially cumulative relationships that likely can predict overall health status and disease risk more fully than individual foods or nutrients. We understand that the authors' mandate has been to evaluate the nutritive perspective of different types of fatty acids. However, when considering the content of the «Fats and oils» chapter and the current chapter, there is no assessment in NNR2022 on the effects of different fatty acids when eaten as a food, in a meal and in a complete diet. 1. Helsedirektoratet. Fett. Kostrådene og næringsstoffer. Accessed February 16, 2023. https://www.helsedirektoratet.no/faglige-rad/kostradene-og-naeringsstoffer/inntak-av-naeringsstoffer/fett 2. Utviklingen i Norsk Kosthold 2022 Matforsyningsstatistikk Rapport. 3. Universitetet i Oslo, Mattilsynet, Helsedirektoratet. Norkost 3 - En Landsomfattende Kostholdsundersøkelse Blant Menn Og Kvinner i Norge i Alderen 18-70 År, 2010-11.; 2011. www.helsedirektoratet.no		

Swedish Food Agency	Swedish Food Agency	Since drugs is not the topic of NNR can you please consider to delete the text related to drugs information in the physiology-part page 3? We understand that it is not the main purpose of NNR and the chapter and maybe not feasible due to word limits. But it would be interesting if some discussion about possible mechanistical pathways of effects could be added. "The upper intake range for total PUFA intake is 10 E%. Increased intakes are not recommended due to potential adverse effects." is stated for pregnant and lactating women. Should this not be applied on the entire population? If the reviews have any results about effects of n-6 PUFA on inflammation that could be added at section 8.4, it would be beneficial (even if there are no associations).	According to summaries in chapter 4 it is concluded that current evidence on a link between fat and T2D is inconsistent. In the abstract it is summarised that dietary PUFAs is associated with reduced risk of type 2 diabetes. Maybe it should be omitted from the abstract? Please add information about the control groups in the last paragraph of section Results of non-qualified SRs, biomarkers studies and RCTs (paragraph before Summary of on page 10). Comment on concluding marks page 15: Could the increased LDL by SFA be supported by oxidative LDL in the atherosclerosis? Did any of the studies look at that? Page 5, second paragraph under section 1. Obesity and body weight, line3-4: The compared groups are overlapping (i.e. ≥30E% and ≤30E%). Should one of them have de sign < or >? Page 36, it is not clear why 200 mg of DHA and not 200 mg EPA + DHA are recommended during pregnancy and lactation.	We have modified accordingly. We ignored possible mechanistical pathways, and the comments on control groups oxLDL. For n6 PUFA and inflammation, we added the following text in section 8.4 "No qSR on the effects of n-6 PUFA on inflammation was available and no SR was identified through the search. However, one SR from 2011, based on n=11 comparisons from human intervention trials, found that decreases (-12% to -90%) in dietary intake of linoleic acid was not associated with changes in arachidonic acid in plasma phospholipids (115). Similarly, increases (+12% to +550%) in dietary linoleic acid was not associated with changes in arachidonic acid in plasma phospholipids. Furthermore, one SR from 2012, based on n=15 human intervention trials, found no effect of dietary linoleic acid on a wide variety of inflammatory markers (116). Thus, based on available evidence from trials in humans, increasing dietary linoleic acid (the major dietary PUFA) does not appear to exert detrimental effects on inflammation. "

Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Fat and fatty acids draft. Here are the comments from LRF. When removing something from the diet, e.g. SFA or TFA, these nutrients will always be substituted with something else. Throughout the paper, information of what the substitute is, is not always given. Abstract The authors claim that "trans fatty acids (TFA), regardless of source, impairs blood lipid profile compared to unsaturated fat". However, recent meta-analyses of both observational and randomized studies have shown that the current intake level of natural trans fatty acid is not associated with health issues. Bendsen et al. Consumption of industrial and ruminant trans fatty acids and risk of coronary heart disease : a systematic review and meta-analysis of cohort studies. Eur J Clin Nutr. 2011 Gayet-Boyer et al. Is there a linear relationship between the dose of ruminant trans-fatty acids and cardiovascular risk markers in healthy subjects: results from a systematic review and meta-regression of randomized clinical trials. Br J Nutr. 2014;112(12):1914-22. Page 5-6:	Page 6, Cardiovascular diseases and blood lipids: Trans fatty acids We are missing references that point to the differences between ruminant and industrial t-FA, respectively. For instance, de Souza et al (2015) conclude that "trans fats are associated with all cause mortality, total CHD, and CHD mortality, probably because if higher evels f intake f industrial trans fats than ruminant trans fats." They continue: Dietary guidelines must carefully consider the health effects of recommendations for alternative macronutrients to replace trans fats and saturated fats." Further, Seyyedsalehi et al (2014) conclude that "ruminant TFAs do not appear to be associated with colorectal cancer". Moreover, Kuhnt et al (2016) state that "an analysis of the few studies relating to R-TFA alone makes clear that no convincing adverse physiological effect can be attributed to R-TFA". De Souza RJ et al. Intake of saturated and trans unsaturated fatty acids and risk of all cause mortality, cardiovascular disease, and type 2 diabetes: systematic review and meta-analysis of observational studies. BMJ. 2016;351:h3978 Seyyedsalehi MS et al. Dietary Ruminant and Industrial Trans-Fatty Acids Intake and Colorectal Cancer Risk. Nutrients. 2022 Nov 20;14(22):4912. Kuhnt K et al. Evaluation of the Impact of Ruminant Trans Fatty Acids on Human Health: Important Aspects to Consider. Crit Rev Food Sci Nutr. 2016 Sep 9;56(12):1964-80.	Considered

		The authors report that "participants who were randomized to a lower fat (≤30 E%) versus higher fat (≥30 E%) diet, without the intention to reduce weight in any participants for at least six months. They found that the effect of eating less fat (compared with higher fat intake) was a mean body weight reduction of 1.4 kg." What was the fat exchanged with? Carbohydrates or protein? The authors report that "the study included RCTs in children aged 2-18 years randomized to a lower fat (30% or less of total energy (TE)) versus usual or moderate-fat diet (greater than 30%TE)". What was the fat exchanged with? Carbs or protein?? The authors conclude that "overall, consistent data show that a high content of fat in the diet (>30E%) gives a slightly higher incidence of overweight in adults in the general population. Again, what was the fat exchanged with? Carbohydrates or protein? Page 6, Cardiovascular diseases and blood lipids: The authors report that "the intake of SFA and the ratio of unsaturated to SFA is considered to be important for the serum levels of LDL-cholesterol, which is causal for the process of atherosclerosis." Our opinion is that a more nuanced picture needs to be drawn here. Not all SFA affects LDL in the same way, especially not if the overall diet also		

		considering dairy matrix is considered. Saturated fatty acids It is not that clear that the benefits of reducing SFA is mainly found when substituted with PUFA. From the literature, there is some evidence that replacement with carbohydrates is the same or even worse. The paragraph on Non-Qualified SR are mainly concerning dairy SFA and the results here show that that dairy SFA is not harmful. A conclusion to this sub paragraph is, however, lacking. Could the heading be changed or could dairy fat get its on heading? The results from Dairy SFA is so different that the rest of the SFA that it needs to be handled separately. Also a discussion of the matrix effect is lacking here. Compare, e.g. butter versus cheese/yoghurt/milk.		
Ann-Kristin Sundin	LRF	Here are the comments from LRF (continued): Page 15, concluding remarks: The authors conclude that "overall, the evidence presented above strengthen the current advice to reduce the consumption of saturated fat in the Nordic and Baltic countries. Replacing saturated fat with unsaturated fat provides the largest reduction in LDL-cholesterol and can reduce cardiovascular disease caused by atherosclerosis." We find it most unfortunate that the authors chose not to mention the fact that the dairy SFAs do not have the same	Data gaps for future research: The authors state that "more research is needed in order to understand the protective associations between ruminant TFA and odd-chain fatty acids and risk of type 2 diabetes and cardiovascular disease found in 37 observational studies. More research is needed to address the potential impact of dietary fat type on musculoskeletal- and mental health. More research is needed to investigate the potential food source-specific effects of SFA." We are pleased to see that r-TFA and dairy fats are concluded to have beneficial health effects and respectfully urge the	We have highlighted the role of the food matrix in Data gaps

		severe effects. We therefor respectfully urge the authors to make it clear in their conclusion in this part that dairy SFA are not associated with the negative health effects mentioned above. Hypertension A SR from 2020 (53) comparing the effect of ruminant and industrial TFA on cardiometabolic risk markers identified two trials reporting effects on blood pressure, with no differential effects of ruminant and industrial TFA on systolic or diastolic blood pressure. Again, here it seems as if industrial and ruminant TFA is equally detrimental to health. However, De Silva et al (2015) conclude that "rTFA may have beneficial effects on cardiometabolic risk factors conversely to their counterpart iTFA. Dietary sources of TFA should be taken into account in future cardiometabolic studies". We therefor suggest that the authors of this NNR chapter take into consideration that there are reasons to treat rTFA differently in nutrient recommendations and FBDG that iTFA. Da Silva MS et al. Natural Rumen-Derived trans Fatty Acids Are Associated with Metabolic Markers of Cardiac Health. Lipids. 2015 Sep;50(9):873-82. Total mortality The authors state that "based on both trials and observational studies, reducing intake of SFA does not influence the risk of all-cause mortality".	authors to embed that conclusion into the paragraphs above, where no or vague distinctions are made between rTFA and iTFA.	

		We believe this is a strong argument for not setting a maximum intake for SFA. Requirements and recommendations The authors state that "intake of SFA should be less than 10 E% in the general population. Detailed recommendations on intakes of specific types of cholesterol raising SFA, and cholesterol itself, are not given." It is lacking a remark on the fact that not all SFA (dairy) are bad for health. The authors claim that "the intake of TFA should be as low as possible. Importantly, this applies for both natural TFA in dairy products as well as industrially produced, partially hydrogenated fats. Typically, a reduction in SFA intake also leads to reduced intake of both TFA and dietary cholesterol." Our understanding from the literature at hand is that there is a difference between rTFA and iTFA that needs to be taken into account, and we respectfully urge the authors to reconsider this formulation. "By limiting the intake of total fat, a beneficial increase in intake of micronutrients and dietary fiber is typically seen. Further, reduced intake of dietary fat is associated with reduction in body weight and a reduction in SFA intake in a population results in lower total and LDL-cholesterol." We see a risk that a writing like this risk will add to the common and often		

		ungranted fear of fat, given that the dairy matrix science is pointing out that diary products such as cheese and whole-fat yoghurt, have beneficial health effects. It is also very important to state that an exchange for simple carbohydrates may be detrimental to health.		
L.M. Granskog	concerned citizen	Serious questions have been raised about the dietary guidelines with respect to saturated fat. This needs to be discussed. Below are a few examples of articles discussing this. This questions support for the claim that there is evidence good enough for the recommendation that intake of SFA should be less than 10 E% in the general population. Astrup A, Teicholz N, Magkos F, Bier DM, Brenna JT, King JC, Mente A, Ordovas JM, Volek JS, Yusuf S, Krauss RM. Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? Nutrients. 2021 Sep 22;13(10):3305. doi: 10.3390/nu13103305. PMID: 34684304; PMCID: PMC8541481. https://doi.org/10.1016/j.jacc.2020.05.077 Harcombe Z. US dietary guidelines: is saturated fat a nutrient of concern? British Journal of Sports Medicine 2019;53:1393-1396. http://dx.doi.org/10.1136/bjsports-2018-099420	I greatly appreciated the comments regarding observational data, residual confounding, and various degrees of misreporting in the Limitations section of this chapter. The following articles are not discussed in the chapter nor are they in the reference list. They should be. Astrup A, Magkos F, Bier D, et al. Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations. J Am Coll Cardiol. 2020 Aug, 76 (7) 844–857. https://doi.org/10.1016/j.jacc.2020.05.077 Astrup, Arne, Beth H. Rice Bradley, J. Thomas Brenna, Bernadette Delplanque, Monique Ferry, and Moises Torres-Gonzalez. 2016. "Regular-Fat Dairy and Human Health: A Synopsis of Symposia Presented in Europe and North America (2014–2015)" Nutrients 8, no. 8: 463. https://doi.org/10.3390/nu8080463	Considered, food matrix effects highlighted in Data gaps

		Volek JS, Phinney SD, Krauss RM, Johnson RJ, Saslow LR, Gower B, Yancy WS Jr, King JC, Hecht FM, Teicholz N, Bistrian BR, Hamdy O. Alternative Dietary Patterns for Americans: Low-Carbohydrate Diets. Nutrients. 2021 Sep 22;13(10):3299. doi: 10.3390/nu13103299. PMID: 34684300; PMCID: PMC8537012. https://doi.org/10.3390/nu13103299 Teicholz, Nina. A short history of saturated fat: the making and unmaking of a scientific consensus. Current Opinion in Endocrinology & Diabetes and Obesity 30(1):p 65-71, February 2023. | DOI: 10.1097/MED.0000000000000791 https://journals.lww.com/co-endocrinology/fulltext/2023/02000/a_short_history_of_saturated_fat__the_making_and.10.aspx A multivariate analysis of fast food transactions found that only soft drink intake is correlated with changes in BMI; not animal fat products (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3949530/pdf/BLT.13.120287.pdf/) The following generally sums up what some of us are feeling about this topic, it's not hard to find evidence that obesity has increased as has type 2 diabetes. When I was a kid, most kids were normal weight, and I personally didn't know anybody with type 2 diabetes. People did die younger but smoking was very common.		

		AMERICANS FOLLOW THE GUIDELINES, BUT THEIR HEALTH HAS NOT IMPROVED https://www.nutritioncoalition.us/americans-follow-the-guidelines-but-their-health-has-not-improved-1		
Tanja Kalchenko	From Physicians' and nutrition association Food for health	Long chained omega-3 fatty acids EPA and DHA are responsible for many positive health outcomes. But fish and fish oils contains PCB and dioxines - which are fat-soluble and highly toxic organic pollutants that accumulate in the food chain, and end up in fish and other animals, including humans. Fish oil produces try to clean their oil from these toxines, but some amount of toxines is present, nevertheless. Fish and other seafood in Norway account for over 40% of exposure in Norway (Norwegians consumes most fish in the Nordic and Baltic countries). It is therefor important to assess whether algae oil instead of fish oil and fatty fish could give some of the same (or similar) health outcomes. Norwegian Scientific Committee for Food and Environment, VKM published in 2022 to reports, one - assesment of	I suggest writing following on page 35 or 36 (or another page) : Long-chain omega-3 fatty acids EPA and DHA is traditionally associated with fish oils. However, oil from algae (algae oil) contains exactly the same EPA and DHA as fish oils and fatty fish. Today, algae oils as supplement to EPA and DHA are on the market. They are produced on land, in closed systems/tanks, and are therefore completely free of environmental toxins - unlike fish and (to a lesser extent) fish oils. As oily fish is the largest source of PCBs and dioxins (environmental toxins) in the Norwegian diet, and because the tolerable level/limit has already been exceeded in the Norwegian population, it is important to research and assess the following: To what extent can the replacement of fish	Considered

		risk and benefits of fish consumption. And the other report "Risk assessment of dioxins, furans and dioxin-like PCBs in food in Norway. Scientific Opinion of the Panel on Contaminants of the Norwegian Scientific Committee for Food and Environment." The VKM says following, as summary of the report "Risk assessment of dioxins, furans and dioxin-like PCBs in food in Norway", quoted: "Dioxins and dioxin-like PCBs are difficult to break down, fat-soluble and highly toxic organic pollutants that accumulate in the food chain. They end up in animal feed and food because they are found in the environment. Dioxins and dioxin-like PCBs in food do not cause acute health effects. It is primarily the amount in the body after accumulation over many years that can cause health damage." "The food groups that contribute the most are fatty fish, milk and dairy products, and meat." "On average, the Norwegian population is exposed to more dioxins and dioxin-like PCBs from food than the tolerance limit." Source: Norwegian Scientific Committee for Food and Environment (VKM 2022). Dioksiner i maten til den norske befolkningen – Dioxins in the food of the Norwegian population https://vkm.no/risikovurderinger/allevurd	oils (and fatty fish) with algae oils can provide the same positive health effects as EPA and DHA from fish and fish oil. Fish consumption in Norway is the highest in the Nordics and the Baltics, so this could be relevant for all the other countries in the region as well.	

		eringer/dioksinerimatentildennorskebefolkningen.4.413ea92416707dc4375a0a18.html VKM. Risk assessment of dioxins, furans and dioxin-like PCBs in food in Norway. Scientific Opinion of the Panel on Contaminants of the Norwegian Scientific Committee for Food and Environment. Helle Katrine Knutsen, Heidi Amlund, Jonny Beyer, Barbara Bukhvalova, Dagrun Engeset, Inger Therese Laugsand Lillegaard, Espen Mariussen, Gro Haarklou Mathisen, Anne Lise Brantsæter, Sara Bremer, Ingunn Anita Samdal, Cathrine Thomsen, Gunnar Sundstøl Eriksen (2022). VKM Report 2022:16, ISBN: 978-82-8259-391-5, ISSN: 2535-4019. Norwegian Scientific Committee for Food and Environment (VKM), Oslo, Norway EFSA. Risk for animal and human health related to the presence of dioxins and dioxin-like PCBs in feed and food https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2018.5333 Scientific Opinion on the risk for animal and human health related to the presence of dioxins and dioxin-like PCBs in feed and food. EFSA Journal 2018;16(11):5333, 331 pp. https://doi.org/10.2903/j.efsa.2018.5333 EFSA CONTAM Panel (EFSA Panel on Contaminants in the Food Chain), 2018. Environmental toxins and health – FHI,		

		Norwegian Institute of Public Health https://www.fhi.no/ml/miljo/miljogifter/fakta/dioksiner-og-dl-pcb-faktaark/		

4. Carbohydrates

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Rune Heggedal	Rune Heggedal	Due to the substantial increase in the prevalence of mental health disorders and the growing body of theories linking macro- and micronutrients and especially carbohydrates to anxiety and/or depression, it would, in my opinion, be of great importance to summarise the literature on this topic and create an awareness around mental health and nutrition. This begs the question as to why have this not been a priority for the new recommendations? Kose, J., Duquenne, P., Robert, M. et al. Associations of overall and specific carbohydrate intake with anxiety status evolution in the prospective NutriNet-Santé population-based cohort. Sci Rep 12, 21647 (2022). https://doi.org/10.1038/s41598-022-25337-5	No spesific comments	Although mental health was not on the list of predefined outcomes, we wanted to include mental health in the report. We performed a literature review, but we found very few systematic reviews. We therefore decided not to include it.
Mikael Fogelholm	University of Helsinki	No general comments, just a couple of small specific comments.	Page 14, rows 2-3 "increased intake": is this g/day or E%? If it is the former, do the studies tell if this is just because of added energy (unspecific to the form of macronutrients), or specific to sugar? WHO and SACN have suggested that the recommendation of added/free sugars should be max 5 E% and this is mentioned in the text. However, also the more typical max 10 E% is mentioned in the same context. Does the working group want to make a comment on this, mainly if they	WHO uses these words without clarifying whether it is g/day or E%. The WHO report includes exposures total sugars, free sugars, added sugars, % of energy intake from sugars, consumption of sugar-sweetened beverages and fruit juices.Our role in the NNR is primarily to provide the NNR group with the state of the art and current evidence for them to make a decision on recommendations.

			find it warranted to reduce the recommended max level (personally I don't find that the evidence in strong for this).	
Helen Benson	UNESDA Soft Drinks Europe	UNESDA respectfully suggests that the authors consider including the following general points in the final chapter: • The difficulty in making food based dietary guidelines (FBDG) when limited scientific studies are available on many food groups which are either the highest or important contributors to sugars intake in Nordic and Baltic countries. This point was made in the NNR2022 chapter on 'Sweets and sugary foods', noting that the EFSA panel was unable to examine evidence on sources of dietary sugars other than sugar-sweetened beverages (SSBs) and fruit juice mainly due to the heterogenous way of assessing exposure. Although in their opinion the EFSA Panel was not able to examine the energy and non-energy contribution of sugars, they did consider that excess energy intake leading to positive energy balance and body weight gain appears to be the main mechanism by which the intake of dietary sugars may contribute to the intake of chronic metabolic diseases in free-living conditions,1. Therefore, all sources of sugars, or indeed any energy-containing food groups - if consumed in excess resulting in positive energy balance - can result in weight gain and increased risk of metabolic disease. • Much of the evidence on SSBs comes from observational studies, considered	• Section on Dietary Intake - as noted by EFSA, their data on % contribution to added sugar intake in different age groups and countries is not up to date. This is most relevant to the soft drinks sector which has undertaken significant reformulation of soft drinks to contain no or lower levels of sugars. Our sales data suggests that in some Nordic countries >50% soft drink sales are low/no calorie, which is not reflected in EFSA data.1 More recent dietary surveys are available in Denmark, Sweden and Finland showing lower intake of SSBs. We suggest the limitations of EFSA data be noted in the report and, where possible, local data sources be used to supplement this data to reflect more recent intakes and composition. • Section on Total Sugars - the observational evidence cited by the EFSA panel on intake of SSBs and risk of gestational diabetes (GDM) (low certainty) and adverse effects on birthweight (very low certainty) relates to added/free sugars and not total sugars. The authors could note that results of these cohort studies are likely subject to bias, which should be better addressed in future studies (see Research Gap). For example, many factors may be associated with intrauterine growth retardation in Western cohorts and need to be appropriately adjusted for including, but not limited to age, low	We mention that the relationship between free sugar and excess body weight results from excess energy intake.SSB is included in the beverage chapter. We have used the data from dietary surveys provided by EFSA since this is the most recent dietary data presented collectively. For some countries there will be newer data available. We have included a comment on this. We thank you for the comments regarding SSB, and this has been removed and added under added/free sugars. We have clarified the limitation of observational studies. We have clarified the rational for the WHO conditional guideline and added the rational for the 10E% guideline. The SACN report states that it is recommended that the average population intake of free sugars should not exceed 5% of total dietary energy for age groups from 2 years upwards. It is not stated that it is related to weight loss specifically. we have added that more research is needed on other food sources of sugar. We found no reason to restate the level of certainty for the evidence regarding SSB and pregnancy again.

		lower quality evidence being subject to higher risk of bias, mainly in the form of residual and unmeasured confounding and usually (as noted by EFSA) without adjustment for total energy intake. It is well documented that high consumers of SSBs are more likely to have less healthy lifestyles, dietary patterns and consume more calories in general. And it is considered extremely difficult, if not impossible, to isolate effects of single dietary components from these other dietary and lifestyle factors 2, 3. Any evidence identified by EFSA on SSBs arising from randomised controlled trials was generally of much lower certainty, 1. 1. EFSA Panel on Nutrition 2022 https://doi.org/10.2903/j.efsa.2022.7074 2. Khan and Sievenpiper 2016 https://doi.org/10.1007/s00394-016-1345-3 3. Ioannidis 2018 https://doi.org/10.1001/jama.2018.11025	socioeconomic status, ethnicity or race, substance abuse, medication, maternal anthropometry, parity, and inter-pregnancy interval.2 And as per our general point, results of cohort studies investigating associations between SSB intake and risk of GDM are likely to be subject to residual confounding and collinearity effects from other aspects of a less healthy diet and lifestyle. It should be noted that for both outcomes total energy intake was not kept constant in analyses. • Summary of main results o It is not clear why the authors only refer to the WHO conditional guideline which was based on very low-quality data from national population studies in relation to risk of dental caries. o The authors should note the rationale for the SACN quantitative recommendation for average population intake of free sugars, which was based on an informed judgment to support a theoretical moderate degree of weight loss.5 • Section on Research Gap – o The fact that that there is such limited evidence available on food sources of dietary sugars, other than on SSBs and fruit juice, should be highlighted by the authors. Evidence on all food sources of dietary sugars is imperative to inform FBDG. o For completeness, the authors should restate here that the certainty in the evidence on SSBs and pregnancy outcomes is low to very low.	

			1. Sales and Consumption – UNESDA 2. Sharma et al., https://doi.org/10.4137/cmped.s40070 3. Chen et al., https://doi.org/10.2337/dc09-0866 4. Donazar-Ezcurra et al., https://doi.org/10.1016/j.clnu.2017.02.005 5. SACN SACN Carbohydrates and Health Report - GOV.UK (www.gov.uk)	
Ellen Ulleberg	Norwegian Dairy Council	We thank the NNR committee for the opportunity to comment on the draft of the chapter Carbohydrates. The chapter concludes that a high intake of free and added sugars could be linked to negative health effects. However, there is a lack of data describing the intake of free and added sugar in different age groups and the draft also lacks an overview of the contribution of different food sources to the intake of such sugars. In the section describing dietary intakes in the Nordic and Baltic countries milk and dairy are mentioned as important sources of free and added sugars (page 8, first paragraph). This statement needs a reference. While the authors do state that “Contributions for free sugars and added sugars differ between countries” the chapter lacks an overview describing how it differs and which of the mentioned food groups contributes the most to the overall intake of free and added sugar. In Norway milk and dairy products are not a substantial contributor of added sugars.	Table 1 does not show data for children in Norway and the age 10-11 and 14-15 years seems wrong as the national dietary surveys have been performed only for 4-year old, 9-year old and 13 year old children in addition to adults. Please add correct ages and references and explain the “*” used in the table. Table 2 lacks data for Norway and Iceland. If such data can’t be found in the EFSA report used as a reference other relevant references should be consulted (1-3). References 1. Helsedirektoratet. UNGKOST 3 Landsomfattende kostholdsundersøkelse blant elever i 4. og 8. klasse i Norge, 2015 2. Helsedirektoratet. Norkost 3 En landsomfattende kostholdsundersøkelse blant menn og kvinner i Norge i alderen 18-70 år, 2010-11. 3. Helsedirektoratet. UNGKOST 3 Landsomfattende kostholdsundersøkelse blant 4-åringer i Norge, 2016	We present mean intake in different age groups using the most recent national dietary surveys presented in the EFSA report. We have clarified that the data is not up to date. The sources of added sugar are presented in the sweets chapter. The contribution from dairy is still significant and should be mentioned as a source. We thank you for this comment and have updated our Table 1, which lacked Norwegian data. We have not included data for Norway and Iceland since they are not included in the EFSA report.

		The national dietary surveys have found that added sugar contribute on average 12% of energy among 9- and 13-year-olds (1) and 7 % of the energy for adults (2). The largest sources of added sugar are sugar and sweets in addition to sugary drinks and cakes. Milk, yoghurt and cream accounted for about 11% of the added sugar for both children and adults. A similar pattern has been found for 4-year old children, 9% of their energy intake came from added sugar and the contribution from milk and yoghurt was 16 % (3). It is important to note that the amount of sugar added to some dairy products such as yoghurts and flavoured milk has been gradually reduced by the dairy industry as part of the work in collaboration with the health authorities, "Partnership for a healthier diet". This is not reflected in the national dietary surveys as they are based on older data, but the gradual reduction in the amount of free sugar in the Norwegian diet since the last dietary survey has been documented at a wholesale level (4). We would therefore argue that milk and dairy products are not a major source of added sugar, at least not for all countries. If the authors wish to include dairy products in the list of major sources to free and added sugar, they should also mention which dairy products contribute the most. References 1. Helsedirektoratet. UNGKOST 3		

		Landsomfattende kostholdsundersøkelse blant elever i 4. og 8. klasse i Norge, 2015 2. Helsedirektoratet. Norkost 3 En landsomfattende kostholdsundersøkelse blant menn og kvinner i Norge i alderen 18-70 år, 2010-11. 3. Helsedirektoratet. UNGKOST 3 Landsomfattende kostholdsundersøkelse blant 4-åringer i Norge, 2016 4. Helsedirektoratet. UTVIKLINGEN I NORSK KOSTHOLD 2022 Matforsyningsstatistikk. Report IS-3061.		
Anne-Mette Nielsen	Nordic Sugar	The authors refer mainly to the EFSA's scientific opinion on Tolerable upper intake level for dietary sugars (EFSA NDA Panel et al. 2022), the WHO - Guideline: Sugars intake for adults and children (WHO: Sugars Intake for Adults and Children 2015) and the SACN-Carbohydrate and Health Report (The Scientific Advisory Committee on Nutrition 2015) to indicate that a higher intake of added and free sugars is related to several metabolic diseases. This being the case, the role of energy intake and the separation of sugars from different sources (liquid vs. solid) was not considered. Moreover, the authors indicate that higher intakes of added and free sugars induce a micronutrient dilution, however a recent study by Lemming and Pitsi (2022) finds that there is no micronutrient dilution in Nordic Countries with daily mean intakes of most vitamins and minerals being above recommend Intake. Overall, a paragraph on dental caries and a discussion of the overall quality of carbohydrates is missing.	Part 1 of 3: Comments related to page 9-13 Page 9: Total carbohydrates a. Carbohydrates should not be viewed through a single lens, there are differences between e.g., carbohydrates from fruits & vegetables and whole and refined grains on health (Mozaffarian 2016). The authors should consider a more detailed classification of carbohydrates. b. A paragraph for dental caries is missing. It is well-known that all fermentable carbohydrates are cariogenic (Touger-Decker and van Loveren 2003). A recently published systematic review commissioned by WHO concluded that especially rapidly digestible starches, like starch, increase the risk of dental caries (Halvorsrud et al. 2019). In this chapter, the authors indicate that dietary sugars are cariogenic but other fermentable carbohydrates are not, which is scientifically false. Page 9: Glycaemic index and glycaemic	We have clarified what is important for carbohydrate quality. we have added more information in research gap. We have added a sentence on the importance of food source.It was not our role to give recommendations. We mention that the excess body weight associated with free sugars intake results from excess energy intake. The evidence shows that higher intake of added sugar is associated with lower intake of micronutrients. Neither EFSA nor the WHO guidelines mention other cariogenic carbohydrates. We therefore only report the evidence for sugar and dental caries. We have clarified the basis for the WHO 5% recommendation. We mention that the evidence for free and added sugar and type 2 diabetes is low. We found no reason to modify the text. We mention the strong evidence for SSB. We found no reason to modify the text. we have included a sentence regarding the limitation of observational studies. We found no reason to not mention this and to question the evidence from EFSA.

		Several remarks should be included to improve the chapters quality: a. A differentiation of carbohydrate by quality should be included, as carbohydrates cannot be rated the same way. In the US more than 40 % of total energy intake come from “low-quality carbohydrates” (such as refined grains or starchy vegetables) (Shan et al. 2019), which are associated with several chronic metabolic diseases (Mozaffarian 2016). b. EFSA’s Scientific Opinion on dietary sugars did not determine a high level of certainty, but rather low scientific evidence. If scientific evidence is not rated high, the “true effect” might be still different from the estimated effect and therefore EFSA’s results should be viewed with caution. It should be pointed out that there is currently insufficient evidence and further research is needed. This is also the case for the WHO recommendation to reduce free sugars intake (low to moderate evidence). c. EFSA did not separate between sugars in solid foods and sugars in beverages in their scientific opinion. The authors need to separate out results from solid foods and from beverages when discussing health outcomes, since evidence from studies on beverages is not necessarily applicable to food sources of sugars. d. EFSA's analysis is only valid for added and free sugars intake in the range of 10 to 30 E%. Below this level, there is high	load a. Foods with a high glycaemic index can increase the risk of dental caries. Higher glycaemic index foods produced greater acute plaque pH decreases compared to lower glycemic index starchy foods (Atkinson et al. 2021). A paragraph should be added addressing this issue. Page 10: Cancers a. It should be noted that WCRF concluded that although a significant positive association was observed for total carbohydrate independently, the evidence was limited, and no conclusion was possible. b. The WCRF report's key findings for endometrial cancer were that excess body fat is one of the strongest factors that increases risk for this cancer. Page 12: Total Sugars a. Since EFSA´s analysis for total sugars on pregnancy endpoints (gestational diabetes and birthweight), concluded no positive and causal relationship, it is not clear why the authors write about EFSA’s assessment of sugar-sweetened beverages (SSBs) and pregnancy endpoints in this paragraph. The sentences about SSBs and gestational diabetes and birthweight should be deleted, respectively. It should be emphasized that total sugars are not related to detrimental pregnancy endpoints. Page 12: Fructose a. All reports cited here (EFSA, SACN and	We have only included the qualified SR and EFSA report provided by the NNR. We have provided a reference (same as EFSA) in the paper for this. We clarify what the 5E% from WHO is based on. As mentioned in the WHO report, although fluoride reduces dental caries, it does not completely prevent dental caries. Page 16: This has been added. Micronutrient dilution with high sugar intake is shown in several populations. We have therefore not changed the conclusion. The included studies show a clear trend. The included articles show clear micronutrient dilution with high sugar consumption. We have added a sentence on the US dietary guidelines 2020-2025 for added sugar, and that is similar as the guidelines 2015-2020.We have deleted oral health in relation to total carbohydrate. Regarding limitations WHO: This has been clarified. SACN: We have not taken this into account.

		uncertainty regarding the relationship between intake of added and free sugars and the risk of various metabolic diseases. Therefore, EFSA’s analysis cannot not be used to tighten current NNR recommendation on added sugars intake. e. The limitations of the WHO recommendation on free sugars intake need to be discussed. The systematic review and meta-analyses (Te Morenga et al. 2012) did not find any effect of free sugars on body weight under isocaloric conditions; only if intake of free sugars exceeded energy requirements of the individual, which is the case for all macronutrients (Naude et al. 2022; Hall and Guo 2017). f. A higher intake of certain nutrients can lead to a decrease in the intake of other nutrients, but this is not only the case for added and free sugars. Recent intake data show that daily mean intakes of most vitamins and minerals are above recommend Intake in the Nordic countries (Lemming and Pitsi 2022), suggesting that the assumption that higher intakes of added and free sugars typically induce micronutrient dilution may not be evidenced based. g. All fermentable carbohydrates (not only sugars) are cariogenic (Touger-Decker and van Loveren 2003), also shown by a WHO commissioned systematic review (Halvorsrud et al. 2019). The authors should include a section focusing on	WCRF (World Cancer Research Fund 2018)), indicated limited evidence or found no association for fructose and health-related outcomes, which should be emphasized in the paragraph. Page 13: Free and added sugars / Obesity a. When making reference to EFSA´s scientific opinion on sugars, the authors should note the number of limitations in the methodology, as described by EFSA in its report. b. EFSA did not stratify their results on obesity by food sources (solid vs. liquid). For body weight, 6 of 11 RCTs were from beverages, and 5 from mixed sources, respectively. None of the investigated studies were from solid foods only. Evidence from studies looking at sugars from liquids are not necessarily applicable to food sources of sugars. (Cassady et al. 2012; Houchins et al. 2012). c. Systematic reviews and meta-analyses have not shown any effect of free sugars effect on body weight under isocaloric conditions (Te Morenga et al. 2012; Fattore et al. 2017). Body weight increases if free sugars are consumed as an excess source of energy, which is a well-known effect of energy on body weight, independent of energy source (macronutrients)(Hall and Guo 2017). This information should be added in this paragraph. Page 13: Free and added sugars /	

		carbohydrates and dental caries. The conditional WHO Recommendation to reduce free sugar intake to less than 5% to prevent dental caries should be deleted, as it is based on very low evidence and obsolete data on oral health from Japan (1950s), not comparable to todays' health care in the Nordics countries.	Cardiovascular disease a. EFSA did not find any relationship of added and free sugars on endpoints of cardiovascular disease except for sugar sweetened beverages (SSB). However, the authors should note the limitations of these SSB-studies such as there being no energy control and them being observational studies; for SSB studies the risk of residual confounding remains high (Arsenault et al., 2017; Leme et al., 2021; Mello et al., 2021; Narain et al., 2017; Purohit et al., 2022).	
Anne-Mette Nielsen	Nordic Sugar	Part 2 of 3 separate parts	Part 2 of 3 comments related to page 15-16 Page 15: Free and added sugars / Type 2 diabetes a. Available evidence from systematic reviews and meta-analyses do not indicate that different types of sugars are associated with increased risk of type 2 diabetes (Neuenschwander et al. 2019; Tsilas et al. 2017). b. A differentiation between dietary sugars from liquids and solid foods on type 2 diabetes is necessary. c. It should be mentioned that for studies on sugar-sweetened beverages, it is likely that the influence of residual confounding remains high (Arsenault et al., 2017; Leme et al., 2021; Mello et al., 2021; Narain et al., 2017; Purohit et al., 2022). d. The clinical relevance of EFSA's finding that in the high sugar arm fasting glucose	Please see complete answer above

			level raise by 1.94 mg/dl should be seriously questioned and discussed for the population of the Nordic countries. Page 15: Free and added sugars / Cardiometabolic risk markers a. A recently published Cochrane Review on added sugars and cardiometabolic markers did not find any effect of high added sugars intake on LDL- and HDL-Level and only minimal effect on total cholesterol- and triglycerides level (Bergwall et al. 2022). Furthermore, the authors stated that the effect was so small that the clinical relevance is uncertain. The Cochrane review should be included in this paragraph and the clinical relevance of EFSA's outcome should be discussed. Page 16: Free and added sugars / Dental caries a. The authors may wish to provide a primary reference for the statement "it is well-established that dietary sugars are involved in dental caries". EFSA made this statement but did not provide a reference for it. b. When discussing the relationship between free/added sugars and dental caries, the specific reference to WHO's Conditional Recommendation to reduce free sugar intake to less than 5% based on the prevention of dental caries (WHO: Sugars Intake for Adults and Children 2015) should be deleted. This	

			recommendation is based on obsolete ecological studies in Japanese children in the 1950s, comparing annual sugar supply data with oral health in a time the Japanese population did not used fluoride toothpaste, which is the most important factor in caries prevention (van Loveren 2019). Furthermore, the use of fluoride toothpaste improved oral health in the Nordic countries since 1980 (The WHO Oral Health "Country/Area Profile Programme". Link) therefore the chapter should discuss the role of fluoride, other preventative oral health measures and the role of rapidly digestible starches in relation to dental caries. Page 16: Subtitle needed for next section - jumps from dental health into the summary.	
Anne-Mette Nielsen	Nordic Sugar	Comments part 3 of 3 separate parts	Part 3 of 3 separate parts. Comments related to page 17 Page 17: a. For micronutrient dilution, a higher intake of certain nutrients can lead to a decrease in the intake of other nutrients but this is not only the case for added and free sugars. The references cited by the authors (González-Padilla et al. 2020) should not be considered scientific proof that an intake of free and added sugars, at the average intake level of the Nordic populations, causes micronutrient dilution (see table 2). Furthermore, recent intake data showed that daily mean intakes of most vitamins and minerals were above	Please see complete answer above

			recommended Intake in the Nordic countries (Lemming and Pitsi 2022). The authors should instead conclude that current scientific evidence is not sufficient to conclude that a higher intake of added and free sugars causes inevitable micronutrient dilution. b. The systematic review of Louie and colleagues, chosen by the authors as a general overview, concluded that the small to moderate negative association between dietary added sugars and micronutrient intake is unlikely to be of clinical significance (Louie et al. 2015). c. Additionally, intakes below approximately 19% of energy intake from added sugars were generally not associated with micronutrient inadequacy in US children and adolescents (Fulgoni et al. 2019) and up to 18% energy intake from added sugars was not associated with micronutrient inadequacy in US adults (Fulgoni et al. 2020). Up to 25% energy intake from free sugars does not result in micronutrient dilution in Australian adults (Mok et al. 2018) and was almost transferable to 20% energy intake from free sugars providing an adequate micronutrient supply in Australian children and adolescents (Wong et al. 2019). Taken together, these data underline adequate micronutrient intake in the Nordic countries at current average dietary sugar intakes. d. The authors should mention that there	

			was not substantial enough evidence to support the U.S.A. 2020 Dietary Guidelines Advisory Committee's draft recommendation to reduce the recommendation for added sugar intake to no more than 6 percent of total daily calories. The U.S. Departments of Agriculture (USDA) and Health and Human Services jointly reviewed the scientific advisory committee's recommendations, coming to the conclusion that there wasn't enough evidence that altering the current recommendation, of less than 10% of added sugars, would substantially impact health. Page 17: Requirement and recommend intakes / Summary of main results a. The sentence that total carbohydrate intake is not detrimental for oral health should be deleted. All fermentable carbohydrates are cariogenic. b. Limitations of WHO recommendations should be highlighted in this paragraph and the quality of evidence. Authors should state: - The 10% recommendation is based on (moderate quality evidence) on relationship between intake of free sugars and dental caries. - The 5% conditional recommendation is based on (very low quality evidence) on relationship between intake of free sugars and dental caries. c. It should be mentioned that SACN, did not find any associations and biological	

			mechanism of dietary sugars on health outcomes, investigated in the chapter on carbohydrates except from dental caries. Full reference list is available on request from the authors.	
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this valuable opportunity to submit comments on the Carbohydrate draft. These are the comments from LRF. Page 8, row 5: The authors claim that milk and dairy are among important sources of free sugars and added sugars. First, In Sweden, the total contribution of carbohydrates from milk and dairy, is 7%. The monosaccharide contribution from milk and dairy is 4%, whereas saccharose is 5%. (Data from Riksmaten för vuxna 2010-11, p 139). Even counting sweetened dairy, the contribution, thus, is very low. Second, listing milk and dairy, which are such important sources of essential nutrients as well as contributing to so many health benefits, such as lowered risk of cardiovascular diseases, together with nutrient low foods such as syrups, confectionery and water-based sweet desserts, gives the reader the wrong impression. Therefore, we strongly suggest that milk and unsweetened dairy are either removed from the list of important sources of free sugars (which would be the most		The contribution is still significant. We have clarified that it is from sweetened milk and dairy.Page 10: This is included in the fat chapter.

		reasonable option, given the very limited contribution of free sugars coming from milk and dairy), or the sentence is rephrased by subdividing into "important sources" (i.e. sugars, confectionery, sugar-sweetened beverages) and "other sources" (processed fruit (free sugars), flavored milk products + baby foods) Page 10, Cardiometabolic risk markers, row 5: We kindly advice the authors to note the differences between the various saturated fatty acids and acknowledge the impact of food matrix on health outcome. An intake of saturated fatty acids is not equivalent to an intake of a food source containing those very same saturated fatty acids. The food matrix science needs to be taken into account in this chapters, as well as in others throughout the NNR 2022.		
Nina Teicholz	Nutrition Coalition	There is a wealth of literature showing that low-carbohydrate diets lead to superior health outcomes. The American Diabetes Assn (ADA) recognizes a very low-carb diet as having the most evidence for blood-sugar control, which is crucial for managing or even reversing diabetes. This diet is a standard of care for the ADA. The American Heart Association also recognizes that this diet has the best outcomes from weight loss and lowering triglycerides as well as raising HDL, in its recent guidelines for people with diabetes. The evidence for low-carbohydrate diets is sufficient for this to be one dietary option, especially for populations suffering from pre-diabetes/diabetes, overweight/obesity, and heart disease. See	There is a wealth of literature showing that low-carbohydrate diets lead to superior health outcomes. The American Diabetes Association (ADA) recognizes a very low-carb diet as having the most evidence for blood-sugar control, which is crucial for managing diabetes. For this reason, a very low-carbohydrate diet is now a standard of care for the ADA. The American Heart Association also recognizes this diet as having the best outcomes from weight loss and certain heart disease risk factors (triglycerides, HDL) in its recent guidelines for people with diabetes. The evidence for low-carbohydrate diets is now sufficient for this approach to be included as one dietary option in national guidelines, especially for populations	We only include qualified SR based on studies of the general population.

		all references here: https://www.mdpi.com/2072-6643/13/10/3299	suffering from pre-diabetes/diabetes, overweight/obesity, and heart disease. See this paper by leaders in the field: Volek, J.S.; Phinney, S.D.; Krauss, R.M.; Johnson, R.J.; Saslow, L.R.; Gower, B.; Yancy, W.S., Jr.; King, J.C.; Hecht, F.M.; Teicholz, N.; Bistrian, B.R.; Hamdy, O. Alternative Dietary Patterns for Americans: Low-Carbohydrate Diets. Nutrients 2021, 13, 3299. https://doi.org/10.3390/nu13103299 https://www.mdpi.com/2072-6643/13/10/3299 To say that carbohydrates and glycemic index have no relationship to health outcomes ignores a large body of scientific literature. It is not evidence-based and needs to be re-examined in light of the abundant number of studies on this topic, including the literature cited in this paper.	
Rikke Bekker Henriksen	DI Fødevarer / Danish Federation of Food and Drink	Danish Food and Drink Federation would like to add a few general comments to the NNR 2022 chapter on Carbohydrates. One of the main references is the EFSA Scientific opinion on dietary sugars (1). We would like to address, that the EFSA journal has some limitations which should be taken into consideration in this chapter as well. EFSA`s analysis is only valid for added and free sugars in the range of 10-30%. There is no validated evidence for the risk of metabolic diseases for intakes below 10% added and free sugars because of high scientific uncertainties. Therefore, EFSA´s analysis cannot be used to tighten the	No comments	It was not our aim to provide recommendations. Health effects on different foods are included in the chapter on sweets and on beverages. We comment that the data might not be up to date. WHO: We have clarified this.

		current 10% NNR recommendation on added sugars intake. EFSA did not separate between sugars in solid foods and sugars in beverages in their scientific opinion. The authors need to separate results from solid foods and from beverages when discussing health outcomes, since evidence from studies on beverages is not necessarily applicable to food sources of sugars. Besides this, the EFSA scientific opinion is not up-to-date in regards of intake data on sugar-sweetened beverages (SSB). Sales data from UNESDA (2) show that in some Nordic countries >50% soft drink sales are low/no calorie, which is not reflected in EFSA analysis. Finally, we would also like to address that WHOs quantitative recommendations (3) are based on the prevention of dental caries. The strong recommendation to keep intake of free sugars below 10% is based on moderate quality of evidence from observational studies, whereas the conditional recommendation to keep intake of free sugars below 5% is based on very low-quality of evidence. 1. "Tolerable Upper Intake Level for Dietary Sugars." EFSA Journal. European Food Safety Authority 20 (2). 2. https://www.unesda.eu/sales-and-consumption/ 3. "WHO: Sugars Intake for Adults and		

		Children. 2015. WHO Guidelines Approved by the Guidelines Review Committee. Geneva: World Health Organization.		
Plant-food Sweden and Plantebranchen	Plant-food Sweden and Plantebranchen	We welcome the opportunity to contribute to the public consultation on the draft NNR chapter on Carbohydrates. Please find our remarks under detailed comments section.	P 10. CANCERS On page 10 it is stated that there is an increased risk of endometrial cancer with increasing amount of dietary carbohydrates, and it is specifically referenced to diets high in "sugars and highly processed foods", e.g.: "The evidence for carbohydrate is derived largely from developed countries where a large proportion of carbohydrate is in the form of sugars and highly processed foods (16)." Although being a correct quote from the WCRF report, we find this sentence misleading. During scrutiny, we found no definition of sugars or highly processed foods in the WCRF report. In fact, it is only mentioned in a "note". NNR chapters are associated with and, thus, expected to be critical in their use of definitions. Using terms such as "sugars and highly processed foods" without clear definitions is not aligned with the scientific standard of NNR and may misinform the debate on sugars, processed foods and health. As it lacks definitions, we suggest removing this sentence from the NNR chapter. P 10-11. GLYCAEMIC INDEX AND GLYCAEMIC LOAD Despite the overall conclusion with respect to GI/GL (inconsistency with respect to effects) there were several associations	Considered

			presented from epidemiological evidence (glycaemic index, p 11), e.g.: - stroke mortality (low) - type 2 diabetes incidence (very low) - coronary heart disease incidence (low) - all-cause mortality, coronary heart disease mortality, cancer mortality, stroke incidence, colorectal cancer incidence (very low) Most of the associations were reported in Reynolds et al. However, the WCRF review also concluded that diets characterized by a higher glycaemic load is probably a cause of endometrial cancer. Fiber is an important confounder with respect to GI/GL (and a possible source of residual confounding), as diets with low glycaemic index are often linked to high fiber intake. We thus suggest inserting a comment on whether fiber intake was adjusted for or not. The same applies to the data presented from the RCTs. Also, it would be informative to know whether the reviews (Reynolds, SACN and WCRF) handled the confounding effect of fibre differently given the differences in results. P. 13-14 OBESITY Supposedly the groups with low and high sugar intake in a RCT are the same population, only different treatment arms. Therefore, the following sentences in the presentation of results are confusing: "The WHO review found moderate evidence using data from RCTs suggesting	

			an association between reduction of free sugars intake and reduced body weight in adults. Also in adults, an increased intake of free sugars was associated with a comparable increase in body weight." We suggest that you comment on the study design and why the results cannot be expressed as difference between groups, e.g. standard procedure. Also, we suggest clarifying the term "complementary feeding period" (e.g., 6 to 23 months of age). P. 18 SUMMARY OF MAIN RESULTS (LAST PARAGRAPH) On page 18 it is stated that: "WHO finds that increasing or decreasing free sugars is associated with parallel changes in body weight." We suggest discussing this finding in more detail in the Obesity section (P 13-14), so that it can be understood why this statement is high-lighted in the summary of main results, when clearly there is so much evidence pointing in the other direction (no effect of sugars on body weight in prospective trials and small effects in RCTs). In fact, is sounds like a dose-response effect. Is that a fact? You also write that the WHO report found that: "the excess body weight associated with	

			free sugars intake results from excess energy intake". This too challenges other reports, such as the EFSA report, which hypothesised that foods with sweet taste drives consumption of all macronutrients thus obscuring an effect of sugars on obesity as compared to other macronutrients in prospective trials. We suggest that this too is explored in greater detail in the Obesity section (P 13-14).	
Anna Maria Karlsen	NHO Mat og Drikke / FoodDrinkNorway	Please find FoodDrinkNorway`s general comments for consideration.  One of the main references is the EFSA`s scientific opinion on tolerable upper intake levels for dietary sugars. It is important to keep in mind that EFSA`s evaluation has limitations in the methodology that should be carefully assessed. As an example, EFSA did not separate between sugars in solid foods and in sugars in beverages. Second, EFSA`s analysis is only valid for added and free sugars in the 10-30 E% range. There is no validated evidence for the risk of metabolic diseases for intakes below 10 % added and free sugars because of high scientific uncertainties. Consequently, the EFSA´s opinion cannot be used as evidence for lowering the current 10% NNR recommendation on added sugar intake. Further, the EFSA scientific opinion is based on the EFSA nutrient composition database. This database only contains data	none	This chapters covers added and free sugar regardless of source. the limitation of the current evidence is already mentioned in the text. we mentioned that some of the surveys are rather old.

		on total sugars from national food composition databases up to 2012 (Norway not included). Considering the intensively accelerating reduction of sugars in food and beverages by the European food and drink industry in the last decade, the intake of dietary sugars today differs significantly compared to 2012. For SSBs, sales data from UNESDA show that in some Nordic countries, including Norway, >50% of soft drink sales are low/no calories (UNESDA). In Norway, the food industry and the health authorities have collaborated to improve the diet of the population through a signed agreement (Memorandum of Understanding) since 2016. Significant reductions of added sugars in food and beverages have been implemented. The Norwegian population's intake of added sugar is now reduced to 12 E% (The Norwegian Directorate of Health, 2022). This should be reflected in the interpretation of the intake of carbohydrates and health outcomes in the NNR2022 chapter. References: Norwegian Directorate of Health (2022). Utviklingen i norsk kosthold 2022. UNESDA. https://www.unesda.eu/sales-and-consumption/		

Anders Herlin	Associate professor at Swedish Universtiy of Agricultural Sciences	Although the review has some merits, it fails in some aspects of scientific rigor. This includes a number of systemic reviews but fails in the process of including its own search string. A critical approach to the reviews is also lacking. They should have asked about the quality of the referred studies in each review. They also seem to have missed an important review by Volek et al. (2021) - the reference to this study is given in the specific comments. The huge importance of the matter, and given the recent years' opinions and scientific progress in the area, sound scientific, unbiased, background knowledge should be presented.	The conclusion in the abstract and other parts may have been differently formulated if the paper by Violek et al. had been included. Volek, J.S.; Phinney, S.D.; Krauss, R.M.; Johnson, R.J.; Saslow, L.R.; Gower, B.; Yancy, W.S., Jr.; King, J.C.; Hecht, F.M.; Teicholz, N.; Bistrian, B.R.; Hamdy, O. Alternative Dietary Patterns for Americans: Low-Carbohydrate Diets. Nutrients 2021, 13, 3299. https://doi.org/10.3390/nu13103299	We have only included qualified SR.
Elisabet Rytter	Swedish Food Federation	It is important to note that in EFSA`s opinion on tolerable upper intake level for dietary sugars (2022) there is no validated evidence for the risk of chronic metabolic diseases for intakes below 10 E% added and free sugars because of high scientific uncertainties (see opinion page 4 “The Panel notes that the relationship between the intake of added and free sugars and risk of chronic metabolic diseases could not be adequately explored at levels of intake < 10 E% owing to the low number of RCTs available, and that the uncertainty about the shape and direction of the relationship at these levels of intake is higher than at intakes ≥ 10 E%.”). We therefore consider that EFSA´s analysis should not be used as a basis for reducing the current NNR recommendation on added sugars intake (< 10 E%). Notice that EFSA scientific opinion doesn´t	Page 8, row 5: The authors claim that milk and dairy are among important sources of free sugars and added sugars is not in line with the result in Riksmaten 2010 (page 86); “The largest sources of added sugar were sugar sweetened beverages, buns, cookies, cakes, sweets and chocolate. We therefor consider that milk and dairy should be removed from the list of important sources of free sugars and added sugar.	We have mentioned the limitation of evidence. EFSA: this in included in the beverages chapter. We find it relevant to report the conclusion from the scientific advisory committee of 6 E% based on micronutrient dilution. We have also added a sentence on the US dietary guidelines for added sugar. Neither EFSA nor the WHO guidelines mention other cariogenic carbohydrates. We therefore only report the evidence for sugar and dental caries. We have clarified the basis for the WHO 5% recommendation.

		include current data on intake of sugar-sweetened beverages (SSB) for some Nordic countries. Sales data from Swedish brewery association and from UNESDA show that >50% soft drink sales are low/no calorie. https://sverigesbryggerier.se/statistik/ https://www.unesda.eu/sales-and-consumption/ In 2020 the U.S. Departments of Agriculture (USDA) and Health and Human Services reviewed the scientific advisory committee's draft recommendation to reduce intake of added sugar to < 6 E%. They conclude that there wasn't enough evidence altering the current recommendation, of less than 10 E% of added sugars. Fermentable carbohydrates (not only sugars) are cariogenic (Touger-Decker and van Loveren 2003; WHO commissioned systematic review by Halvorsrud et al. 2019). We therefore suggest adding a section in the chapter, focusing on carbohydrates and dental caries. Notice WHOs Recommendation to reduce free sugar intake to less than 5% to prevent dental caries is based on very low evidence quality and obsolete data on oral health from Japan (1950s), not comparable to todays' health care in the Nordic countries.		

Swedish Food Agency	Swedish Food Agency	Provides a good overview of carbohydrates.	Abstract: The first line in results is vague. Which outcomes are total carbohydrate intake weakly associated with? Could the sentence be rephrased to make it clearer that the evidence, with a few exceptions, is limited? p. 8, second paragraph. Why specifically highlight Denmark in the text when there are methodological uncertainties in the Danish data? p.12, Under the heading total sugars other exposures than total sugars are presented. For example "Based on data from two observational studies, there is evidence for a positive and causal relationship between sugar sweetened beverages and risk of GDM.." and later in the same paragraph sucrose, glucose, fructose and lactose and type 2 diabetes are discussed. These results do not fit under the heading total sugars. p.16, The paragraph on micronutrient dilution needs a heading. p.18, In the summary of main results different cut-offs for added/free sugars are presented. Could the different cut-offs be commented and how WHO and SACN ended up with these specific cut-offs. WHO also has a 10E% cut-off, what is the difference between 5E% and 10E%?	We have modified the results for carbohydrates in the abstract. We report data from the recent EFSA report, where this is presented. They state, as we have, that there are uncertainties in these data. As intakes in some groups are highest in Denmark, this is presented. We agree and have included the text under a new heading on pregnancy and neonatal outcomes. A new heading is included. we have clarified the basis for the WHO cutoffs.

L.M. Granskog	concerned citizen	At the CDC website I looked for information about how many people in the US have pre-diabetes or diabetes. According to what I found ca. 49% of the population over age 65 in the US has pre-diabetes, the number is ca. 38% for the entire population (https://www.cdc.gov/diabetes/data/statistics-report/prevalence-of-prediabetes.html). According to another page another ca. 29 % of the population over the age of 65 has actual diabetes, the total percentage for the population as a whole is ca. 15% (https://www.cdc.gov/diabetes/data/statistics-report/diagnosed-undiagnosed-diabetes.html). This would indicate that in the US, for those over the age of 65, ca. 77% of them have either pre-diabetes or diabetes. For the entire population, ca. 53% have either pre-diabetes or diabetes. Some common foods of the sort many people may think are recommended "whole grain" foods, such as cornflakes, apparently cause blood sugar spikes even in the majority of people considered to be healthy (https://doi.org/10.1371/journal.pbio.2005143 https://biox.stanford.edu/highlight/diabetic-level-glucose-spikes-seen-healthy-people). Are the majority of people having blood sugar spikes from eating what they may believe are healthy foods? Who are dietary recommendations actually for? Ultra-processed food producers, pharmaceutical companies? (https://doi.org/10.1017/S13689800220006	The point is well made in the conclusion that "with increasing intake of added and free sugar there is less room for healthy foods and micronutrients, which is especially important for those with low energy intake, such as children". This is also true for the elderly, - those 77% (??) with pre-diabetes or diabetes, or whatever percentage it is in the Nordic countries. There is research which indicates that the elderly need more protein and high quality protein to avoid sarcopenia and general frailty (https://doi.org/10.3390/nu8060359). Perhaps it would be wise if people who are working on dietary guidelines could repeat the research done by Harvard medical students, and eat their way through the foods they are recommending with continuous glucose monitoring (https://doi.org/10.1177/15598276221119989).	The observational studies are the best available evidence regarding long-term health effects of high sugar consumption. Children is included as an example, this is also true for elderly and others with low energy intakes.

		72) At what cost to society? In 2020, 387 billion kroner were spent on health care in Norway (https://www.ssb.no/nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/lav-vekst-i-helseutgiftene-i-2020). This is also associated with significant ghg emissions (https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf). Dietary guidelines influence what food is made available. What does the rise in obesity and diabetes have to do with the dietary guidelines? (https://doi.org/10.3389/fnut.2021.748847, https://www.nutritioncoalition.us/americans-follow-the-guidelines-but-their-health-has-not-improved-1/ https://www.dietdoctor.com/diabetes/what-happened-how-to-fix-it). People and animals will apparently continue eating until they get enough protein (https://doi.org/10.1038/508S66a, https://doi.org/10.1111/j.1467-789X.2005.00178.x). Why are poor quality observational studies, based on one or few unreliable food frequency questionnaires followed years later by measuring health outcomes, with a host of confounding factors and usually with low absolute risk differences, used to conclude anything? (https://www.nutrirecs.com/media-coverage/correlation-not-causation-between-red-and-process-meat-consumption-and-health-risk/). This feels out touch with the reality people with blood sugar issues experience daily. No country in the world can afford the health		

		care costs or function well if half the population has diabetes. The suffering with this is immense. Efforts have been made to improve the dietary guidelines process. The results of this do not inspire trust. (https://doi.org/10.1093/pnasnexus/pgac107 https://www.cambridge.org/core/journals/public-health-nutrition/article/conflicts-of-interest-for-members-of-the-us-2020-dietary-guidelines-advisory-committee/843992D8901540296BCEB43D716C1497 https://www.nutritioncoalition.us/2020-dietary-guidelines-info/dietary-guidelines-fail-to-meet-review-standards).		

5. Dietary fibre

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	No general comments.	Page 14. At the end of this page, it is stated that when the diet in affluent society is omnivorous, higher fiber intake in children unlikely impair their growth. So, implicitly it is stated that vegetarian diets typically higher in fiber, may results impaired growth in children. Macronutrients and anthropometrics of vegan, vegetarian and omnivorous children (1-3 years) were studied recently in Germany. Conclusion of this VeChi Diet study was that there were no significant differences in anthropometrics in different diet groups. Reference: Weder S et al. Energy, macronutrient intake, and anthropometrics of vegetarian, vegan and omnivorous children (1-3 years) in Germany (VeChi Diet Study). Nutrients 2019;11(4):832. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6521189/#!po=31.0811	As there has been some long-standing concern about the effect of high fibre intakes in interfering children's growth (see Williams et al. 1995), the NNR committee addressed the question of high fibre intakes and growth in children by commissioning a systematic review on the subject (Dierkes et al. Food & Nutr Res 2023), which included eligible studies by until November 2021. The text and conclusions made in fibre chapter are largely based on this and earlier systematic reviews of similar high quality. Briefly, high fibre intake seems to be of no general concern, at least with omnivorous children that were addressed in most studies. At the moment, we cannot make reliable conclusions concerning vegan children as there is a lack of good quality and large enough studies on the subject. The study by Weder et al. is one of the very few and is a cross-sectional study with self-reported anthropometric measures, and therefore less strong in giving evidence compared to prospective cohorts and controlled trials included in Dierkes et al. (2023). Overall, that is the reason we phrased our conclusion as the following and do not see a science-based reason to change it: "However, it seems unlikely that even higher fibre intakes than currently would result in impaired growth in children on omnivorous diets in affluent societies such as Nordic and Baltic countries." Dierkes J, Nwaru BI, Ramel A, Arnesen EK, Thorisdottir B, Lamberg-Allardt C, Spielau U, Söderlund F, Bärebring L, Åkesson A. Dietary fiber and growth, iron status and bowel function in children 0-5 years old: a systematic review. Food Nutr Res 2023;67. doi: 10.29219/fnr.v67.9011.

Swedish Food Agency	Swedish Food Agency	No general comments.	Page 12 paragraph 3. The abbreviation CRC (colorectal cancer?) is not spelled out. At the end of the section "Physiology" (page 6, paragraph 3), the authors state that most mechanisms and health beneficial effects of SCFAs have been demonstrated in animal models and not human studies. A clearer reference in the text of this section whether the observations are based on animal data or human data would be nice if it could be included.	CRC has been spelled out now. Thank you for notifying us. With regards to physiological and health effects of short chain fatty acids, it is true that most of the mechanistic insight of short chain fatty acids (SCFAs) are gathered from animal studies, often combined with in vitro cell studies. However, human studies have also contributed to the knowledge of SCFAs, in particular on concentrations and uptake/absorption in the large intestine. Moreover, there are some clinical studies that have looked into the effect of SCFAs on appetite regulation. The text has now been modified to clarify what is known from animal studies and what is known in humans.
Tanja Kalchenko	Physicians' and nutrition experts' association Food for the health	Very good summary, thank you	I suggest to add following in abstracts, to make it clear: There is no fiber in any animal foods - meat, dairy, eggs or fish/seafoods	We find this unnecessary to state because it is not entirely true. Although it is fair to say that almost all dietary fibres come from plants, one exception is human breast milk, which contains fibres in the form of galactooligosaccharides. Moreover, other animal sources may also contain molecules with possible "fibre-like" properties. Such molecules could include heavily glycosylated proteins (e.g., proteoglycans), whose properties may escape normal digestion and affect microbiota in the colon (1). Although such molecules are not part of the current fibre definition, we can not exclude that certain molecules that we ingest of animal origin have "fibre-like" properties that could be a part of the fibre definition in the future. 1. H Jia, M Hanate, W Aw, H Itoh, K Saito, S Kobayashi, et al., Eggshell membrane powder ameliorates intestinal inflammation by facilitating the restitution of epithelial injury and alleviating microbial dysbiosis, Scientific reports 2017 7 43993.doi:10.1038/srep43993

6. Protein

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Göran Christiansson	Framtidskultur Halland AB	I miss nuts.	Nuts are amazing. Ecological superheroes. Nut trees are vastly superior to other annual crops when it comes to capturing CO_2, stabilizing the soils and reducing eutrophication. We can grow much more local, organic nuts in Scandinavia, especially in Denmark and southern Sweden, but also in Norway and Finland. Hazelnuts, walnuts, hickory nuts and sweet chestnuts. See Weiss, Philipp "Nötodlarens Handbok".	Thank you for your comment. Although nuts are an important nutritional source of protein, the possibilities to grow them in all Nordic or Baltic countries are nevertheless limited and they are mostly imported. For needing to be concise with the text, deeper discussion about nuts could not be included.
Heli Åby	Atria Suomi Oy	-	page 2. the positive aspects of animal protein and its nutrients are neglected. Meat is an excellent source of high-quality protein. It contains all the amino acids that our bodies need. Proteins are the body's protective nutrients. They are necessary for growing muscle and repairing damage to the body, and they help to stave off hunger. Meat also provides group B vitamins, and it is a good source of iron. It is a good idea to eat a diverse range of meat: chicken, pork, and beef in lean pieces. Cold cuts and other meat products could be eaten in moderation as part of a varied diet. page 4. Because the bioavailability is generally lower in plant-based proteins compared to animal based protein the recommended intake of plant based vs. animal based protein should be taken into account. We need less animal-based protein compared to plant based protein for the bioavailability and quality of proteins.	Thank you for your comment. The final chapter (starting at p. 4) now contains a brief review on what happens to the overall quality of a diet when animal-sources proteins are partially replaced with plant-sourced ones, taking into account the other (than protein) nutrient composition in a protein source. Both positive and negative changes occures, which needs to be taken into account when assesing a healthiness of a diet.

			page 4. A typical Nordic mixed diet should be more uphold, because the differences in quality between proteins in mixed diet is less critical, because mixed diet contains variety of protein sources. From the varied mixed Nordic diet, we can easily secure that we get a good mix of good quality proteins. page 5. Vulnerable groups such as elderly should be considered in recommendation of protein intake. The appetite usually decreases among elderly, and they usually eat less. Therefore, it is important that they get good quality protein with indispensable amino acids. It is also important that the recommended protein sources come from foods that they prefer. page 6. The protein intake among Nordics countries is ranging from 15E% to 18E% being within the current Nordic nutrition recommendation 10-20 E%. The data behind Nordic protein intakes is partly dated. page 10. It is important to eat varied and balanced diet. Most studies on the relationship between protein intake and cancer are food-based, and therefore we cannot isolate the protein intake as such from other nutrients. What about other nutrients, is it same? page 11. In the new NNR should there be recommendation of good quality protein like in the EFSA´s recommendation, they recommend 0,83 g of good quality protein/kg BW/d? Should there be different	

			recommendation for plant-based protein for vegetarian/vegan diets?	
Gunnar Johansson	Professor emeritus i kostvetenskap från Umeå universitet	1. Det finns inte redovisat och jag har inte sett någon studie som visat på proteinbrist i de nordiska länderna eller Baltikum. Finns det sådana studier bör de redovisas. Finns det inte sådana studier bör det sägas. Även om ni säger det så tycker jag det ska vara tydligare att om man har proteinbrist så är det kopplat till även andra näringsämnen. Det är mycket svårt att enbart få proteinbrist utan att få brist på andra näringsämnen. Man äter för lite mat helt enkelt. 2. Eftersom det är svårt att specifikt studera protein så tycker jag att man tydligare ska säga det och mer tala om proteinrika livsmedel och vilka livsmedel man talar om.	3. Jag håller inte med om slutsatsen av referens 66 på sidorna 10 och 11. "Several meta-analyses on high animal protein intake was positively associated with cardiovascular mortality and high plant protein intake was inversely associated with all-cause and cardiovascular mortality, especially among individuals with at least one lifestyle risk factor. Where, the substitution of plant protein for animal protein, especially that from processed red meat, was associated with lower mortality, suggesting the importance of protein sources (60,61,62,63,64,65)." "Other studies are inconclusive about the association between protein sources and mortality (66). Från referens 66: Conclusion: This study demonstrates that higher plant protein intake is associated with a reduced risk of all-cause and CVD-related mortality. Persons should be encouraged to increase their plant protein intake to potentially decrease their risk of death. Jag menar att referens 66 säger att plant protein är fördelaktigt (och inte inconclusive).	Thank you for your comment. Protein-energy malnutrition may occur in sick or frail elderly, or those who are not eating enough due to various reasons, despite the fact that protein deficiencies are not common in Nordic or Baltic countries.
Donald K. Layman, Ph.D., Professor	Department of Food Science & Human Nutrition, University of	The NNR2022 Protein report provides a good overview of amino acid metabolism and physiology. The report correctly acknowledges that dietary proteins are simply food sources of amino acids and	Essential References (from Professor Donald K. Layman): (1) Optimum Dietary Protein Intake for Adults:	Thank you for your comments. The text and references have been revised according to the NNR protocol.

	Illinois at Urbana-Champaign, Illinois, USA	that dietary protein recommendations represent a surrogate estimate of requirements for essential amino acids. While amino acids serve as building blocks of protein, but they are unique nutrients with distinct, non-interchangeable metabolic roles and individual dietary requirements. Just as vitamins A, B6, C, and D have distinct functions and metabolic requirements despite being grouped as vitamins, amino acids are equally distinct despite being grouped as protein. The future of Personalized Nutrition requires recognizing amino acids as individual nutrients. This recognition and understanding becomes imperative with the ongoing narrative about the need for more plant-based diets. As essential nutrients, amino acid requirements are absolute needs based on body weight and should always be represented as grams/kilograms of body weight. The report creates a serious misconception by repeatedly expressing protein needs as percentage of energy intake (%En). As an absolute dietary requirement, the relationship of protein to %En is inverse or reciprocal. With high daily energy intake, protein can be a relatively low %En within the range of 14% to 16%, however with low daily energy intake, such as older adults or weight loss, protein density must increase to 20% to 30%En. Expressing protein as %En is never appropriate unless the specific population and metabolic status are defined.	Layman. Dietary Guidelines should reflect new understanding about adult protein needs. Nutrition & Metabolism 6:12, 2009; doi: 10.1186/1743-7075-6-12 Bauer et al. Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the PROT-AGE Study Group. JAMDA 14:342, 2013. Humayun et al. Reevaluation of the protein requirement in young men with the indicator amion acid oxidation technique. Am J Clin Nutr. 86:995, 2007. Rafii et al. Dietary protein requirement of female adults >65 years determined by the indicator amino acid oxidation technique is higher than current recommendations. J. Nutr. 145:18, 2015. (2) Animal Protein Foods and Cardiovascular Disease and Cancer: Zeraatkar et al. Effect of lower versus higher red meat intake on cardiometabolic and cancer outcomes. Ann Intern Med 2019; doi:10.7326/M19-0622. Zeraathker et al. Red and processed meat consumption and risk for all-cause mortality and cardiometabolic outcomes. Ann Intern Med 2019; doi: 10.7326/M19-0655. O'Conner et al. Total red meat intake of >0.5 servings/d does not negatively influence cardiovascular disease risk factors: a systemically searched meta-analysis of	

		The report also misuses the term "requirement" by referring to the RDA (Recommend Dietary Allowance) as the protein "daily requirement" versus the correct definition that the RDA is the "minimal protein intake to prevent signs of inadequacy in 97% of healthy, active, young adults". The RDA was never evaluated as an optimum daily intake, only the minimum to prevent detectable inadequacy based on short-term nitrogen balance. The healthy range for protein as established by the U.S. National Academy of Sciences as the Dietary Reference Intakes is 0.8 g/kg (RDA) up to >2.5 g/kg (Upper Limit). An Upper Safe Limit has never been officially defined, but urea cycle capacity is >3.0 g/kg. Extensive research by groups around the world have established an optimum daily intake for adults in the range of 1.2 to 1.6 g/kg. The associations of total protein and animal protein to cardiovascular disease, cancer, and T2D are vague and based solely on epidemiology studies showing very weak correlations (RR and HR of ~1.2). The authors need to provide clear evidence of the relevance of these epidemiology studies and not just superficial conclusions and extrapolations. The report needs to acknowledge the extensive data refuting these weak epidemiology claims. When confounding behaviors such as smoking and BMI and dietary factors including fiber and calories are factored out, the weak correlations disappear. The review also fails to include	randomized controlled trails. Am J Clin Nutr 105:57, 2017. Han et al. Reduction of red and processed meat intake and cancer mortality and incidence. Ann Intern Med 2019; doi: 10.7326/M19-0699 Roussell et al. Beef in an optimal lean diet study: effects on lipids, lipoproteins, and apolipoproteins. Am J Clin Nutr 95:9, 2012. Maki et al. A meta-analysis of randomized controlled trials that compare the lipid effects of beef versus poultry and /or fish consumption. J Clin Lipidology 6:352, 2012 (3) Animal Protein Foods and Type 2 Diabetes: Mateo-Gallego et al. Energy-restricted, high-protein diets more effectively impact cardiometabolic profile in overweight and obese women than lower-protein diets. Clin Nutr 36:371, 2017. Hill et al. Type and amount of dietary protein in the treatment of metabolic syndrome: a randomized controlled trial. Am J Clin Nutr. 102:757, 2015. Micha et al. Red and processed meat consumption and risk of incidence of coronary heart disease, stroke, and diabetes mellitus. Circulation 121:2271, 2010. (4) Protein and Kidney Health Berryman et al. Diets higher in animal and plant protein are associated with lower	

		the large number of well-controlled RCTs that show total protein and animal protein are neutral or positive factors for body weight, glycemic regulations, and biomarkers for cardiovascular health. Contrary to the report, multiple reviews establish that protein intakes above the minimum RDA have no negative impact on renal function or kidney health. This myth should not be perpetuated in Dietary Guidelines with vague unsubstantiated statements. The brief suggestion that reducing animal protein is an issue of climate change and sustainability is beyond the expertise of these authors. It is a complex topic that deserves rigorous science and not unfounded opinions. If included in the report, the statement should be one of simply suggesting it as a topic for research and scientific evaluation.	adiposity and do not impair kidney function in US adults. Am J Clin Nutr. 104:743, 2016. Devries et al. Changes in kidney function do not differ between healthy adults consuming higher- compared with lower- or normal-protein diets: A systematic review and meta-analysis. J. Nutr. 148:1760, 2018. Van Elswyk et al. A systematic review of renal health in healthy individuals associated with protein intake above the US Recommended Daily Allowance in randomized controlled trails and observational studies. Adv Nutr 9:404, 2018. Martin et al. Dietary protein intake and renal function. Nutrition & Metabolism 2:25, 2005; doi: 10.1186/1743-7075-2-25. (5) Animal Protein, Sustainability, and Climate Change: Layman. Assessing the role of cattle in sustainable food systems. Nutrition Today 53:160, 2018.	
Hannah Theobald	Quorn Foods	The draft NNR chapter on protein refers to sources of protein being either animal or plant in nature but does not recognise the fact that fungi are also a source of protein, or that fungal sources of protein are consumed in the Nordic diet. We would like to see this addressed and provide the following rational: • Fungi are recognised as a distinct Kingdom in the taxonomic order; separate from plants and animals. This distinction was recognised in the 1950s (1) and	Page 1, abstract Reference to the fact that fungi (particularly fungal biomass in the form of mycoprotein) are also a source of protein, in addition to plants and animals is missing. Page 1, introduction, paragraph 1 The validity of the statement 'Animal-sourced proteins are the building blocks for several structural elements' is queried. No reference is provided and there is no physiological reason why the same amino acids found in plants or fungi do not do the	Thank you for your comment. Fungi are indeed a possible protein source that could be consumed more in the future. However, fungi and other new foods still lack research on their nutrient bioavailability, not yet warranting recommendations to the general public.

		formalised in 1969 (2). Despite this, fungi are still often misclassified as plants (3), and this misclassification can be seen today in food-based dietary guidelines and nutrient profiling models around the world (where mushrooms are classed as a vegetable in FBDGs, public health messaging around fruits and vegetables and in the 'fruits, vegetables, nuts,' component of the UK Nutrient Profiling Model/NutriScore). Fungi are recognised as being taxonomically distinct from plants for a few reasons, including the fact that fungi lack chloroplasts (found in plants) and derive their energy through the enzymatic degradation of decaying organic matter (whereas plants derive their energy from photosynthesis) (2) and contain fibre in the form of chitin (while plants contain cellulose). Furthermore, fungi are molecularly closer to animals than plants (4). • In the Nordics, fungal sources of dietary protein are available in the form of mycoprotein, which is fermentation-derived fungal biomass. Mycoprotein has been available in the Nordic marketplace for over 20 years (specifically, Quorn mycoprotein has been available in Sweden since 1999, Finland and Denmark since 2014 as well as Norway since a similar date). • Mycoprotein is a bioavailable source of protein (5), which has been shown to stimulate muscle protein synthesis to a greater extent than milk (6). Mycoprotein	same thing. Page 2, introduction, paragraph 2 Reference to the fact that fungi (particularly fungal biomass in the form of mycoprotein) is also a source of protein, in addition to plants and animals, is missing. Add in the fact that fungal-derived mycoprotein comprises of 11.5g protein/100g (wet weight) (13). Page 4, physiology and metabolism, paragraph under table While fungal protein is absent from the section, recent evidence suggests that mycoprotein provides a bioavailable source of protein (5), which has been shown to stimulate muscle protein synthesis to a greater extent than milk (6) and contains low amounts of phytic acid (14). Although the DIAAS of mycoprotein has yet to be measured the PDCAAS of Quorn mycoprotein has been calculated to be 0.996 (15). References 5. Dunlop MV et al (2017) British Journal of Nutrition. 118(9): 673-685. DOI: https://doi.org/10.1017/s0007114517002409. 6. Monteyne AJ, Coelho MOC, Porter C, Abdelrahman DR, Jameson TSO, Jackman SR, Blackwell JR, Finnigan TJA, Stephens FB, Dirks ML, Wall BT (2020) Mycoprotein ingestion stimulates protein synthesis rates to a greater extent than milk protein in rested and exercised skeletal muscle of healthy young men: a randomized controlled trial. Am J Clin Nutr. 112(2): 318-	

		which provides a number of health benefits. A growing body of evidence also shows that mycoprotein provides a number of health benefits: it has been shown to exert LDL-cholesterol lowering properties (7,8), moderates insulinaemia (9,10) and helps decrease energy intake (11) amongst other benefits (12). References: 1. Martin GW (1955) Are fungi plants? Mycologia. 47 (6): 779-792. https://www.jstor.org/stable/3755502 2. Hagen JB (2012) Five Kingdoms, more or less: Robert Whittaker and the broad classifications of organisms. BioScience, 62 (1): 67-74 https://doi.org/10.1525/bio.2012.62.1.11 3. Lovett B (2021) Three reasons fungi are not plants. https://asm.org/Articles/2021/January/Three-Reasons-Fungi-Are-Not-Plants 4. Wainright PO, Hinkle G, Sogin ML, Stickel SK (1993) Monophyletic origins of the metazoa: evolutionary link with fungi. Science. 260 (5106): 340-342. https://www.science.org/doi/10.1126/science.8469985 5. Dunlop MV et al (2017) British Journal of Nutrition. 118(9): 673-685. DOI: https://doi.org/10.1017/s0007114517002409. 6. Monteyne AJ, Coelho MOC, Porter C, Abdelrahman DR, Jameson TSO, Jackman SR, Blackwell JR, Finnigan TJA, Stephens FB, Dirks ML, Wall BT (2020) Mycoprotein ingestion stimulates protein synthesis rates to a greater extent than milk protein	333 doi: 10.1093/ajcn/nqaa092 13. Denny et al (2008) Nutrition Bulletin. 33 (4): 298-310 https://doi.org/10.1111/j.1467-3010.2008.00730.x 14. Mayer Labba IC, Steinhausen H, Almius L, Bach Knudsen KE, Sandberg AS (2022) Nutritional composition and estimated iron and zinc bioavailability of meat substitutes available on the Swedish market. Nutrients, 14(19) 3903. https://www.mdpi.com/2072-6643/14/19/3903 15. Edwards DG, Cummings JH (2010) Proceedings of the Nutrition Society. 69 (OCE4), E331. DOI: https://doi.org/10.1017/S0029665110001400	

		in rested and exercised skeletal muscle of healthy young men: a randomized controlled trial. Am J Clin Nutr. 112(2): 318-333 doi: 10.1093/ajcn/nqaa092 7. Turnbull et al (1992) Am J Clin Nutr. 55(2):415-9. DOI: 10.1093/ajcn/55.2.415 8. Coelho et al (2021) Br J Nutr. 125 (2):147-160. https://doi.org/10.1017/s0007114520002524 9. Turnbull & Ward (1995) Am J Clin Nutr. 61(1): 135-40 . https://doi.org/10.1093/ajcn/61.1.135 10. Bottin et al (2016) Br J Nutr. 116(2):360-74. https://doi.org/10.1017/s0007114516001872 11. Cherta-Murillo et al (2020) Br J Nutr. 123(12):1321-1332. https://doi.org/10.1017/s0007114520000756 12. Finnigan et al (2019) Curr Dev Nutr. 3(6): nzz021. https://doi.org/10.1093/cdn/nzz021		
Lars T. Fadnes	University of Bergen	The chapter provides a comprehensive overview on protein intake, physiological aspects, and several associated health outcomes. The chapter seems to generally be well argued. However, there are some arguments that seem to be less well founded (see more specific comments below). References (to below): Schlesinger S, Neuenschwander M, Schwedhelm C, Hoffmann G, Bechthold A, Boeing H, et al. Food Groups and Risk of Overweight, Obesity, and Weight Gain: A	The chapter provides a comprehensive overview on protein intake, physiological aspects, and several associated health outcomes. The chapter seems to generally be well argued. However, there are some arguments that seem to be less well founded. For example, you use the term “high-quality protein” (a term frequently used in the past, but has received substantial criticism, see for example Young & Pellett). As you write, it could include aspects related to absorption, to which degree the protein has a complete amino acid profile (by itself, however as long as it is	Thank you for your comment. While the term 'high-quality protein' can of course be criticised, from essential nutrient point of view it cannot be food-based assesment (red meat, milk, legumes), but needs to be approached as any other nurient with determining its physiological need. Indeed, FAO recommends to treat each amino acid as an individual nutrient when evaluating protein quality.

		Systematic Review and Dose-Response Meta-Analysis of Prospective Studies. Advances in nutrition. 2019;10(2):205-18. Bechthold A, Boeing H, Schwedhelm C, Hoffmann G, Knuppel S, Iqbal K, et al. Food groups and risk of coronary heart disease, stroke and heart failure: A systematic review and dose-response meta-analysis of prospective studies. Critical reviews in food science and nutrition. 2019;59(7):1071-90. de Gavelle E, Huneau JF, Bianchi CM, Verger EO, Mariotti F: Protein Adequacy Is Primarily a Matter of Protein Quantity, Not Quality: Modeling an Increase in Plant:Animal Protein Ratio in French Adults. Nutrients 2017 Young VR, Pellett PL: Plant proteins in relation to human protein and amino acid nutrition. The American journal of clinical nutrition 1994, 59(5 Suppl):1203S-1212S. Zhong VW, Allen NB, Greenland P, Carnethon MR, Ning H, Wilkins JT, et al. Protein foods from animal sources, incident cardiovascular disease and all-cause mortality: a substitution analysis. Int J Epidemiol. 2021;50(1):223-33. Schwingshackl L, Hoffmann G, Lampousi AM, Knuppel S, Iqbal K, Schwedhelm C, et al. Food groups and risk of type 2 diabetes mellitus: a systematic review and meta-analysis of prospective studies. European Journal of Epidemiology. 2017;32(5):363-	eaten with supplementing sources [e.g., combining legumes and grains], its independent completeness is of less relevance. The term as used, does to a limited degree take into account that different type of protein sources (e.g., red and processed meats) can be substantially associated with diseases such as cardiovascular disease, colorectal cancers, and all-cause mortality, while others such as nuts and legumes are inversely associated with several of these chronic diseases. Thus, referring to "high quality" when referring to absorption and single-item completeness, is simplistic. Why not rather be more specific, referring to the absorption rates, amino acid profile, but also how the sources are associated with chronic diseases (see several references below, some of them already included in your chapter)? This reference to quality seems be used similarly several places throughout the chapter (e.g., "Dietary protein intake in the Nordic and Baltic countries is mainly with high-quality protein where"... If commenting on the Nordic and Baltic countries, would it not be of relevance to comment on the differences in associations to chronic disease observed between fish or legumes vs. red or processed meats? Similar as mentioned above, the sentence "However, protein digestibility and bioavailability may become an issue in protein transition towards more plant-based diets in vulnerable groups such as the elderly, as protein bioavailability is known to	

		75. Schwingshackl L, Hoffmann G, Iqbal K, Schwedhelm C, Boeing H. Food groups and intermediate disease markers: a systematic review and network meta-analysis of randomized trials. American Journal of Clinical Nutrition. 2018;108(3):576-86.	decrease with age." does not take associated between different type of protein sources and with cardiovascular, diabetes type 2 and biomarkers for disease (see Bechthold, Schwingshakl etc), where for example a high intake of red and processed meats might thus contribute to frailty and disease-related aging. Protein substitution aspects could also be of relevance and could be discussed more (see Zhong et al). It is also a bit surprising that you write about kwashiorkor-like clinical pictures in the section "Protein intake and health outcomes relevant for Nordic and Baltic countries". You write that "Severe protein deficiency results in oedema, muscle weakness, and changes to the hair and skin. Protein deficiency is often linked to energy deficiency and protein-energy malnutrition". I have spent about half of my time during the last two decades with clinical work (in addition to work as a researcher/professor), and exempt in the terminal phase of for example people with end-stage disease, I have hardly seen any of these in Norway (in contrast to what is not uncommonly seen in countries with starvation). Is there any epidemiological support that these are frequent in the Nordic and Baltic countries, despite not so obvious to note for clinicians? If not, they might be better either removed or commented on their (in)frequency. Relating to the section on obesity, saying something about the protein sources would be more useful. See for example the	

			assessment from Schlesinger et al. A small note, there seems to be a spelling error on page 4 where it now reads "Faba bean. I assume it should be "Fava bean". References: Schlesinger S, Neuenschwander M, Schwedhelm C, Hoffmann G, Bechthold A, Boeing H, et al. Food Groups and Risk of Overweight, Obesity, and Weight Gain: A Systematic Review and Dose-Response Meta-Analysis of Prospective Studies. Advances in nutrition. 2019;10(2):205-18. Bechthold A, Boeing H, Schwedhelm C, Hoffmann G	
Amanda Jakobsson	Svenskt Kött	The purpose of the chapter is to describe the accumulated evidence for the health significance of proteins, as a basis for setting and updating recommendations on protein intake. The chapter reports, similar to NNR2012, to a large extent and with a balanced view of the relationship between plant-based and animal proteins and how they can be combined in a healthy diet. It is also welcomed that the authors request more advanced methods and long-term studies to evaluate the differences between different protein sources. Furthermore, it is positive that the authors draw attention to Gilani S. et al.'s study (2018; Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and the Bioavailability of Amino Acids and on Protein Quality) and the fact that the	However, the statement that "Replacing animal protein with vegetable protein should also be considered for sustainability aspects can also be a public health strategy to lower the risk of CVD mortality and T2D" needs to be both substantiated and nuanced. There are plant-based diets that are reprehensible from an environmental perspective, just as there is animal production that contributes to ecosystem services, among other things. Furthermore, the reasoning around cardiovascular disease (CVD) and type 2 diabetes (T2D) should be further developed as the studies the authors refer to have apparently come to different conclusions. When the authors refer to The World Cancer Research Fund's (WCRF) recent dietary survey regarding risks of colorectal cancer, it should also be mentioned that the WCRF	The text and references have been reviewed.

		uptake of proteins (bioavailability) can become problematic for sensitive groups such as the elderly with an increased intake of plant-based proteins - this is because the ability to assimilate protein, among other things, decreases with increasing age. This is particularly relevant in relation to the risk of fractures, which the chapter also deals with. In the matter of a green protein shift and bioavailability, there are additional new studies that should be noted in the chapter. The low estimated availability of iron from extracted and textured field bean protein is confirmed in a clinical study. Absorption of non-heme iron in 27 women of childbearing age was 4.2% from meals with textured field bean protein, 21.7% and 9.2% from beef and cod protein, respectively, C. Mayer Labba (2022); Lower absorption of non-heme iron in healthy women from single meals of textured fava bean protein compared with beef and cod protein meals: Two single-blind randomized trials. Furthermore, studies have shown that meat substitutes that are available on the Swedish market have deficiencies in nutritional content and bioavailability, especially when it comes to iron and zinc. See C. Mayer Labba (2022); Nutritional composition and estimated bioavailability of iron and zinc for meat substitutes available on the Swedish market and S. Bryngelsson et al (2022); Nutritional assessment of plant-based meat	does not advocate excluding meat from the diet, as meat is a valuable source of nutrients, especially the nutreints protein, iron, zinc and vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. The Swedish Food Agency's recommendation to eat a maximum of 500 grams of red meat a week, including cured meats, is based on the risk of certain cancer diagnoses. However, there are new studies which nuance this picture, and which should be taken into account in this context. (See The global, regional and national burden of colorectal cancer and its attributable risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 in The Lancet, https://www.thelancet .com/journals /langas/article/PIIS2468-1253(19)30345-0/full text).	

		analogues on the Swedish market. In summary, it is important to have a nuanced and evidence-based holistic view of different forms of protein and here NNR2022 needs to be able to contribute with real support. The chapters on protein and legumes, among other things, should therefore be reviewed jointly. Regarding the importance of protein quality, see McAuliffe, G A et al (2022); Protein quality as a complementary functional unit in life cycle assessment (LCA).		
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan	It should be emphasized, that in Nordic countries the issue is not the quantity, nor the quality of protein, but an excess protein intake, mainly from animal sources. For example, in Finland two thirds of the protein is derived from animal sources, and 20 % of people got protein more than recommended. Further, 79 % men and 26 % ate red and processed meat more than recommended. Reference: Valsta L, Kaartinen N, Tapanainen, Männistö S, Sääksjärvi K. Ravitsemus Suomessa – FinRavinto 2017 -tutkimus [Nutrition in Finland – the National FinDiet 2017 Survey]. Institute for Health and Welfare (THL). Helsinki, Finland 2018. Available: https://www.julkari.fi/handle/10024/137433 It should also be emphasized, that if variety of plant protein sources are eaten and caloric intake is adequate, vegetarian, including vegan, diets meet or exceed	Page 1-2: It says here: "Animal-sourced are the building blocks for severe cellular structure elements…". Is this a typo? Should it be: "Amino acids are the building blocks…"? Because every indispensable amino acid can be derived from plant-based protein. Page 2. It says here, that only dry matter of plant-based foods can contain protein as much as 17-40 %. That is not true: specially many new generations plant proteins contain a lot of protein. Seitan, made of wheat gluten, contain typically around 30 % protein, and mixed plant proteins (oat, pea, broad bean) "Härkis" (https://www.beanit.fi/fi/tuotteet/beanit-harkapapumuru-maustamaton/) and "Nyhtökaura" (https://www.valio.fi/tuotteet/ruoanlaiton-lihattomat-proteiinituotteet/goldgreen-nyhtokaura-nude/) contains 16 % and 27 % protein, respectively. It is also worth of	The typo has been corrected.

		recommended protein intakes, as well as all indispensable amino acids. Reference: Academy of Nutrition and Dietetics: Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. Journal of the Academy of Nutrition and Dietetics 2016;116:1970-80. Available: https://pubmed.ncbi.nlm.nih.gov/27886704/	noting, that products with mixed plant proteins have an excellent amino acid composition. Page 4, table 2. Perhaps it should be mentioned here that NA means that there is not a limiting amino acid. Page 4. As seen in table 5 in the WHO's publication (reference 24), processing of plant-based proteins improves their absorption, and this should be mentioned here. For example, absorption of wheat gluten is 99 % white wheat flour 96 % and soy protein isolate 95 %. Page 4-5. It should be emphasized here, that combining indispensable amino acids at each meal is not needed but eating a variety of plant foods during day. Reference: Academy of Nutrition and Dietetics: Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. Journal of the Academy of Nutrition and Dietetics 2016;116:1970-80. Available: https://pubmed.ncbi.nlm.nih.gov/27886704/ Page 6-8, Chapter "Dietary intake in Nordic and Baltic countries": Excess intake of protein could be mentioned here (see general comments) as well as intake of vegans, because protein intake from a vegan diet remains a myth. According to a recent systematic review average protein intake in vegans was adequate, being 12,9 % of total energy intake (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic	

			review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/) Page 11 and 14. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Page 12. It says here:" In the Nordic setting quantity is more important because protein sources are usually of animal origin, and quality is not a concern". This may implicitly raise a concern of quality when protein sources are of plant origin. Please, see our previous comments of plant proteins. Page 16. Looks like something is missing from reference 38. Journal, issue, volume, pages, or doi-number?	
Ulrika Åkesson	Food Frame Sweden	Kapitlet ger övergripande bred och balanserad syn på vikten av tillfredsställande mängd och kvalitet av protein. Författarna pekar på bristande vetenskap inom området, vilket är viktigt i en tid med stort fokus på alternativ och omställning till alternativa proteiner. Kapitlet visar på förståelse för att behovet ser olika ut vid olika tidpunkter i livet. När det konkret handlar om grönt proteinskifte kopplat till utmaningar gällande biotillgänglighet finns fler studier än de som nämns i kapitlet. Den låga uppskattade tillgängligheten av järn från extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Absorptionen av icke-hemjärn hos 27 kvinnor i fertil ålder var 4,2 % från måltider med texturerat åkerbönaprotein, 21,7 % och 9,2 % från nötkötts- respektive torskprotein, C. Mayer Labba (2022); Lower Non-Heme	När författarna hänvisar till The World Cancer Research Fund (WCRF) senaste livsmedelsundersökning angående risker för kolorektal cancer bör också nämnas att WCRF inte förespråkar att kött utesluts från kosthållningen, eftersom kött är en värdefull källa till näringsämnen, särskilt protein, järn, zink och vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Livsmedelsverkets rekommendation om att äta maximalt 500 gram rött kött i veckan inklusive charkprodukter är baserat på risken för vissa cancerdiagnoser. Det finns emellertid nya studier som nyanser denna bild och som bör beaktas i sammanhanget. (se The global, regional, and national burden of colorectal cancer and its attribute risk	Thank you for your comment. It is true that WCRF do not recommend to give up all red meat consumption and actually has increased the upper limit of consumption from 350 g/wk in their earlier report in 2007 to 500 g/wk in their latest report. However, the text need to be concise and it does not state that all consumption of red meat needs to be ceased.

		Iron Absorption in Healthy Females from Single Meals with Texturized Fava Bean Protein Compared to Beef and Cod Protein Meals: Two Single-Blinded Randomized Trials. Andra studier visar att köttsubstitut på svensk marknad har uppenbara brister i näringsinnehåll och biotillgänglighet, inte minst när det gäller järn och zink: Se C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioaviability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. Mot bakgrund av att mottagare av NNR:s rekommendationer i det operativa arbetet planerar och hanterar substitut till kött som alternativa måltider är det särskilt viktigt att kunna ge en evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlen om protein respektive baljväxter, bland annat, borde hanteras mer gemensamt. Proteinets sammansättning i olika livsmedel samt den påverkan som kombinerade proteinråvaror har på smältbarhet i kroppen gör att generella påståendet "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" snarare	factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 i The Lancet, https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext).	

		missleder än vägleder den som ska tolka rekommendationen. En nyansering behöver till som klarar av att kommunicera jämförelser som visar på alternativens olika bidrag av betydande ekosystemtjänster. Särskilt i ett nordiskt perspektiv där markeffektivitet kan ökas genom utveckling och återskapande av betesmarker kan ge bade förbättrad biologisk mångfald och viktiga rekreationsmiljöer för människan.		
Maria Häger	HKScan Sweden AB	Kapitlet redovisar, i likhet med NNR2012, i stor utsträckning en balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner och hur de kan kombineras i en sund kosthållning. Det är också välkommet att författarna efterfrågar mer avancerade metoder samt långtidsstudier för att utvärdera skillnaderna mellan olika proteinkällor. Vidare är det positivt att författarna uppmärksammar Gilani S. med fleras studie (2018; Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and the Bioavailability of Amino Acids and on Protein Quality) och det faktum att upptaget av proteiner (biotillgänglighet) kan bli problematiskt för känsliga grupper såsom äldre vid ett ökat intag av plantbaserade proteiner – detta därför att förmågan att tillgodogöra sig bl a protein minskar med stigande ålder. Detta är särskilt relevant i förhållande till risken för frakturer, som kapitlet också behandlar. Det är sammanfattningsvis angeläget att	I frågan om ett grönt proteinskifte och biotillgänglighet finns ytterligare nya studier som bör uppmärksammas i kapitlet. Den låga uppskattade tillgängligheten av järn från extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Absorptionen av icke-hemjärn hos 27 kvinnor i fertil ålder var 4,2 % från måltider med texturerat åkerbönaprotein, 21,7 % och 9,2 % från nötkötts- respektive torskprotein, C. Mayer Labba (2022); Lower Non-Heme Iron Absorption in Healthy Females from Single Meals with Texturized Fava Bean Protein Compared to Beef and Cod Protein Meals: Two Single-Blinded Randomized Trials. Vidare har studier visat att köttsubstitut som finns tillgängliga på den svenska marknaden har brister i näringsinnehåll och biotillgänglighet, inte minst när det gäller järn och zink. Se C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioaviability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional	Thank you for your comment. The final chapter (starting at p. 4) now contains a brief review on what happens to the overall quality of a diet and nutrient status when animal-sources proteins are partially replaced with plant-sourced ones, taking into account the other (than protein) nutrient composition in a protein source. Both positive and negative changes occures, which needs to be taken into account when assesing the healthiness of a diet.

		ha en nyanserad och evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlen om protein respektive baljväxter, bland annat, bör således ses över gemensamt.	assessment of plant-based meat analogues on the Swedish market. Angående betydelsen av proteinets kvalitet, se McAuliffe, G A et al (2022); Protein quality as a complementary functional unit in life cycle assessment (LCA). Påståendet att "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" behöver emellertid både underbyggas och nyanseras. Det finns plantbaserade dieter som är förkastliga ur miljöperspektiv, likväl som det finns animalieproduktion som bidrar med betydande ekosystemtjänster, bland annat. Vidare bör resonemanget kring hjärt-och kärlsjukdomar (CVD) och typ 2-diabetes (T2D) utvecklas ytterligare då de studier som författarna hänvisar till uppenbarligen har kommit till skilda slutsatser. När författarna hänvisar till The World Cancer Research Fund (WCRF) senaste livsmedelsundersökning angående risker för kolorektal cancer bör också nämnas att WCRF inte förespråkar att kött utesluts från kosthållningen, eftersom kött är en värdefull källa till näringsämnen, särskilt protein, järn, zink och vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/.	

			Livsmedelsverkets rekommendation om att äta maximalt 500 gram rött kött i veckan inklusive charkprodukter är baserat på risken för vissa cancerdiagnoser. Det finns emellertid nya studier som nyanser denna bild och som bör beaktas i sammanhanget. (se The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 i The Lancet, https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext).	
Kristina Karlsson	Mycorena AB	The draft NNR chapter on protein refers to sources of protein being either animal or plant in nature but does not recognise the fact that fungi are also a source of protein, or that fungal sources of protein are consumed in the Nordic diet. We would like to see this addressed and provide the following rational: • Fungi are recognised as a distinct Kingdom in the taxonomic order; separate from plants and animals. This distinction was recognised in the 1950s (1) and formalised in 1969 (2). Despite this, fungi are still often misclassified as plants (3), and this misclassification can be seen today in food-based dietary guidelines and nutrient profiling models around the world (where mushrooms are classed as a vegetable in	Page 1, abstract Reference to the fact that fungi (particularly fungal biomass in the form of mycoprotein) are also a source of protein, in addition to plants and animals is missing. Page 1, introduction, paragraph 1 The validity of the statement 'Animal-sourced proteins are the building blocks for several structural elements' is queried. No reference is provided and there is no physiological reason why the same amino acids found in plants or fungi do not do the same thing. Page 2, introduction, paragraph 2 Reference to the fact that fungi (particularly fungal biomass in the form of mycoprotein) is also a source of protein, in addition to plants and animals, is missing. Add in the fact that	Thank you for your comment. Fungi are indeed a possible protein source that could be consumed more in the future. However, fungi and other new foods still lack research on their nutrient bioavailability, not yet warranting recommendations to the general public.

		FBDGs, public health messaging around fruits and vegetables and in the 'fruits, vegetables, nuts,' component of the UK Nutrient Profiling Model/NutriScore). Fungi are recognised as being taxonomically distinct from plants for a few reasons, including the fact that fungi lack chloroplasts (found in plants) and derive their energy through the enzymatic degradation of decaying organic matter (whereas plants derive their energy from photosynthesis) (2) and contain fibre in the form of chitin (while plants contain cellulose). Furthermore, fungi are molecularly closer to animals than plants (4). • In the Nordics, fungal sources of dietary protein are available in the form of mycoprotein, which is fermentation-derived fungal biomass. Mycoprotein has been available in the Nordic market for over 20 years, specifically mycoprotein has been available in Sweden since 1999, Finland and Denmark since 2014 as well as Norway since a similar date. Another great benefit is that mycoprotein can be produced locally in the Nordics either as food products or as an ingredient to be used in a variety of food products as is being done by the Gothenburg based company Mycorena since 2017 (5). • Mycoprotein is a bioavailable source of	fungal-derived mycoprotein comprises of 11 g protein/100g (wet weight) (14), but may vary between 8-15 g protein/100g depending on moisture content of the mycoprotein. Page 4, physiology and metabolism, paragraph under table While fungal protein is absent from the section, recent evidence suggests that mycoprotein provides a bioavailable source of protein (6), which has been shown to stimulate muscle protein synthesis to a greater extent than milk (7) and contains low amounts of phytic acid (15). Although the DIAAS of mycoprotein has yet to be measured the PDCAAS of mycoprotein has been calculated to be 0.996 (16). References 1. Martin GW (1955) Are fungi plants? Mycologia. 47 (6): 779-792. https://www.jstor.org/stable/3755502 2. Hagen JB (2012) Five Kingdoms, more or less: Robert Whittaker and the broad classifications of organisms. BioScience, 62 (1): 67-74 https://doi.org/10.1525/bio.2012.62.1.11 3. Lovett B (2021) Three reasons fungi are not plants. https://asm.org/Articles/2021/January/Three-Reasons-Fungi-Are-Not-Plants 4. Wainright PO, Hinkle G, Sogin ML, Stickel SK (1993) Monophyletic origins of the metazoa:	

		protein (6), which has been shown to stimulate muscle protein synthesis to a greater extent than milk (7). Mycoprotein which provides a number of health benefits. A growing body of evidence also shows that mycoprotein provides a number of health benefits: it has been shown to exert LDL-cholesterol lowering properties (8,9), moderates insulinemia (10,11) and helps decrease energy intake (12) amongst other benefits (13). For references, see pasted under 5. Specific comments to the chapter.	evolutionary link with fungi. Science. 260 (5106): 340-342. https://www.science.org/doi/10.1126/science.8469985 5. Mycorena, https://mycorena.com/ 6. Dunlop MV et al (2017) British Journal of Nutrition. 118(9): 673-685. DOI: https://doi.org/10.1017/s0007114517002409. 7. Monteyne AJ, Coelho MOC, Porter C, Abdelrahman DR, Jameson TSO, Jackman SR, Blackwell JR, Finnigan TJA, Stephens FB, Dirks ML, Wall BT (2020) Mycoprotein ingestion stimulates protein synthesis rates to a greater extent than milk protein in rested and exercised skeletal muscle of healthy young men: a randomized controlled trial. Am J Clin Nutr. 112(2): 318-333 doi: 10.1093/ajcn/nqaa092 8. Turnbull et al (1992) Am J Clin Nutr. 55(2):415-9. DOI: 10.1093/ajcn/55.2.415 9. Coelho et al (2021) Br J Nutr. 125 (2):147-160. https://doi.org/10.1017/s0007114520002524 10. Turnbull & Ward (1995) Am J Clin Nutr. 61(1): 135-40 . https://doi.org/10.1093/ajcn/61.1.135 11. Bottin et al (2016) Br J Nutr. 116(2):360-74. https://doi.org/10.1017/s0007114516001872 12. Cherta-Murillo et al (2020) Br J Nutr. 123(12):1321-1332. https://doi.org/10.1017/s0007114520000756 13. Finnigan et al (2019) Curr Dev Nutr. 3(6): nzz021. https://doi.org/10.1093/cdn/nzz021 14. Denny et al (2008) Nutrition Bulletin. 33	

			(4): 298-310 https://doi.org/10.1111/j.1467-3010.2008.00730.x 15. Mayer Labba IC, Steinhausen H, Almius L, Bach Knudsen KE, Sandberg AS (2022) Nutritional composition and estimated iron and zinc bioavailability of meat substitutes available on the Swedish market. Nutrients, 14(19) 3903. https://www.mdpi.com/2072-6643/14/19/3903 16. Edwards DG, Cummings JH (2010) Proceedings of the Nutrition Society. 69 (OCE4), E331. DOI: https://doi.org/10.1017/S0029665110001400	
Sara Lopes	UECBV	We would like to start by thanking the NNR2022 Committee for their work and for the opportunity to give our feedback on the protein chapter. Throughout the document, many single studies were pointed out which contradicted the previous paragraphs and better-quality studies. Some examples are: • 2nd paragraph on the "obesity chapter", • 3rd paragraph on the "cardiovascular diseases and diabetes chapter", • 3rd phrase on "the reasoning behind the upper intake range" chapter, among others. Besides not being representative of the population, these studies are low in the pyramid of evidence and some lack the right referencing. We question the relevance and reasoning for the mention of such articles.	We have some specific comments and questions on the chapter. They are presented below: a) Considering that, as described, there is no gold standard on how to estimate the requirements of nitrogen and that the conversion factor is imperfect and leads to significant mistakes, how can it be affirmed that a reduction in the consumption of animal protein can provide the basic necessities of protein and amino acids? Specially when it is referred that "low protein intake might induce protein sparing and thus lead to underestimation of needs". b) Following that thought, on the 1st paragraph of page 4, we consider that infants, children, adolescents, pregnant women, and low-income groups should be mentioned alongside elderly, due to their increased need in protein (1).	Thank you for your comments. The text and references have been revised according to the NNR protocol

		Overall, one of the main problems in the studies is that protein intake from animal sources, in particular meat, often coincide with other dietary and non-dietary factors such as obesity, smoking, low levels of exercise and physical activity as well as reduced intake of whole grains, fruits, vegetables, nuts and seeds. These factors are not accounted for which creates a bias on the impact of meat consumption. Reports of the risks, on many occasions, are not well described and interpreted, which further contributes for the lack of good evidence (1). As recent evidence states, 21% of the global protein is provided by red meat, as well as other important micronutrients such as complex B vitamins. A decrease in the consumption of red meat can imply an increase in protein deficiency and further increase food insecurity, in particular in infants, children, adolescents, pregnant women, elderly and low-income groups (2). References: 1. http://dx.doi.org/10.1071/an21235 2. http://dx.doi.org/10.3389/fnut.2022.76679 6	c) On the other hand, according to Herreman et al. soy has two limiting amino acids: methionine and cysteine (2). Therefore, table 2 and the second paragraph on page 4 should be corrected. d) On page 9, 1st sentence, an article of 1987 is referenced as the proof that high total and animal protein intake is associated with increased risk of type 2 diabetes. How can it be credible that recommendations for 2023 and onwards being based on science with 40 years old? Recent evidence shows that red meat intake does not impact most glycaemic and insulinemic risk factor for type 2 diabetes (3). e) Later in the same page, it is affirmed that "it should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D.", however when we look into the evidence described in the previous paragraph it is stated that neither RCTs nor SR found any apparent effects. Why is this phrase stated when better quality studies say otherwise? Besides that, plant-based alternatives can be unsustainable depending on their provenience and processing (4). f) Finally, on bone health, it is declared that protein increases calcium absorption and bioavailability, but also that vitamin D in adequate levels is fundamental. Animals are a source of protein, calcium and vitamin D, so it seems a bit contradicting that high	

			animal intake can increase the risk of fractures when it's the source of the main nutrients that can prevent it. References: 1. http://dx.doi.org/10.3390/nu11122891 2. https://doi.org/10.1002/fsn3.1809 3. https://doi.org/10.1038/s41430-022-01150-1 4. https://www.who.int/europe/publications/i/item/WHO-EURO-2021-4007-43766-61591	
Tanja Kalchenko	Physicians' and nutrition association Food for health	Thorough, comprehensive, detailed and in-depth overview. Is this SR forgotten? Arnesen E. K., Thorisdottir B., Lamberg-Allardt C., Bärebring L., Nwaru B., Dierkes J., Ramel A., & Åkesson A. (2022). Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. Food & Nutrition Research, 66. https://doi.org/10.29219/fnr.v66.8242 (Food & Nutrition Research 2022, 66: 8242 – http://dx.doi.org/10.29219/fnr.v66.8242) https://foodandnutritionresearch.net/index.php/fnr/article/view/8242/14336	Protein intake in younger children On page 12 We suggest to keep, after this sentence "The upper level of healthy protein intake in infancy and childhood has yet to be firmly established." the same statement as in NNR 2012: " In several Nordic countries, mean protein intake is close to 15 E% during the first years of life indicating that a large proportion of young children have a higher protein intake that might contribute to increased risk of later obesity (22)". Then I suggest writing following: "Too high protein intake among the yongest children? According to nationwide dietary survey among 2-year-olds in Norway, conducted by Norwegian Institute for public health, 2020, we can see that the energy-percent intake	Thank you for your comments. The text and references have been revised according to the NNR protocol

			from protein is as recommended between 10 and 20 E%. Nonetheless, the intake of protein per kilogram BW is 3 grams protein per 1 kg BW. (Total energy intake was about 1313 kcal per day, and intake of protein was 52 gram per day. A 2-year-old child weighs about 16 – 17 kg.). 3 grams protein per 1 kg BW is 3 times higher then necessary and may pose a risk for obesity and other health problems in the future. The newest meta-analysis and SR, Arnesen 2022, where 21 studies from 27 publications were included, examined the evidence for an association between the dietary protein intake in children and the growth and risk of overweight or obesity up to 18 years of age in settings relevant for the Nordic countries. Total protein intake and BMI were assessed in 12 cohorts, of which 11 found positive associations. –The evidence for a positive relationship between total protein intake and BMI was considered probable. –Furthermore, there was probable evidence for an association between higher intake of animal protein and increased BMI. –There was limited, suggestive evidence for an effect of total protein intake and higher risk of overweight and/or obesity, The conclusion in the SR is that in healthy, well-nourished children of Western populations, there is probably a causal relationship between a high-protein intake in early childhood (≤ 18 months) – particularly protein of animal origin – and	

			higher BMI later in childhood, with consistent findings across cohort studies. A lack of RCTs precluded a stronger grading of the evidence." Sources: 1. Astrup H, Myhre JB, Andersen LF, Kristiansen AL.[Småbarnskost 3. Nationwide dietary survey among 2-year-olds in Norway] Rapport 2020. Oslo: Folkehelseinstituttet og Universitetet i Oslo, 2020. 2. Arnesen E. K., Thorisdottir B., Lamberg-Allardt C., Bärebring L., Nwaru B., Dierkes J., Ramel A., & Åkesson A. (2022). Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. Food & Nutrition Research, 66. https://doi.org/10.29219/fnr.v66.8242 (Food & Nutrition Research 2022, 66: 8242 – http://dx.doi.org/10.29219/fnr.v66.8242) https://foodandnutritionresearch.net/index.php/fnr/article/view/8242/14336 3. Nordic Council of Ministers. Nordic Nutrition Recommendations 2012: integrating nutrition and physical activity. Copenhagen: Nordic Council of Minsters; 2014. 4. Hornell A, Lagstrom H, Lande B, Thorsdottir I. Protein intake from 0 to 18 years of age and its relation to health: a systematic literature review for the 5th Nordic Nutrition Recommendations. Food Nutr Res. 2013;57. https://www.norden.org/en/publication/nordic-nutrition-recommendations-2012	

Tanja Kalchenko	Physicians' and nutrition association Food for health	Thorough, comprehensive, detailed and in-depth overview. In this comment I want to problematise the (unnecessarily) high intake. And the current sources of protein. As well as emphasizing that the current intake of protein can be safely reduced, at the expense of red and processed meat, without having to maintain the same level/amount of protein intake.	Intake in Nordic and Baltic countries On page 6, in the first paragraf, after sentence nr 2, I suggest adding following : "These outcomes are uncommon in Nordic and Baltic countries, among general/healthy population." On page 8, below the table 4.5, I suggest writing following: "Adults on average get up to 18% of their energy, which is in line with recommendations. About 60 % protein comes from animal sources. Daily intake in Norway is 96 grams on average. The biggest sources in Norwegian diet, for example, is meat and meat products, contributing 27% of the total intake. Dairy products account for 22% and fish – 10 %. (1,2,3) High protein inntake from animal sources leads to several undesireble health outcomes, see sources 60,61,62,63,64,65 (in your draft) and Zhong 2020 (source 4 below). It could be nutritionally safe, and healthy, to reduce the total amount protein, and then – especially from read and processed meat. It is not necessary to replace all the amount of animal protein with (the same amount of) plant protein. This is because the intake is already quite high. Theoretically, read and processed meat can be cut out completely, and populations will still get enough protein. Almost the same applies to children 12 – 14	Thank you for your comments.It is imperative to acknowledge the potential of non-animal protein sources such as plant-based protein in the sustainable protein production industry. Despite the limited scope of the chapter, it is important to recognize that the use of these sources is likely to play a significant role in the future. Therefore, it is necessary to take into account the potential benefits and drawbacks of plant-based protein sources as a potential alternative to traditional animal protein sources. The text and references have been revised according to the NNR protocol

			months. They get about 3 grams of protein per 1 kg of BW daily, and this amounts to about 16 E%. The recommended safe intake is 0.8 – 0.9 grams of protein per 1 kg of BW." I therefore propose the following sentence from NNR 2012: "In several Nordic countries, the average protein intake is close to 15 E% during the first years of life, which indicates that a large proportion of young children have a higher protein intake which can contribute to an increased risk of later obesity (22)". "Half of the meat intake in Norway comes from sausages, meat pies, spreads, chicken nuggets and other processed finished meat products (source 5 below). These belong to the category processed meat, which both WHO, WCRF, Harvard T.H. Chan medical school and some others advise against eating on a regular basis. It is because these cause cancer – primarily in the colon. The evidence is high – convincing. It would be very beneficial for the public to reduce the consumption of these products. (source 6-10 below)." "It is both healthy and nutritionally safe to reduce consumption of meat and dairy. These can be replaced with legumes and nuts. But this is not necessary until the reduction is quite substantial – as in vegan diets. In general, and for those who do not follow aforementioned diets, the substitution with protein rich plant foods is not necessary."	

			Sources: 1. Norkost 3, 2011 https://www.helsedirektoratet.no/rapporter/norkost-3-en-landsomfattende-kostholdsundersokelse-blant-menn-og-kvinner-i-norge-i-alderen-18-70-ar-2010-11/ 2. Matprat.no. Proteins https://www.matprat.no/artikler/ernaring/proteiner/ 3. Norwegian Directorate of Health. Utviklingen i norsk kosthold 2022. 4. Zhong VW, Van Horn L, Greenland P, et al. Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality. JAMA Intern Med. 2020;180(4):503-512. doi:10.1001/jamainternmed.2019.6969 5. Page 309, chapter 29. (Norwegian Directorate of Health) Kostråd for å fremme folkehelsen og forebygge kroniske sykdommer – Metodologi og vitenskapelig kunnskapsgrunnlag. Nasjonalt råd for ernæring, 2011 6. Rock CL, Thomson C, Gansler T, et al. American Cancer Society Guideline for Diet and Physical Activity for Cancer Prevention. CA Cancer J Clin. Published online June 9, 2020. 7. WHO, 2015. Cancer: Carcinogenicity of the consumption of red meat and processed meat. 8. Healthy Eating Plate. Harvard School of Public Health 9. American Institute for Cancer Research. Recommendation on Red and Processed Meat 10. Cancer Research UK. Limit red meat and	

			avoid processed meat revention-recommendations/limit-red-meat-and-avoid-processed-meat/	
Tanja Kalchenko	Physicians and nutrition association Food for health	Thorough and in depth overview. I have a comment about Obesity: I think that NNR2022 should have explaination/comments about popular diets that often contains unhealthy amounts and sources of protein. Especially when it comes to treatment of obesity and diabetes.	On page 8, could you please add the source for this: "However, a large US cross-sectional study found a favourable association between both animal and plant-sourced protein, particularly with central adiposity." And what amounts of protein? How strong is the evidence here? It sounds like "protein is generally good for maintaining a healthy weight". And "high protein diets is good for maintaining a healthy weight". If so, it contrasts with other health outcomes - especially mortality. Should we treat/prevent obesity with diets that lead to higher mortality, diabetes and cancer? I suggest adding an explanation about low carb, paleo and keto diets. In practice, they are misunderstood, both by the public and by physicians, nutritionsts and PTs (personal trainers). In these diets, carbohydrates should be replaced with fat, not with protein. And at least not with protein from red and processed meat. I suggest you write following in Health outcomes, Obesity (or after Obesity, as a separate section): "Low carb, keto and paleo diets with high protein intake, especially from meat, gives undesireble health outcomes Low carbohydrate diets and keto-diets are	Thank you for your comments. While we do cover a wide range of topics in this chapter, we have chosen not to include popular diets at this time. We appreciate your interest and hope that the information we do provide is still helpful to you. The text and references have been revised according to the NNR protocol

			popular among the general public. These are used to treat obesity, and sometimes diabetes. These diets do not initially need to contain a lot of protein, and at least protein from red and processed meat, to give desired results. Increaseing the amount of protein is not necessary, as carbohydrates can be replaced with fat for the same desired results. High intake of protein from meat leads to increased mortality from cardiovascular disease and other adverse health outcomes (source 1,2 below, and sources on mortality section, number 60 - 66 in current draft). Some plant protein sources - some nuts and seeds, edamame beans, soy milk and tofu can be included in many low carb, keto and paleo diets. Some low carb diets may also contain other plant protein sources. Sources: 1. Song, Mingyang et al. "Association of Animal and Plant Protein Intake With All-Cause and Cause-Specific Mortality." JAMA internal medicine vol. 176,10 (2016): 1453-1463. doi:10.1001/jamainternmed.2016.4182 2. Zhong VW, Van Horn L, Greenland P, et al. Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality. JAMA Intern Med. 2020;180(4):503-512. doi:10.1001/jamainternmed.2019.6969 https://pubmed.ncbi.nlm.nih.gov/32011623/	

			3. Chen Z, Glisic M, Song M, et al. Dietary protein intake and all-cause and cause-specific mortality: results from the Rotterdam Study and a meta-analysis of prospective cohort studies. Eur J Epidemiol. 2020;35(5):411-429. doi:10.1007/s10654-020-00607-6 https://pubmed.ncbi.nlm.nih.gov/32076944/ 4. Low-Carbohydrate Diets https://www.hsph.harvard.edu/nutritionsource/carbohydrates/low-carbohydrate-diets/ 5. Jenkins DJ, Wong JM, Kendall CW, et al. The effect of a plant-based low-carbohydrate ("Eco-Atkins") diet on body weight and blood lipid concentrations in hyperlipidemic subjects. Arch Intern Med. 2009;169:1046-54. 6. Elliott PS, Kharaty SS, Phillips CM. Plant-Based Diets and Lipid, Lipoprotein, and Inflammatory Biomarkers of Cardiovascular Disease: A Review of Observational and Interventional Studies. Nutrients. 2022 Dec 17;14(24):5371. doi: 10.3390/nu14245371. PMID: 36558530; PMCID: PMC9787709. 7. Diabetes UK. Low-carb diet and meal plan. https://www.diabetes.org.uk/guide-to-diabetes/enjoy-food/eating-with-diabetes/meal-plans/low-carb	
Tanja Kalchenko	Physicians' and nutrition association Food for health	Section about Health outcomes is incredibly comprehensive and complete. The opening sentences on page 10 under Mortality, as well as sources	In Mortality you write following: "Several meta-analyses on high animal protein intake suggested a positive association with cardiovascular mortality".	Thank you for your comments. The association between protein intake and mortality has not been studied thoroughly within Nordic or Baltic countries. However, we can assume

		60,61,62,63,64,65, is very important: "Several meta-analyses on high animal protein intake suggested a positive association with cardiovascular mortality while high plant protein intake was inversely associated with all-cause and cardiovascular mortality, especially among individuals with at least one lifestyle risk factor. Where, the substitution of plant protein for animal protein, especially that from processed red meat, was associated with lower mortality, suggesting the importance of protein sources 60,61,62,63,64,65". How relevant is our lands protein intake to these health outcomes?	The current consumption of the protein in Nordic and Baltic countries is up to 16 - 18 E%. And the biggest sources are read and processed meat and dairy products. How relevant is this for the public, as it comes to increased mortality? Could you comment on this, or write something about how high is the current level/amount of protein intake is in Nordic and Baltic countries, regarding to mortality and other health outcomes? I think that this is relevant for Northen and Baltikum. On page 10, in section Mortality, I suggest therefor adding following as the first sentence: "The current consumption of protein in Nordic and Baltic countries is quite high up to 16 - 18 E%. And the biggest sources are read and processed meat and dairy products. This amount/intake increase mortality and morbidity."	there is no difference compared to Western countries. The text and references have been revised according to the NNR protocol
Tanja Kalchenko	From Physicians' and nutrition association Food for health	Comprehensive, in depth and good overview. However, concepts as "complete proteins", digestibility and antinutrients in plants protein sources are given too much significance. Even vegans gets more than enough of all the essential aminoacids, in developed countries	I suggest adding a separate section, and writing following on page 11: "Plant protein sources – more healthy and nutritionally adequate, should be chosen more often Many studies (as above in this Protein chapter in NNR 2022) show that plant protein is preferable, as it results in reduced morbidity and mortality. Plant sources of protein and essential amino acids are nutritionally safe.	Thank you for your comment. A balanced view need to be kept through out the text and we cannot claim more benfits for plant-based proteins than the current scientific evidence allows us.

			Concepts such as complete proteins, digestibility and anti-nutrients in plant protein sources are important theoretically. But the practical meaning of these terms is very limited in the Nordic and Baltic countries. Studies on vegans in developed countries, including those on blood analysis of amino acid content (EPIC-Oxford cohort, Schmidt, 2016), show that vegans get enough of essential amino acids, including lysine. This is because vegan diets in developed countries include various plant sources of protein. Total intake of protein tends to exceed the requirement (Mariotty, 2019). This results in the intake of all 20 amino acids which are more than sufficient to cover the need. This means that protein digestibility is not an issue in the Nordic and Baltic countries.” My explanation Mariotti an Gardner writes in the study: "It is commonly, although mistakenly, thought that the amino acid intake may be inadequate in vegetarian diets. As we and others have argued, the amounts and proportions of amino acids consumed by vegetarians and vegans are typically more than sufficient to meet and exceed individual daily requirements, provided a reasonable variety of foods are consumed and energy intake needs are being met. The claim that certain plant foods are “missing”	

			specific amino acids is demonstrably false.” “Lysine is present in much lower than optimal proportions for human needs in grains, and similarly the sulfur containing amino acids (methionine and cysteine) are proportionally very slightly lower in legumes than would be optimal for human needs. This would be important for someone who ate only rice or only beans, for sustenance, every day. This classic implementation of a protein quality assessment framework focusing on isolated single proteins remains an erroneous approach in practice [36,37]. The terms “complete” and “incomplete” are misleading [33,38]. In developed countries, plant proteins are mixed, especially in vegetarian diets, and total intake of protein tends to greatly exceed requirement. This results in intakes of all 20 amino acids that are more than sufficient to cover requirements. In the EPIC-Oxford study, amino acid intakes were estimated in both meat-eaters and vegetarians [24]. For the lacto-ovo-vegetarian and vegans assessed, based on an average body weight of 65 kg, we calculated that lysine intakes were 58 and 43 mg/kg, respectively, largely higher than the 30 mg/kg estimated average requirement [39].” Sources: 1. Mariotti F, Gardner CD. Dietary Protein and Amino Acids in Vegetarian Diets-A Review. Nutrients. 2019 Nov 4;11(11):2661. doi: 10.3390/nu11112661. PMID: 31690027;	

			PMCID: PMC6893534. 2. Schmidt JA, Rinaldi S, Scalbert A, Ferrari P, Achaintre D, Gunter MJ, Appleby PN, Key TJ, Travis RC: Plasma concentrations and intakes of amino acids in male meat-eaters, fish-eaters, vegetarians and vegans: a cross-sectional analysis in the EPIC-Oxford cohort. European journal of clinical nutrition 2016, 70(3):306-312. 3. Young VR, Pellett PL: Plant proteins in relation to human protein and amino acid nutrition. The American journal of clinical nutrition 1994, 59(5 Suppl):1203S-1212S. 4. de Gavelle E, Huneau JF, Bianchi CM, Verger EO, Mariotti F: Protein Adequacy Is Primarily a Matter of Protein Quantity, Not Quality: Modeling an Increase in Plant:Animal Protein Ratio in French Adults. Nutrients 2017, 9(12).	
L.M. Granskog	concerned citizen	The well known article by Hall, K.D. et.al. https://doi.org/10.1016/j.cmet.2019.05.008 mentions that a possible partial explanation for the weight gain with ultra-processed food is the protein leverage hypothesis, and these references are among those cited in that article: https://doi.org/10.1017/S1368980017001574 https://doi.org/10.1111/j.1467-789X.2005.00178.x Animals that don't get enough protein will apparently keep eating until they do. https://doi.org/10.1038/508S66a This an important point which deserves discussion in this chapter.	The following quote is in the chapter on page 9. This sentence should be omitted. These references should rather be discussed: https://doi.org/10.1038/srep26074 https://doi.org/10.1007/s11367-022-02123-z . "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" There is no reference for this claim, nor any good evidence for it (https://doi.org/10.7326/M19-1621). People	Thank you for your comments. The text and references have been revised according to the NNR protocol

			can do postprandial blood sugar measurements after a meal with pulses and grains or a meal with beef and broccoli, and find out for themselves what causes them to have higher blood sugar. Please understand that people actually do this. Perhaps it would be wise if anybody giving nutritional advice did their own continuous glucose monitoring as did some medical students at Harvard who have published their findings (https://doi.org/10.1177/15598276221119989). Medical care has very substantial ghg emissions which are rarely publicly discussed (https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf http://dx.doi.org/10.1136/medethics-2020-106842). Claims that animal sources of protein are less environmentally sustainable than plant protein fail routinely to take into account the totality of the evidence (https://doi.org/10.1038/srep26074 https://doi.org/10.1007/s11367-022-02123-z). The chemicals/pesticides used in monocrop agriculture, the soil erosion/runoff/leaching that occurs with monoculture crops have been neglected to be considered. Animals well raised are integral parts of well functioning ecosystems, their bodily emissions are part of the biogenic carbon cycle. Ruminant agriculture has been critical for food sustainability in Nordic countries for literally thousands of years. The bias against animal source foods which is present throughout	

			these dietary guidelines chapters is misleading. Much depends on how food is produced. Animals can be raised without toxic chemicals, fossil fuels, massive soil erosion, and the destruction of entire ecosystems above and below ground. They are important for maintaining biodiversity. That cannot be said for tilled fields that produce monoculture crops.	
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Protein draft. Here are the comments (1/2) from LRF. Abstract; "Proteins are especially required during active growth in pregnancy, lactation, childhood, tissue and wound healing and tissue building in sports." As evident from the Fig 1 + the "Old adult" section, proteins are also especially required in elderhood due to increased degradation. Hence this should be mentioned in the above sentence as well. Page 1-2: "Animal-sourced are the building blocks for several cellular structural elements." This sentence is unclear – seems like 'Animal-sourced' is a typo for 'amino acids'. Page 2: Suggest addition of 'cheese' or 'milk and milk products' as relevant protein sources, and not only milk (ref: Danskernes kostvaner 2011-2013 p. 118). Page 2 above Table 1: An error in non-dispensible that should read 'non-indispensable', as in Table 1. Page 2, paragraph 3. The authors fail to	Page 5: The text would benefit from mentioning children, ill, and frail, in addition to the elderly, as vulnerable groups. A protein shift in public meals toward less animal protein sources requires the consumer to eat larger volumes of a given protein source, which poses a great risk of not only protein deficiency, but also deficiency of the micro nutrients that are typically associated with animal protein foods, such as iron and zinc. These micronutrients have a significantly lower bioavailability in plant foods. Page 6: As previously commented by the LRF and organisations, the population surveys used in the NNR work are, in the case of Sweden, Norway, and Denmark, more than 10 years old, and for Estonia almost 10 years old. Stating the level of intake from such old data renders very uncertain conclusions about the quality and quantity changes that we may or may not need to do on a population basis. The text would benefit from recognizing this fact. Page 8, Protein intake and health outcomes for Nordic and Baltic countries: Severe protein deficiency symptoms are stated.	Thank you for your comments. The text and references have been revised according to the NNR protocol.

		mention the bioavailability and amino acid profile differences between animal and plant protein sources. Stating these differences is essential, especially for meal planning purposes regarding vulnerable groups such as children and adolescents, women of fertile age, ill, frail, and elderly. We therefor urge the authors to complete this paragraph accordingly. Page 4, paragraph right below table 2, row 2: The authors claim that "unprocessed, unpurified plant protein sources contain antinutrients such as /…/ which interfere with the digestion of plant proteins…". However, while processing procedures, such as cooking and soaking, reduce the content of antinutrients, the bioavailability properties are still significantly lower for plant protein sources than for animal protein sources. Stating this fact is essential, especially for meal planning purposes regarding vulnerable groups such as children and adolescents, women of fertile age, ill, frail, and elderly. We therefor urge the authors to complete this paragraph accordingly. Page 4, line 3: Suggest deletion of at least "-based", as that is a marketing term rather than a scientific term, but preferably delete "animal and plant-based" as that is irrelevant. The importance is "…limiting AA for various protein sources". The same goes for the Table 2 heading. Page 4, Table 2:	However, the less severe, but still detrimental for health, are omitted, such as impaired immune function, wound healing, fatigue, and risk for micronutrient deficiencies. Such less severe deficiencies are probably common among vulnerable groups who are at risk or are indeed consuming too little energy due to any given reason. Children, ill, frail, and elderly are among those vulnerable groups. The text would benefit from mentioning this. Page 8, Cardiovascular diseases and diabetes: Ref 32 (Tian et al, 2017) state that dairy and dairy products are "the protective factors of T2DM". Further it is stated in this reference that "The research indicated the type of dietary protein and food sources of protein that should be considered for the prevention of diabetes". However, the authors of this protein draft fail to mention this distinction, and we urge them to add this to the text, and not only be content with stating that "total protein and animal protein" could increase the risk of T2DM. Further, ref 33 (Virtanen et al, 2018) state that "total protein intake was not associated with risk of HF…". Further, Virtanen et al state that "…higher intake of fermented dairy protein was generally associated with healthier lifestyle and dietary factors". Moreover, they state that "…Proteins from total meat and meat subtypes, milk, and plant sources had nonsignificant associations toward increased HF risk". This needs to be clarified in the protein draft. Interestingly, Virtanen state that "higher	

		Protein content column: Suggest creating such a column, to make the table practically useful and not misleading. Currently, you may think that including potatoes in your dish secures you the protein/AAs you need, but as the protein content in potato is relative low, this is not the case. This needs to be directly apparent from this table and write it in the text section. Protein source column: Suggest addition of 'MILK' - all other protein sources in this table is foods and not protein subfractions. Non-experts may not know that whey + casein = milk. DIAAS column: Suggest arranging the rows chronologically according to DIAAS value (It is done partly but not completely with the lowest in the top row and highest value in bottom row). Limiting AA column: Suggest replacing "NA" (not applicable) with e.g. "None" as that is a more accurate descriptor of the case that there is no limiting AA – non-scientists may not be aware. Page 4, below Table: Normal approach in the NNR chapters is to write what foods are the best sources, nevertheless the best sources of high-quality protein is not mentioned, only the best ones of plant origin. To be truly guiding, milk, cheese, meat, egg and soy beans should be mentioned (regardless of their origin) as foods being best providers of high-quality protein (potatoes are not due to their low protein content). Page 5, section above Figure 1: In older	intake of the major plant protein sources was associated with increased risk of HF among those without disease history". Finally, Virtanen, in their discussion, state that " total dairy and fermented dairy were associated with increased HF risk", but admit that "total or fermented dairy intake has not been related to HF risk in other studies." The results from Virtanen are interesting, but since the majority of studies associate dairy products with a decreased risk of CVD, it would be suitable to mention that in the protein draft for the sake of balance. Lastly, Virtanen sums up: "To sum up, we did not find a plausible explanation for why fermented dairy or its protein would be more detrimental than nonfermented dairy. Thus, considering that we included many analyses in the present study, we cannot exclude the possibility of a chance finding explaining the result." Therefor, we urge the protein draft authors to add more representative studies to their reference list for the sake of balance, as well as be clear about the circumstances regarding reference 32 and 33.	

		adults/elderhood protein breakdown is increased, as is mentioned in the "Old adult" section. Suggest to mention that in this section as well describing the protein turnover (breakdown and synthesis) in different situations and life stages.		
Ann-Kristin Sundin	LRF	Dear NNR Committee, Here are the comments (2/2) on the Protein draft from LRF: Page 8, bottom: In general, comparing animal (protein) versus plant (protein) may not be very insightful as e.g. the animal group is very heterogeneous on health impacts. Suggest to include evidence from e.g. dairy protein and meat protein separately like performed in the "Cancer" section. Consumption of dairy (and its protein) is consistently decreasing the risk or not associated with T2D. And if no data is available, then that is the case. Page 9, Bone health: There seem to be a mixup of references. The authors refer to "an older Norwegian study", number 40, but that refers to Wallace and Frankenfeld (2017). Page 9: It is stated: "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" This seems problematic as it is stated above that RCTs did not show apparent effects on the risk factors for CVD or T2D, and the evidence from observational		Thank you for your comments. The text and references have been revised according to the NNR protocol

		studies is limited - suggestive. Moreover, indicating that plant protein is more environmentally (we assume this is what they mean) sustainable that animal protein is too simplistic to hold true. Also, the authors are most likely referring to 'climate impact' not to 'sustainability. And as written in the disclaimer, climate/sustainability aspects are to be integrated in the main NNR report rather than in the individual chapters. We therefor urge them to remove this sentence. Page 9, bottom: "Thus, the possible effect of protein intake on bone health might depend on an input of calcium and vitamin D above this level". This seems to be crucial and should be clear in the conclusion. Page 10, cancer summary sentence; "while plant-based foods are commonly associated with a somewhat lower risk of cancers, different animal-based foods may have opposite effects on cancers as demonstrated by red and processed meat and dairy products in colorectal cancer." Based on the Cancer section content/evidence (not only colorectal cancer), suggest phrasing according to results rather than origin by adding "dairy" to the first part of the sentence i.e. "..while plant-based foods and dairy are commonly associated with a somewhat lower risk of cancers in opposition to red and processed meat". Also, referring to our comment on the term "plant based", it would be more		

		suitable to use "plant". Page 11, top: "Thus, the literature supports current dietary recommendations to increase the intake of plant protein in place of animal protein." Suggest a comment on the heterogeneous pooling of all animal proteins, as they seem to have different health impacts. The pooling, therefor, play no valuable role. On the contrary, it adds to the misconception of the health impacts of stratified animal foods that the general public might have. Page 13, top-mid: "Physical function, or physical performance, is the clinically relevant outcome of muscle mass" Physical performance is ONE clinically relevant outcome - muscle mass is also clinically relevant on its own due to metabolic/endocrine effects apart from physical function.		
Kajsa Asp Jonson	Self employed	Dear Committee, Thank you for the opportunity to comment on the Protein draft. Please se my input below:	Abstract; "Proteins are especially required during active growth in pregnancy, lactation, childhood, tissue and wound healing and tissue building in sports." How about older people? Please add this target group! Page 1: "Animal-sourced are the building blocks for several cellular structural elements." Is this the word you actually mean? Page 2: Suggestion: add milk and milk products as protein sources, and not only	Thank you for your comment. Older adults, children and pregnant women are special target groups in the chapter

			milk Page 2. Add information about bioavailability and differences in amino acids between animal vs. plant based protein. Page 4: Please add information about processes that can change protein bioavailability. Page 4: To make the information about protein sources complete, please add: milk and different dairy products, meat, egg etc. Page 5: To make the information about vulnerable groups more complete, please add children, ill and frail persons, in addition to the elderly. A green protein shift in public meals requires larger portions, and a good knowledge in how to make meals and nutrition intake complete. Page 8, bottom: In general, comparing animal (protein) versus plant (protein) may not be very insightful as e.g. the animal group is very heterogeneous on health impacts. Suggest to include evidence from e.g. dairy protein and meat protein separately like performed in the "Cancer" section. Consumption of dairy (and its protein) is consistently decreasing the risk or not associated with T2D. And if no data is available, then that is the case. Page 9: "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of	

			CVD mortality and T2D" (this comment also applies on the cancer section) I think this type of general message is problematic – "plant based" is not a guarantee that the foods and ingredients are healthy. Vegetarian food can (as when animal based food is included) be both good and bad for your health. And: All plant based food is not sustainable. Page 13: "Physical function, or physical performance, is the clinically relevant outcome of muscle mass" Please change THE to A (or "one of the clinically relevant outcomes"...) "Physical function, or physical performance, is a clinically relevant outcome of muscle mass" Best regards, Kajsa Asp Jonson, reg. dietitian, medicine journalist, Kungälv, Sweden.	
Ellen Ulleberg	Norwegian Dairy Council	We thank the NNR committee for the opportunity to comment on the draft of this chapter. The chapter initially describes advantages of proteins from animal-based food such as the content of all indispensable amino acids in the right proportions needed and good bioavailability. The authors also state that in a mixed Nordic diet containing different protein sources in adequate amounts, the protein quality of individual protein sources may not be an issue for most people as different protein sources will complete each other and in total provide all indispensable amino acids.	Page 9: In the section describing the relationship between protein intake and CVD and diabetes the authors conclude by stating that "replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D". This statement is unfortunate as the source of animal protein (as for plant protein) is not irrelevant when looking at disease outcomes. As stated in the draft of the chapter on Milk and Dairy Products, even though milk and dairy products are animal foods, their consumption "has not been associated with increased risk of cardiovascular disease" and "Current evidence suggest inverse association with	Thank you for your comments. The text and references have been revised according to the NNR protocol

		Nevertheless, we agree with the authors that a transition from animal to plant proteins with a lower digestibility and bioavailability could become an issue for vulnerable people such as the elderly, those with poor appetite and those who eat do not or cannot include legumes or nuts in their daily diet. This is an important matter that should have been described in more detail.	cardiometabolic risk". As for diabetes the authors of the same chapter state that "an inverse association with intake of dairy and type 2 diabetes has been reported, specifically for low-fat dairy, yoghurt and cheese". This is a good example of how making conclusions based on animal products as a group is a too coarse, and the intake of different foods within this group can have different health outcomes. Milk and dairy products show a reduced risk of CVD and type 2 diabetes and is a part of a healthy diet pattern. Pages 10-11 (Mortality): The text states that regarding mortality "the literature supports current dietary recommendations to increase the intake of plant protein in place of animal protein". However, the current recommendations in all Nordic countries does not state that we should replace animal protein with plant proteins. It is recommended to eat more plant-based but this does not equal the substitution of animal proteins. From the chapter Milk and Dairy products, it is clearly stated that most of the systematic reviews and/or meta-analyses found no association between total dairy intake and all-cause mortality. Thus, the using mortality as a reason for replacing milk proteins with plant proteins in the diet is not valid. Page 12 (Infants and children): The authors stated that there are "Convincing results show that higher protein intake in infancy and early childhood contributes to an increased risk for obesity later in life" and that "there is suggestive evidence that	

			animal protein intake, especially from dairy products, has a stronger association with growth, particularly with weight gain, than plant protein". We find it strange that the authors come to this conclusion about animal proteins as the systematic review by Arnesen et al. performed as part of the background material for NNR concludes much more carefully stating that there was "limited, suggestive evidence for an effect of total protein intake and higher risk of overweight and/or obesity, while no conclusions could be made on the associations between animal vs. plant protein intake and risk of overweight and/or obesity". We therefore ask that de authors review the literature again and include the systematic review by Arnesen et al. References • Arnesen E. K., Thorisdottir B., Lamberg-Allardt C., Bärebring L., Nwaru B., Dierkes J., Ramel A., & Åkesson A. (2022). Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. Food & Nutrition Research, 66.	
Christiane Hoffmann	Kjøtt- og fjørfebransjens Landsforbund	KLF supports the scientific input from Animalia and MatPrat. We ask the authors to remove the suggestion that replacing animal protein is an issue of sustainability, as sustainability is integrated at a later stage of the report. We would like to point out, that animal protein foods are a source of high quality protein. This is never stated in the paper. The main problem of studies on high intake of protein from animal sources is,	Thank you for the opportunity to comment on the chapter.	Thank you for your comments. The text and references have been revised according to the NNR protocol

		that it very often corresponds with other lifestyle factors. These other lifestyle factors, like smoking and obesity are known factors to influence the overall health and therefore they can implicate a causal relationship without being true. We would like to conclude with pointing out that meat is a foodsource high in protein, vitamin B6, vitamin B 12, zinc and iron and a decrease in meat consumption can therefore lead to deficiencies.		
Puk Holm	Danisg Agriculture & Food Council	Thank you for the opportunity to comment on the NNR 2022 chapter on Protein. Expressing protein or amino acid requirements based on percentage of energy intake (E%) is, a less accurate way to express the need for protein. On an unspecific population basis, the requirement is better expressed as grams of protein per kilograms of body weight and according to individual diets and life stage (1). The overall impression of this chapter is a degradation of animal protein and emphasizing of plant protein. Consequences on supply of essential amino acids in a shift towards more plant-based protein need to be assessed prior to potential recommendations. With increased recommendations on plant-based diets comes an increased necessity to understand and be aware of the function and amount of the individual amino acids in the different food stuffs. As animal sourced foods contain all essential amino acids in themselves, plant-based need to be coupled two or more to provide similar protein quality. The high-quality of animal protein that is recognized in NNR	References: 1. Layman DK. Dietary guidelines should reflect new understandings about adult protein needs. Nutr Metab, 6, 12, 2009. doi:10.1186/1743-7075-6-12 2. Nordic Nutrition Recommendations 2012 – integrationg nutrition and physical activity. 5th edition. Nord 2014:002. ISBN 978-92-893-2670-4 3. FAO. Dietary Protein Quality Evaluation in Human Nutrition. Report of an FAO Expert Consultation. Vol 92.; ISSN 0254-4725, 2013. 4. Bauer J, Biolo G, Cederholm T, et al. Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the prot-age study group. J Am Med Dir Assoc. 2013;14(8):542-559. doi:10.1016/j.jamda.2013.05.021 5. Humayun MA, Elango R, Ball RO, Pencharz PB. Reevaluation of the Protein Requirement in Young Men with the Indicator Amino Acid Oxidation Technique 13.; 2007. https://academic.oup.com/ajcn/article/86/4/995/4649413 6. Moughan PJ. Population protein intakes	Thank you for your comment. There is a clear need for more studies on the bioavailability of different protein sources and their optimal amino acid combinations.

		2012 (p. 282) now seem unsubstantially degraded in this Protein chapter (2). The emphasis on individual amino acids is also supported by FAO: "In the context of whole diets and the nutritional adequacy of a food protein or a mixture of food proteins, the assessment of the nutritional value of a protein should reflect its ability to satisfy the metabolic needs for individual amino acids and nitrogen. Once again dietary protein should be considered as a source of amino acids as individual nutrients" (3). A shift in diets is a potential shift in protein-quality which is not scientifically documented and evaluated in the text, but it is assumed plant-based protein to be healthier. As commented in earlier PC´s, it is not a matter of plant versus animal sourced foods for healthier diets, it is a matter of combination of foodstuffs and amount of nutrient dense foods and then lifestyle in general. Animal sourced foods provide important and highly bioavailable nutrients in healthy diets difficultly replaced by other sources and therefore supply plant foods in balanced diets. Research is needed to clarify the synergistic effects in Food Matrices. There is an issue around the use of Recommended Dietary Allowance (RDA). This term seems to be used as equal to the daily requirement of protein. RDA refers to a "minimal protein intake" to prevent detectable inadequacy, and a healthy range of protein intake of up to 2,5 g/kg is communicated by the U.S. National Academy of Sciences. An upper and safe	and food sustainability indices: The metrics matter. Global Food Security, vol. 29, June 2021, 100548. https://doi.org/10.1016/j.gfs.2021.100548 7. Smith NW et al. Animal and plant-sourced nutrition: complementary not competitive. Perspectives on animal biosciences. Special issue: ADSS 2020, 2021. doi:10.1071/AN21235 8. O'Connor et al. Total red meat intake of >0.5 servings/d does not negatively influence cardiovascular disease risk factors: a systemically searched meta-analysis of randomized controlled trails. Amr J Clin Nutr 105:57-69, 2017. 9. Berryman CE et al. Diets higher in animal and plant protein are associated with lower adiposity and do not impair kidney function in US adults. Amr J Clin Nutr, 104: 743-49, 2016. 10. Sanders LM et al. Red meat consumption and risk factors for type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. Eur J Clin Nutr, 5 May 2022. https://doi.org/10.1038/s41430-022-01150-1	

		limit has not been defined. RDA of 0.83 g/kg is too low and should be 1.2-1.6 g/kg for an optimal daily intake of protein (4-7). As we did not get opportunity to comment on the review article "Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis", and as we did not find reason for the conclusion that high intake of animal sourced protein as predictor for overweight later in life, we will bring up the issue around disease and overweight in relation to protein intake here. We find there is only suggestive, weak evidence that total protein or animal sourced protein should be associated with increased cardiovascular disease, cancer, T2D or overweight. It is striking that an article from 1987 is referred to as the evidence of high total and animal protein intakes association with increased risk of type 2 diabetes. Recent review article concludes that red meat intake does not impact glycaemic and insulinemic risk factors for type 2 diabetes (8-10).		
Guro Waage	Nortura SA	Dear NNR Committee, we thank you for this opportunity to comment on the draft of protein. The abstract appears incomplete and do not replicate most findings of the article. It is difficult, both through the abstract and the rest of the chapter, to draw conclusion based on the findings presented. Further, the chapter lacks clear delimitations. The authors states in the abstract that proteins are widespread in	Spesific comments part 1: Physiology and metabolism, P4, last paragraph: In practice, the differences in quality between proteins might be less critical in diets containing a variety of protein sources such as in a typical Nordic mixed diet11. [...] With the current Nordic relatively high protein intake, replacing part of animal proteins with plant proteins would probably lead to somewhat lower protein intake and lower bioavailability but still provide enough protein and indispensable amino acids15.	Thank you for your comment. In the future, we are sure that amino acid profile and bioavailability will have more focus.

		foods, deriving from both animal and plant sources, which is true. However, it is unclear how the authors define a source of protein. Thought the chapter the reader is given the impression that most foods are categorized as a source of either plant- or animal protein, and that a decrease in protein from animals are necessary to increase the consumption of plant-based protein, something that appears unvarnished in terms of health. Regarding animal protein, it is unclear when the effect of protein is seen, or when the effect seen is due to other nutrients/ingredients/processing. For example, red meat and processed meat are highlighted several times through the chapter. Although the association between red meat, processed meat and certain health outcomes is not linked to the content of protein, the findings are used to draw conclusions to decrease all sources of animal protein. On the other hand, if this is the correct way to define a source of protein, few differences between other protein sources are highlighted. E.g. It appears that all sources of plant protein are healthy, regardless of the food they come from. For example, highly processed plant-based meat and dairy substitutes are not mentioned or discussed ones through the chapter. Nortura do agree that increased consumption of fruits, vegetables, pulses, legumes and so on, would be beneficial for health, but we do not agree that any	The chapter authors refer to source 11 in the first sentence. This is a study of Bandyopadhyay et al., which have done an Evaluation of Protein Quality in Humans and Insights on Stable Isotope Approaches to Measure Digestibility - A Review (1). This study has evaluated the methods used to define protein quality and does not substantiate the claim of the chapter authors. Replacing part of animal proteins with plant proteins might provide enough indispensable amino acids, but the assumption is based on one single study. The challenge with the aforementioned study is that the diet given to the participants does not necessarily reflect a typical plant-based diet. As Päivärinta et al describes; with the exception of soy, providing all essential amino acids with plant-based proteins requires sufficient diversity of plant protein sources (2). To use the conclusion of this study, we must assume that the population has a good knowledge of nutrition and how to cook. Furthermore, the amount of essential amino acids does not appear to have been either assessed or analyzed in this study. So, it does not, as the chapter authors write, provide an answer to whether a more plant-based diet supplies enough indispensable amino acids. Before new recommendations are made with emphasis on plant-based proteins, this should be examined more carefully.	

		increase in plant-based food must come at the expense of all animal food. In this discussion, the quality of the diet and the specific sources of protein are probably as important as the contradiction presented here. The chapter should include a section on data gaps/limitations/lack of knowledge to discuss all the uncertainties and lack of knowledge presented (and not presented) through this paper.	The nutrients found in meat are abundant and of high physiological quality. Meat contains a sufficient amount of complete and highly digestible proteins with all of the essential amino acids to support growth, development, maintenance and repair of the human body (3) and provides, in most cases, an above average source of vitamin B12, zinc, phosphorus, iron, and zinc (4, 5). Adequate dietary protein is important for individuals during all stages of life and, in particular it is critical to meet the requirements for essential or indispensable amino acids. It is recommended to meet dietary protein intakes by ingesting highly digestible and high-quality proteins (6). Meat is generally considered as high-quality proteins for the human diet, and this in the absence of refined carbohydrates and excess calories. In concrete terms, shifting to a diet based only on plants, to get the intake of proteins required by the dietary guidelines, the amount of food (measured in unit of mass) is higher than the amount of meat which can provide the same quantity of proteins. This should be taken into consideration. P 6, paragraph 4: Dietary protein intake in the Nordic and Baltic countries is mainly with high quality protein where protein contains all indispensable amino acids in the right proportion required by the human body, i.e., that is a protein with high biological value". This statement lacks a source. Also, we miss an assessment of the	

			sources of protein, which forms the basis for this statement.	
Guro Waage	Nortura SA	See spesific comments	Part 2: Cardiovascular disease and diabetes (P.9): First sentences: Habitual high intake of total and animal protein is associated with an increased risk of T2D4. The reference must be wrong. The article is form 1987, and discusses New concepts of amino acids, and nothing about T2D. Last sentences of the section: It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D. First, considering sustainability is beyond the scope of the article. Second, to suggest that replacement of animal protein with plant protein might be a health strategy to lower the risk of CVD mortality and T2D, does not seem to be in line with what the research says. As the authors themselves describes the RCTs did not show apparent effects on risk factors for CVD an T2D, which indicates that the association seen in the cohort studies is not causal. Third, there are several well controlled RCTs that show total protein and animal protein are neutral or positive factors for body weight, glycemic regulations, and biomarkers for cardiovascular health, which is not included in the assessment (7,8,9,10). We ask for this sentence to be omitted. Also, according to the NNR committee, a systematic review of Plant protein intake in	Thank you for your comments. This has been corrected where text and references have been revised according to the NNR protocol

			adults and atherosclerotic/cardiovascular and disease type 2 diabetes, are to be published. We wonder why this chapter is published before the SR? Mortality, page 10: Several meta-analyses on high animal protein intake was positively associated with cardiovascular mortality and high plant protein intake was inversely associated with all-cause and cardiovascular mortality, especially among individuals with at least one lifestyle risk factor. Where, the substitution of plant protein for animal protein, especially that from processed red meat, was associated with lower mortality, suggesting the importance of protein sources 60, 61, 62, 63, 64, 65. As writhen in the section, the positively association between high animal protein intake and cardiovascular mortality were seen especially among individuals with at least one lifestyle risk factor. This suggests that the overall lifestyle is of greater importance than the protein source. We do not argue that high intake of processed red meat might be an issue, but this is probably not due to the content of protein and cannot be transferred to apply to the entire animal vs. plant-based protein discussion. This is an example on how this chapter lacks a clear definition and demarcation, and that the missing section of limitation, is crucial to discuss these findings. Further, in the sources stated by the authors, most of the studies shows that an increase in plant-based protein could be	

			beneficial for human health, but what most of the sources do not show, is that a decrease in animal-based protein is in favor of health. It is unclear why the authors equate this. Continuing in part 3	
Guro Waage	Nortura SA	Se spesific comments	Part 3: (Mortality continued, see part 2) As an example, Song M, et al., (source 60) found that the relationship of animal and plant protein with mortality varied by lifestyle factors and any statistically significant protein-mortality association were restricted to participants with at least one of the unhealthy behaviors, including smoking, heavy alcohol drinking, overweight or obesity, and physical inactivity. Further they state that residual confounding form lifestyle factors contributed to the observed protein-mortality associations, and that their results may suggest that the adverse effects of high animal protein intake and beneficial effects of plant protein may be enhanced by other unhealthy lifestyle choices and become evident among the subgroup of individuals with these behaviors who may already have had some underlying inflammatory or metabolic disorders (11). Xiang-Xiu et al (source 62), found that Increased total protein showed no clear association with risk of all-cause, CVD, and cancer mortality. Moreover, higher intake of animal protein may be associated with an increased risk of CVD mortality (highest vs lowest intake: RR = 1.11; 95% CI: 1.01, 1.22; each 3% increment of intake: RR = 1.02; 95%	The text and references have been reviewed.

			CI: 0.98, 1.06). Because of the low RR, they only conclude that the study demonstrates that higher plant protein intake is associated with a reduced risk of all-cause and CVD (12). Naghshi S., et al (source 63), found that higher intake of total protein was associated with a lower risk of all-cause mortality, and intake of plant protein was associated with a lower risk of all cause and cardiovascular disease mortality. Intake of total and animal protein was not significantly associated with risk of cardiovascular disease and cancer mortality (13). Nachvak SM, et al., (source 64), have only looked at the intake of soy-protein. They have not assessed the intake of animal protein, nor made a comparison between plant-based and animal protein (14). The scope of the chapter is to assess protein, but once again it seems to turn in to a discussion of animal vs plant-based food. It is important to keep in mind that not all plant-based protein sources are necessarily healthy, and not all animal-based food is unhealthy. The quality of the diet and the lifestyle is probably equally important (15). Recommended intake – Adults p.11: The Authors write that SRs were done to update new edition of NNR to assess the possible health effects of varying protein and evaluate the evidence for optimal protein intake. For most outcomes, the evidence of a relation to protein intake was assessed as inconclusive (e.g., all-cause mortality, cancer mortality and cancer	

			diseases, cardiovascular disease, bone health, body weight control, body composition, and renal function). The mentioned SRs lacks references. Further, through the chapter, it appears that the chapter authors choose to ignore the findings of the SRs, to draw their own conclusions. We wonder why NNR has carried out SRs, if the authors of the chapter choose to ignore the results.	
Guro Waage	Nortura SA	See spesific comments.	Part 5: Infants and children p.12: The authors stats that Convincing results show that higher protein intake in infancy and early childhood contributes to an increased risk for obesity later in life. The NNR committee/ the NNR-SR Centre, by Arnesen et al. have conducted a systematic review on Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis (16). We question why this systematic review is not included in the chapter? The chapter authors states that there are convincing results that higher protein intake in infancy and early childhood contributes to an increase risk of obesity later in life, while Arnesen et al., concluded there was limited, suggestive evidence for an effect of total protein intake and higher risk of overweight and/or obesity. Further the chapter-authors cite a high quality multi-centre, double-blind, randomized controlled trial from 2009, who tested the effect on growth of a low vs a	The text and references have been reviewed.

			high protein intake during the first two years of life (17). Based on this article a conclusion is drawn that protein source seams to be important, and that evidence also suggest that animal protein intake, especially from diary products, has a stronger association with growth, particularly with weight gain, than plant protein. This RCT was also included in the systematic review conducted by Arnesen et al, who states that "no conclusion could be made on the association between animal vs. plant protein intake and risk of overweight and/or obesity". We ask how the authors of the chapters, can draw another conclusion based on the available evidence, compared to the authors of the SR.	
Guro Waage	Nortura SA	Se spesific comments	Sources for all 5 parts: 1. Bandyopadhyay S, Kashyap S, Calvez J, et al. Evaluation of Protein Quality in Humans and Insights on Stable Isotope Approaches to Measure Digestibility - A Review. Adv Nutr. 2022 Aug 1;13(4):1131-1143. doi: 10.1093/advances/nmab134. PMID: 34755836; PMCID: PMC9340995 2. Päivärinta E, Itkonen ST, Pellinen T, et al. Replacing Animal-Based Proteins with Plant-Based Proteins Changes the Composition of a Whole Nordic Diet-A Randomised Clinical Trial in Healthy Finnish Adults. Nutrients. 2020 Mar 28;12(4):943. doi: 10.3390/nu12040943. PMID: 32231103; PMCID: PMC7231027. 3. Bohrer. Review: Nutrient density and nutritional value of meat products and non-meat foods high in protein. ScienceDirect. July 2017, Pages 103-112	The text and references have been reviewed.

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			PMC5048552. 12. Xiang-Xiu Qi, Peng Shen. Associations of dietary protein intake with all-cause, cardiovascular disease, and cancer mortality: A systematic review and meta-analysis of cohort studies. Nutrition, Metabolism and Cardiovascular Diseases 2020;30:1094-1105. 13. Naghshi S, Sadeghi O, Willett WC, Esmaillzadeh A. Dietary intake of total, animal, and plant proteins and risk of all cause, cardiovascular, and cancer mortality: systematic review and dose-response meta-analysis of prospective cohort studies. BMJ. 2020 Jul 22;370:m2412. doi: 10.1136/bmj.m2412. PMID: 32699048; PMCID: PMC7374797. 14. Nachvak SM, Moradi S, Anjom-shoae J, Rahmani J, et al. Soy, Soy Isoflavones, and Protein Intake in Relation to Mortality from All Causes, Cancers, and Cardiovascular Diseases: A Systematic Review and Dose–Response Meta-Analysis of Prospective Cohort Studies, Journal of the Academy of Nutrition and Dietetics 2019;119:1483-1500.e17. 15. Gregório MJ, Rodrigues AM, Eusébio M, et al. Dietary Patterns Characterized by High Meat Consumption Are Associated with Other Unhealthy Life Styles and Depression Symptoms. Front Nutr. 2017(June). doi:10.3389/fnut.2017.00025 16. Arnesen et al. Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. Food Nutr Res 2022 (PDF) 17. Koletzko B, von KR, Closa R, et al. Lower protein in infant formula is associated with	

			lower weight up to age 2 y: a randomized clinical trial. American Journal of Clinical Nutrition. 2009;89(6):1836–45.	
Karianne Spetaas Henriksen	Animalia	We appreciate the opportunity to comment on NNR2022s draft chapter on Protein. The chapter gives a good overview of the physiology and metabolism of protein, assessment of nutrient status and dietary intake, and discuss different needs across different populations. However, our impression is a somewhat unbalanced depiction of animal protein as unfavourable for health, an assertion not substantiated by the science. Throughout the chapter, statements are made that one should replace animal protein foods with plant protein foods for better health. This is contrary to the authors remarks that the evidence on protein and assessed health outcomes is inconclusive and/or limited. Several of the cited studies regarding CVD, DT2 and cancer found no significant association between animal protein intake and increased disease risk/mortality 1–8. Additionally, according to the authors "the results from RCTs did not show apparent effects on the risk factors for CVD or T2D". Thus, observed negative associations related to animal protein seem not to be supported by RCTs, a study type appropriate for studying cause-effect. NNR2022 states that RCTs should be accorded more weight than observational studies9. Another important point, studies	The abstract is the same text as first paragraph of the introduction section and seems unfinished. We miss a presentation of the main findings on dietary protein and the investigated health outcomes. Both in the abstract and throughout the text it is rather challenging to illuminate what the authors' conclusions on protein and disease risk are. This challenges the transparency. In addition, no evaluation of the causality and strength of the evidence on dietary protein intake and health outcomes are given. According to "Instruction to Authors" the chapter should include "Data gaps for future research". As of now, this is missing. Furthermore, we miss an appraisal of the uncertainties and limitations in the research included, especially a discussion of the confounding factors. It is widely recognised that the nutrition epidemiology has significant limitations and weaknesses, and the certainty and quality of epidemiological correlatives are highly debated. Thus, the authors ought to present possible limitations concerning the findings reported. A cohort study, Liao et al (2019) on colorectal cancer is cited to argue that animal protein should be substituted by plant. If systematic reviews are available, it is the preferred source of updated knowledge, according NNR2022 methodology paper9. We question the rationale for use of individual studies in the	Thank you for your comments. The text and references have been revised according to the NNR protocol.

		examining food groups such as meat, are used to determine whether animal protein is linked to poor health. It is questionable to extrapolate the findings from studies not meant to examine health effects of protein to apply to research question on animal versus plant protein. Furthermore, the scientifically acknowledged biological mechanism coupled with CVD, DT2 and cancer does not include animal protein. We suggest that studies assessing protein specifically is used as basis for conclusions and recommandations in the chapter. Confounding factors are a considerable challenge when assessing different protein sources and health. The authors mention of confounding are minimal. Confounding factors' possible impact on observed associations should be discussed, as the findings likely are affected by other nutrients (i.e. fibre, salt, fat), cooking habits/food processing, meal compositions and/or other lifestyle variables. Moreover, there is little recognition of animal foods as a generally superior protein source, due to the high biological value of animal protein. It should be clearly expressed in both abstract and text that animal foods such as fish, meat, egg and dairy products contribute with high quality protein. Most cited studies show a positive health association of plant protein intake, and we do agree that an increased intake of whole grains, legumes and vegetables would be beneficial for public health. Though we do not agree that an increase in nutritious plant foods necessarily should be at the	chapter, when there is a recent meta-analysis available (also cited by the authors) that found no association between animal protein and colorectal cancer. On page 9 it is proposed one should replace animal protein with plant protein for sustainability aspects. Sustainability is a very complex topic, and conclucions should be based upon rigorous science and a systematic and transparent evaluation of the evidence. As the NNR2022 background papers on sustainability are not finalized, we are enquireing how the authors can make conclucions on dietary changes needed for increased sustainability. Furthermore, NNR states that any relevant sustainability aspect will be integrated in the main NNR2022 report References 1. Laffel LM, Kanapka LG, Beck RW, et al. Effect of Continuous Glucose Monitoring on Glycemic Control in Adolescents and Young Adults with Type 1 Diabetes: A Randomized Clinical Trial. JAMA - Journal of the American Medical Association. 2020;323(23):2388-2396. doi:10.1001/jama.2020.6940 2. Zhao LZQLXWH. Dietary protein intake and risk of type 2 diabetes: a dose–response meta-analysis of prospective studies. Eur J Nutr. 2019;58:1351-1367. 3. Naghshi S, Sadeghi O, Willett WC, Esmaillzadeh A. Dietary intake of total, animal, and plant proteins and risk of all cause, cardiovascular, and cancer mortality: Systematic review and dose-response meta-analysis of prospective cohort studies. The	

		expense of nutritious animal protein foods. While some studies report negative associations for animal protein foods and some health outcomes, the argument above highlights crucial aspects that must be taken into consideration. Currently there is no support for animal protein in a context of a healthy diet, being harmful for human health. However, we do not believe it is a question of animal versus plant protein. Instead, we argue that it is about quality of the specific food sources of protein, as well as the dietary pattern and lifestyle in general. This is not mentioned in the chapter. Rather it appears that plant protein is healthy and animal protein is unhealthy, regardless of the food they come from. We urge that emphasis is put on quality of the food protein source, as well as highlighting the importance of the dietary pattern and lifestyle. It should be stated that a varied and balanced diet including both animal foods and plant foods that are nutrient dense and of good quality is healthy.	BMJ. 2020;370. doi:10.1136/bmj.m2412 4. Lai R, Bian Z, Lin H, Ren J, Zhou H, Guo H. The association between dietary protein intake and colorectal cancer risk: A meta-analysis. World J Surg Oncol. 2017;15(1). doi:10.1186/s12957-017-1241-1 5. Kong F, Geng E, Ning J, et al. The association between dietary protein intake and esophageal cancer risk: A meta-analysis. Biosci Rep. 2020;40(1). doi:10.1042/BSR20193692 6. Mao Y, Tie Y, Du J. Association between dietary protein intake and prostate cancer risk: Evidence from a meta-analysis. World J Surg Oncol. 2018;16(1). doi:10.1186/s12957-018-1452-0 7. Song M, Fung TT, Hu FB, et al. Association of animal and plant protein intake with all-cause and cause-specific mortality. JAMA Intern Med. 2016;176(10):1453-1463. doi:10.1001/jamainternmed.2016.4182 8. Xiang-Xiu Qi PS. Associations of dietary protein intake with all-cause, cardiovascular disease, and cancer mortality: A systematic review and meta-analysis of cohort studies. Nutrition, Metabolism and Cardiovascular Diseases. 2020;30:1094-1105. 9. Christensen JJ, Arnesen EK, Andersen R, et al. The nordic nutrition recommendations 2022 – principles and methodologies. Food Nutr Res. 2020;64:1-15. doi:10.29219	
Ewa Kurowska-Chappell	Danone	Danone welcomes the opportunity to comment on the Protein chapter of the NNR 2022. We would like to share comments on the following: - Page 11 According to the current regulation	Danone welcomes the opportunity to comment on the Protein chapter of the NNR 2022. We would like to share comments on the following: - Page 11 According to the current regulation	

		2016/127 the protein levels in Infant Formula (IF) need to be 0,43-0,6 g/100 kJ for animal-based and 0,54-0,57 g/100 kJ for soy-based formulas, and for Follow On formulas (FO) 0,38 -0,6 g/100 kJ for animal-based and 0,54-0,67 kJ for soy-based formulas. The nitrogen conversion factor (NCF) defined is in all cases 6,25. - Page 2, paragraph 3 The soya and milk nitrogen conversion factor are mentioned in the introduction, but there is no other mentions of it in the document. Additionally in the chapters on impact of protein on health the only differentiation mentioned is between plant and animal-based protein, without further specification on which plant or animal protein. Therefore, we suggest simplifying the third paragraph of page 2 removing the reference to soya and milk conversion factor as well as mentions of sources of errors and quoting EU regulation (EU) No 1169/2011 where it is fixed that the protein content of food is calculated using the formula: protein = total Kjeldahl nitrogen × 6,25. References: COMMISSION DELEGATED REGULATION (EU) 2016/127 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council as regards the specific compositional and information requirements for infant formula and follow-on formula and as regards requirements on information relating to	2016/127 the protein levels in Infant Formula (IF) need to be 0,43-0,6 g/100 kJ for animal-based and 0,54-0,57 g/100 kJ for soy-based formulas, and for Follow On formulas (FO) 0,38 -0,6 g/100 kJ for animal-based and 0,54-0,67 kJ for soy-based formulas. The nitrogen conversion factor (NCF) defined is in all cases 6,25. - Page 2, paragraph 3 The soya and milk nitrogen conversion factor are mentioned in the introduction, but there is no other mentions of it in the document. Additionally in the chapters on impact of protein on health the only differentiation mentioned is between plant and animal-based protein, without further specification on which plant or animal protein. Therefore, we suggest simplifying the third paragraph of page 2 removing the reference to soya and milk conversion factor as well as mentions of sources of errors and quoting EU regulation (EU) No 1169/2011 where it is fixed that the protein content of food is calculated using the formula: protein = total Kjeldahl nitrogen × 6,25. References: COMMISSION DELEGATED REGULATION (EU) 2016/127 of 25 September 2015 supplementing Regulation (EU) No 609/2013 of the European Parliament and of the Council as regards the specific compositional and information requirements for infant formula and follow-on formula and as regards requirements on information relating to infant and young child feeding.	

		infant and young child feeding. COMMISSION DELEGATED REGULATION (EU) …/… of 29.1.2018 amending Commission Delegated Regulation (EU) No 2016/127 with regard to protein requirements for follow-on formula. REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004.	COMMISSION DELEGATED REGULATION (EU) …/… of 29.1.2018 amending Commission Delegated Regulation (EU) No 2016/127 with regard to protein requirements for follow-on formula. REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004.	
Anna Maria Karlsen	NHO Mat og Drikke / FoodDrinkNorway	NHO Mat og Drikke/FoodDrinkNorway will, on behalf of the Norwegian food and drink industry, submit the following four general comments to the public consultation of the NNR2022 chapter 5 Protein: 1. Inclusion of de novo Systematic Reviews The NNR2022 Committee has prioritized 9 PI/ECOTSS for de novo systematic reviews (SRs), whereas topics 1 and 3 are of relevance for protein. We notice that the authors refer to the SR of topic 3, regarding plant protein intake in adults and atherosclerotic/cardiovascular disease and type 2 diabetes, which is not yet published (p. 11). It is very unfortunate that	General comments only.	Thank you for your comment. The text and references have been reviewed.

		this review is not available during the public consultation period. This challenges the transparency of the NNR process. Further, we question why the SR for topic 1 regarding plant protein vs. children by Arnesen et al. is not included or commented on in the chapter (p. 12). This SR, which is published on the NNR website, concludes that there was limited, suggestive evidence for an effect of total protein intake and higher risk of overweight and/or obesity, while no conclusions could be made on the associations between animal vs. plant protein intake and risk of overweight and/or obesity. However, the authors of the NNR2022 chapter on protein state the opposite, namely that convincing results show that higher protein intake in infancy and early childhood contributes to an increased risk for obesity later in life. 2. Reference to sustainability aspects We have noticed that the authors state that replacing animal protein with plant protein for aspects of sustainability is preferable (p. 6). This suggests an underlying bias not yet been substantiated in the NNR2022 process. The public consultation of the background papers for sustainability is not yet completed, so we ask that the NNR2022 chapter on proteins should omit this paragraph. 3. Protein intake in Norway		

		The authors state that the average protein intake among adults is high in the Nordic and Baltic countries (p. 6). This statement gives the impression that the intake is higher than recommended. However, the intake of protein in Norway in 2021 (16 E%, at food supply level) is within the recommended range (10-20 E%) (The Norwegian Directorate of Health, 2022), as stated also in the introduction. We ask for clarification and the addition of comments to this paragraph in the revised chapter. 4. Conclusions and limitations In our opinion, the chapter as presented in the public consultation appears to some degree unfinished. No executive summary of the author's conclusions is presented, and the abstract is duplicated in the introduction. The chapter could preferably be revised for increased readability. Moreover, we kindly ask for a more comprehensive discussion of the limitations of the cited sources, as well as the potential effects of confounding factors, e.g., in the assessment of observed associations between different sources of proteins and health outcomes. Reference: Norwegian Directorate of Health (2022). Utviklingen i norsk kosthold 2022.		
Theres Strand	Svenska Köttföretagen	Kapitlet redovisar, i likhet med NNR2012, i stor utsträckning en balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner och hur de kan	I frågan om ett grönt proteinskifte och biotillgänglighet finns ytterligare nya studier som bör uppmärksammas i kapitlet. Den låga uppskattade tillgängligheten av järn	Thank you for your comments. The final chapter (starting at p. 4) now contains a brief review on what happens to the overall quality of a diet

		kombineras i en sund kosthållning. Det är också välkommet att författarna efterfrågar mer avancerade metoder samt långtidsstudier för att utvärdera skillnaderna mellan olika proteinkällor. Vidare är det positivt att författarna uppmärksammar Gilani S. med fleras studie (2018; Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and the Bioavailability of Amino Acids and on Protein Quality) och det faktum att upptaget av proteiner (biotillgänglighet) kan bli problematiskt för känsliga grupper såsom äldre vid ett ökat intag av plantbaserade proteiner – detta därför att förmågan att tillgodogöra sig bl a protein minskar med stigande ålder. Detta är särskilt relevant i förhållande till risken för frakturer, som kapitlet också behandlar.	från extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Absorptionen av icke-hemjärn hos 27 kvinnor i fertil ålder var 4,2 % från måltider med texturerat åkerbönaprotein, 21,7 % och 9,2 % från nötkötts- respektive torskprotein, C. Mayer Labba (2022); Lower Non-Heme Iron Absorption in Healthy Females from Single Meals with Texturized Fava Bean Protein Compared to Beef and Cod Protein Meals: Two Single-Blinded Randomized Trials. Det är sammanfattningsvis angeläget att ha en nyanserad och evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlen om protein respektive baljväxter, bland annat, bör således ses över gemensamt. Angående betydelsen av proteinets kvalitet, se McAuliffe, G A et al (2022); Protein quality as a complementary functional unit in life cycle assessment (LCA). Påståendet att "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" behöver emellertid både underbyggas och nyanseras. Det finns plantbaserade dieter som är förkastliga ur miljöperspektiv, likväl som det finns animalieproduktion som bidrar med betydande ekosystemtjänster, bland annat. Vidare bör resonemanget kring hjärt-och kärlsjukdomar (CVD) och typ 2-diabetes (T2D) utvecklas ytterligare då de	and nutritional status when animal-sources proteins are partially replaced with plant-sourced ones, taking into account the other (than protein) nutrient composition in a protein source. Both positive and negative changes occures, which needs to be taken into account when assesing the healthiness of a diet.

			studier som författarna hänvisar till uppenbarligen har kommit till skilda slutsatser. När författarna hänvisar till The World Cancer Research Fund (WCRF) senaste livsmedelsundersökning angående risker för kolorektal cancer bör också nämnas att WCRF inte förespråkar att kött utesluts från kosthållningen, eftersom kött är en värdefull källa till näringsämnen, särskilt protein, järn, zink och vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Livsmedelsverkets rekommendation om att äta maximalt 500 gram rött kött i veckan inklusive charkprodukter är baserat på risken för vissa cancerdiagnoser. Det finns emellertid nya studier som nyanser denna bild och som bör beaktas i sammanhanget. (se The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 i The Lancet, https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext).	
Hans Agné	Konsument	Kapitlets syfte är att beskriva den samlade evidensen för proteiners hälsomässiga betydelse, som bas för att sätta och uppdatera rekommendationer om intag. Kapitlet redovisar, i likhet med NNR2012, i	När författarna hänvisar till The World Cancer Research Fund (WCRF) senaste livsmedelsundersökning angående risker för kolorektal cancer bör också nämnas att WCRF inte förespråkar att kött utesluts från kosthållningen, eftersom kött är en värdefull	Thank you for your comments. The WCRF report on diet and cancer is by far considered the most thorough scientific assesment on the association of any dietary intake and cancer, also including the evidence regarding the

		stor utsträckning en balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner och hur de kan kombineras i en sund kosthållning. Det är också välkommet att författarna efterfrågar mer avancerade metoder samt långtidsstudier för att utvärdera skillnaderna mellan olika proteinkällor. Vidare är det positivt att författarna uppmärksammar Gilani S. med fleras studie (2018; Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and the Bioavailability of Amino Acids and on Protein Quality) och det faktum att upptaget av proteiner (biotillgänglighet) kan bli problematiskt för känsliga grupper såsom äldre vid ett ökat intag av plantbaserade proteiner – detta därför att förmågan att tillgodogöra sig bl a protein minskar med stigande ålder. Detta är särskilt relevant i förhållande till risken för frakturer, som kapitlet också behandlar. I frågan om ett grönt proteinskifte och biotillgänglighet finns ytterligare nya studier som bör uppmärksammas i kapitlet. Den låga uppskattade tillgängligheten av järn från extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Absorptionen av icke-hemjärn hos 27 kvinnor i fertil ålder var 4,2 % från måltider med texturerat åkerbönaprotein, 21,7 % och 9,2 % från nötkötts- respektive torskprotein, C. Mayer Labba (2022); Lower Non-Heme Iron Absorption in Healthy Females from Single Meals with Texturized Fava Bean	källa till näringsämnen, särskilt protein, järn, zink och vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Livsmedelsverkets rekommendation om att äta maximalt 500 gram rött kött i veckan inklusive charkprodukter är baserat på risken för vissa cancerdiagnoser. Det finns emellertid nya studier som nyanser denna bild och som bör beaktas i sammanhanget. (se The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 i The Lancet, https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext).	consumption of different protein sources (red meat for example) and CRC cancer risk. Within the scope of the chapter, it was not meaningful to widen the discussion over other nutrients than protein.

		Protein Compared to Beef and Cod Protein Meals: Two Single-Blinded Randomized Trials. Vidare har studier visat att köttsubstitut som finns tillgängliga på den svenska marknaden har brister i näringsinnehåll och biotillgänglighet, inte minst när det gäller järn och zink. Se C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioaviability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. Det är sammanfattningsvis angeläget att ha en nyanserad och evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlen om protein respektive baljväxter, bland annat, bör således ses över gemensamt. Angående betydelsen av proteinets kvalitet, se McAuliffe, G A et al (2022); Protein quality as a complementary functional unit in life cycle assessment (LCA). Påståendet att "It should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D" behöver emellertid både underbyggas och nyanseras. Det finns plantbaserade dieter som är förkastliga ur		

		miljöperspektiv, likväl som det finns animalieproduktion som bidrar med betydande ekosystemtjänster, bland annat. Vidare bör resonemanget kring hjärt-och kärlsjukdomar (CVD) och typ 2-diabetes (T2D) utvecklas ytterligare då de studier som författarna hänvisar till uppenbarligen har kommit till skilda slutsatser.		
Erica Lindberg	Svenska Fåravelsförbundet	Svenska Fåravelsförbundet (SF) önskar lämna följande synpunkter på kapitlet om protein, vars syfte är att beskriva den samlade evidensen för proteiners hälsomässiga betydelse, som bas för att sätta och uppdatera rekommendationer om intag. Kapitlet redovisar, i likhet med NNR2012, i stor utsträckning en balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner och hur de kan kombineras i en sund kosthållning. Det är välkommet att författarna efterfrågar mer avancerade metoder, samt långtidsstudier för att utvärdera skillnaderna mellan olika proteinkällor. Dock är vår uppfattning att det i många delar krävs förtydliganden, nyanseringar och hänsyn till flera källor på olika områden, för att ge en mera balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner, vi hänvisar här till de källor som är detaljerat beskrivna i remissyttrande från organisationen Svenskt Kött. Några exempel: i frågan om ett grönt proteinskifte och biotillgänglighet finns ytterligare nya studier som bör uppmärksammas i kapitlet. Den låga uppskattade tillgängligheten av järn från	Här ställer vi oss bakom de inspel som gjorts av organisationen Svenskt Kött.	Thank you for your comments. The final chapter (starting at p. 4) now contains a brief review on what happens to the overall quality of a diet when animal-sources proteins are partially replaced with plant-sourced ones, taking into account the other (than protein) nutrient composition in a protein source. Both positive and negative changes occures, which needs to be taken into account when assesing the healthiness of a diet. It is true that WCRF do not recommend to give up all red meat consumption, neither does the text in the protein chapter.

		extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Vidare har studier visat att köttsubstitut som finns tillgängliga på den svenska marknaden har brister i näringsinnehåll och biotillgänglighet, inte minst när det gäller järn och zink. SF anser sammanfattningsvis angeläget att ha en nyanserad och evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlen om protein respektive baljväxter, bland annat, bör således ses över gemensamt. Vi vill också poängtera att när författarna hänvisar till The World Cancer Research Fund (WCRF) senaste livsmedelsundersökning angående risker för kolorektal cancer, borde det också nämnas att WCRF inte förespråkar att kött utesluts från kosthållningen, eftersom kött är en värdefull källa till näringsämnen, särskilt protein, järn, zink och vitamin B12 https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Livsmedelsverkets rekommendation om att äta maximalt 500 gram rött kött i veckan inklusive charkprodukter är baserat på risken för vissa cancerdiagnoser. Det finns emellertid nya studier som nyanser denna bild och som också bör beaktas i sammanhanget. (se The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease		

		Study 2017 i The Lancet, https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext).		
Eilin Lundekvam By, senior nutrition advisor	on behalf of Norwegian Meat and Poultry Research Centre (Animalia) and Norwegian Egg and Meat Council (MatPrat)	We appreciate this opportunity to comment on NNR2022s draft chapter on Protein. The findings on protein and non-communicable diseases are quite mixed. Many of the cited studies report a protective association of plant protein. While some of the cited studies on animal protein intake report small increase risk associations. However, several studies find no significant associations between animal protein and disease risk or mortality(1–8), including some of the studies cited as finding cardiovascular mortality associated with animal protein(7–8). Contrary to the evidence cited, the chapter states that one should reduce animal protein intake, although the protein intake in the Nordics is within current nutrition recommendations. This implies that animal protein is unhealthy per se. A claim which is scientifically unsubstantiated. The authors refer to food-based studies, which cannot isolate the effect of the protein intake from other nutrients or ingredients. Still such studies are used to support the argument that animal protein is detrimental to health. It is questionable to apply the findings from studies originally meant to examine something	We question why the authors do not include NNR2022s own qualified systematic reviews on protein: 1) Plant protein intake in adults and atherosclerotic/cardiovascular and disease type 2 diabetes, and 2) Plant protein intake in children and body growth. The first one is not published yet, as far as we know. Thus, challenging the transparency of NNRs updating of the protein chapter, as one cannot assess the findings or conclusions made. The second one is published, but not cited. It should be included in the subsection on children and protein. Interestingly, the authors state on page 12 that "Convincing results show that higher protein intake in infancy and early childhood contributes to an increased risk for obesity later in life". This contradicts the findings of NNRs own qSR, Arnesen et al., concluded "there was limited, suggestive evidence for an effect of total protein intake and higher risk of overweight and/or obesity" On page 9-10 it is suggested that there remains uncertainty whether protein intake impairs renal function. We argue that current research establish that protein intake does not have negative effects on renal function (10-13).	Thank you for your comment. The text and references have been reviewed and this paper has been included.

		else to the research question on health effects of animal or plant protein. Furthermore, the scientifically acknowledged biological mechanism coupled with CVD, T2D and cancer does not include animal protein. The observed associations between animal protein and CVD, T2D and cancer are generally weak, making it difficult to distinguish observed risk from an association influenced by chance, bias and/or confounding. Consistency of an exposure-disease association in various populations can lend credibility to a causal interpretation. The chapter do not address the characteristics of the cited studies, such as study population demographics and study country. However, they do report inconsistency in the results, depending on study type: "While the cohort studies reported associations with decreased risks in the substitution of animal protein with plant protein, the results from RCTs did not show apparent effects on the risk factors for CVD or T2D (p9)". This also reduces the credibility of the associations being causal. Looking closer at one of the cited sources (9), the relationship of animal and plant protein with mortality varied by lifestyle factors and any significant protein-mortality association were restricted to participants with at least one of the unhealthy behaviors, including smoking,	References 1. Laffel LM, et al. Effect of Continuous Glucose Monitoring on Glycemic Control in Adolescents and Young Adults with Type 1 Diabetes: A Randomized Clinical Trial. JAMA - Journal of the American Medical Association. 2020;323(23):2388-2396. doi:10.1001/jama.2020.6940 2. Zhao LZQLXWH. Dietary protein intake and risk of type 2 diabetes: a dose–response meta-analysis of prospective studies. Eur J Nutr. 2019;58:1351-1367. 3. Naghshi S, et al. Dietary intake of total, animal, and plant proteins and risk of all cause, cardiovascular, and cancer mortality: Systematic review and dose-response meta-analysis of prospective cohort studies. The BMJ. 2020;370. doi:10.1136/bmj.m2412 4. Lai R,et al. The association between dietary protein intake and colorectal cancer risk: A meta-analysis. World J Surg Oncol. 2017;15(1). doi:10.1186/s12957-017-1241-1 5. Kong F, et al. The association between dietary protein intake and esophageal cancer risk: A meta-analysis. Biosci Rep. 2020;40(1). doi:10.1042/BSR20193692 6. Mao Y, et al. Association between dietary protein intake and prostate cancer risk: Evidence from a meta-analysis. World J Surg Oncol. 2018;16(1). doi:10.1186/s12957-018-1452-0 7. Song M, et al. Association of animal and	

		alcohol drinking, overweight/obesity, and physical inactivity. Further they state that residual confounding from lifestyle factors contributed to the observed protein-mortality associations, and that their results may suggest that the adverse effects of high animal protein intake and beneficial effects of plant protein may be enhanced by other unhealthy lifestyle choices. As of now potential effects of confounding are briefly mentioned. The chapter should elaborate on the effects of confounding factors. In addition to dietary factors, smoking, alcohol, obesity and physical inactivity are factors with substantial effect on the health outcomes. Even though one adjusts for such variables, residual confounding is likely to persist. This is particularly relevant as observed associations are generally weak. The aforementioned suggests that the overall lifestyle is of great importance. We also argue that quality of the foods and dietary pattern are more significant, rather than animal versus plant protein. Observational studies are a considerable proportion of the scientific basis of the section on protein intake and health outcomes. The limitations and uncertainties of such research should be stressed in the chapter. Causal conclusions must be drawn on the totality of scientific evidence after a rigorous and critical appraisal of the studies have been	plant protein intake with all-cause and cause-specific mortality. JAMA Intern Med. 2016;176(10):1453-1463. doi:10.1001/jamainternmed.2016.4182 8. Xiang-Xiu Qi PS. Associations of dietary protein intake with all-cause, cardiovascular disease, and cancer mortality: A systematic review and meta-analysis of cohort studies. Nutrition, Metabolism and Cardiovascular Diseases. 2020;30:1094-1105. 9. Martin WF, Armstrong LE, Rodriguez NR. Dietary protein intake and renal function. Nutr Metab (Lond). 2005;2. doi:10.1186/1743-7075-2-25 10. Devries MC, et al. Changes in Kidney Function Do Not Differ between Healthy Adults Consuming Higher- Compared with Lower- or Normal-Protein Diets: A Systematic Review and Meta-Analysis. Journal of Nutrition. 2018;148(11):1760-1775. doi:10.1093/jn/nxy197 11. Berryman CE, et al. Diets higher in animal and plant protein are associated with lower adiposity and do not impair kidney function in US adults. American Journal of Clinical Nutrition. 2016;104(3):743-749. doi:10.3945/ajcn.116.133819 12. van Elswyk ME, et al. A systematic review of renal health in healthy individuals associated with protein intake above the US recommended daily allowance in randomized controlled trials and observational studies. Advances in	

		performed using systematic weight-of-the-evidence methodology. We cannot see that such a causality appraisal has been performed.	Nutrition. 2018;9(4):404-418. doi:10.1093/ADVANCES/NMY026	
Magnus Därth	Swedish Meat Industry Association (Kött och Charkföretagen)	Throughout the document, many single studies were pointed out which contradicted the previous paragraphs and better-quality studies. Some examples are: · 2nd paragraph on the "obesity chapter", · 3rd paragraph on the "cardiovascular diseases and diabetes chapter", · 3rd phrase on "the reasoning behind the upper intake range" chapter, among others. Besides not being representative of the population, these studies are low in the pyramid of evidence and some lack the right referencing. We question the relevance and reasoning for the mention of such articles. Overall, one of the main problems in the studies is that protein intake from animal sources, in particular meat, often coincide with other dietary and non-dietary factors such as obesity, smoking, low levels of exercise and physical activity as well as reduced intake of whole grains, fruits, vegetables, nuts and seeds. These factors are not accounted for which creates a bias on the impact of meat consumption. Reports of the risks, on many occasions, are not well described and interpreted, which further contributes for the lack of good evidence (1). As recent evidence states, 21% of the global protein is provided by red meat, as	We have some specific comments and questions on the chapter. They are presented below: a) Considering that, as described, there is no gold standard on how to estimate the requirements of nitrogen and that the conversion factor is imperfect and leads to significant mistakes, how can it be affirmed that a reduction in the consumption of animal protein can provide the basic necessities of protein and amino acids? Specially when it is referred that "low protein intake might induce protein sparing and thus lead to underestimation of needs". b) Following that thought, on the 1st paragraph of page 4, we consider that infants, children, adolescents, pregnant women, and low-income groups should be mentioned alongside elderly, due to their increased need in protein (1). c) On the other hand, according to Herreman et al. soy has two limiting amino acids: methionine and cysteine (2). Therefore, table 2 and the second paragraph on page 4 should be corrected. d) On page 9, 1st sentence, an article of 1987 is referenced as the proof that high total and animal protein intake is associated with increased risk of type 2 diabetes. How can it be credible that recommendations for 2023 and onwards being based on science with 40	Thank you for your comment. In the future, we are sure that amino acid profile and bioavailability will have more focus.

		well as other important micronutrients such as complex B vitamins. A decrease in the consumption of red meat can imply an increase in protein deficiency and further increase food insecurity, in particular in infants, children, adolescents, pregnant women, elderly and low-income groups (2). When reference is made to The World Cancer Research Fund (WCRF) and the latest food study regarding risks of colorectoral cancer it should also be mentioned that WCRF does not recommend that meat is excluded from the diet, since meat is a valuable source of many important nutrients, especially protein, iron, zink and vitamin B12. https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. References: 1. http://dx.doi.org/10.1071/an21235 2. http://dx.doi.org/10.3389/fnut.2022.766796	years old? Recent evidence shows that red meat intake does not impact most glycaemic and insulinemic risk factor for type 2 diabetes (3). e) Later in the same page, it is affirmed that "it should also be considered that replacing animal protein with plant protein for aspects of sustainability may also be a public health strategy to lower the risk of CVD mortality and T2D.", however when we look into the evidence described in the previous paragraph it is stated that neither RCTs nor SR found any apparent effects. Why is this phrase stated when better quality studies say otherwise? Besides that, plant-based alternatives can be unsustainable depending on their provenience and processing (4). f) Finally, on bone health, it is declared that protein increases calcium absorption and bioavailability, but also that vitamin D in adequate levels is fundamental. Animals are a source of protein, calcium and vitamin D, so it seems a bit contradicting that high animal intake can increase the risk of fractures when it's the source of the main nutrients that can prevent it. References: 1. http://dx.doi.org/10.3390/nu11122891 2. https://doi.org/10.1002/fsn3.1809 3. https://doi.org/10.1038/s41430-022-01150-1 4. https://www.who.int/europe/publications/i/item/WHO-EURO-2021-4007-43766-61591	

Irena Jakopanec, MD, PhD	Tønsberg kommune	Part 1 Page 3, methods. The limitations of RCT studies based on macronutrient composition alone are insufficiently addressed. Systematic reviews and meta-analyses across such studies can end up comparing completely different diets with high protein proportion. How was this limitation addressed? 2. Were large population-based cohort studies excluded? If so, wouldn't it be warranted to include this type of evidence where the other evidence (RCT studies) is lacking, insufficient or has great limitations? One should at least discuss the new evidence available from these studies (see point 6 in specific comments) as the results seem conclusive. 3. It is not sufficiently justified why protein quality is used as a measure in this chapter, in spite of the method being highly controversial, and designed to favour the protein of animal origin. The latter is, according to many recent studies, associated with increased long term mortality and chronic disease risk. There is no evidence that would support the assumption that food items with higher protein digestibility are to be preferred in the western diets because their regular intake results in positive health impacts - when compared to intake of foods with lower protein digestibility. In fact, it appears that the opposite is true. If protein quality will be used, it should be	Part 1 1. Under the title "Protein intake and health outcomes relevant for Nordic and Baltic countries" no epidemiological overview over the problem of severe protein deficiency is given, nor is the lack of any data discussed. Can the lack of detailed data be explained by the fact that this is not a problem we see often in our populations? How big is the problem of severe protein deficiency in the North? Should consumers be worried about their protein intake? How rapidly does this problem occur? Under the normal conditions and taking into account high protein intake in the Nordic countries you describe later on, how many are at risk for severe protein deficiency and which groups would be most vulnerable? The paragraphs on the page 6 and 8 on this topic are identical and one of them should be thus deleted. 2. Page 5, first paragraph. The following claim is made: "However, protein digestibility and bioavailability may become an issue in protein transition towards more plant-based diets in vulnerable groups such as the elderly, as protein bioavailability is known to decrease with age." This claim is not supported by relevant evidence. You are using an article referring to developing countries, as well as evidence in rats and/or pigs. Please provide a scientific reference including evidence (not an opinion) that suggests that digestibility and bioavailability are a cause of concern for the elderly in western countries.	Thank you for your comments. The text and references have been revised according to the NNR protocol.

		highlighted that the PDCAAS and DIAAS can be misleading (see the reference and justifications under). Thus, full disclosure of the method limitations is warranted.	3. Page 6-8. Dietary intake in Nordic and Baltic countries. Please provide recommended reference values in the tables so that the reader can compare directly. 4. Page 8, Obesity. You state: "Meta-analysis RCT studies were done in 2013 … ". You conclude with: "It showed that high-protein diets exerted neither specific beneficial nor detrimental effects on obesity, cardiovascular disease, or glycaemic control." However, this is not aligned with what the authors, being aware of the limitations of their methods, actually conclude. The authors felt that drawing conclusions (and recommend high protein diets in the management of overweight and obesity) would be premature. When the results are inconclusive, I would be cautious using the "it showed" to describe them. It is further problematic to describe a year as a "long term" period. Longer RCT studies, if conducted, could potentially provide different results. There are many important methodological limitations with this study, including that high protein diets might mean completely different food items and would thus impact the health differently. To summarise, the evidence you are relying on to describe high protein diet effects on obesity, is lacking and is as such not sufficient to provide more specific recommendations. The comments on cardiovascular disease and glycaemic control should, if you find them relevant (I don't, given the limitations I mentioned), be moved into subsequent chapters below.	

			5. Page 8, Obesity. You state: "However, a large US cross-sectional study found a favourable association between both animal and plant-sourced protein, particularly with central adiposity." Here, no reference is provided. Do you think using a cross-sectional study is warranted without warning the reader about the limitations of such study design? Was this reference a result of your systematic research (described on page 3) and if not, how was it provided? The specific reference should be provided to allow for review.	
Irena Jakopanec, MD, PhD	Tønsberg kommune	Part 2 I would like to refer to the following article on the topic of protein quality, together with its references: David L Katz, Kimberly N Doughty, Kate Geagan, David A Jenkins, Christopher D Gardner, Perspective: The Public Health Case for Modernizing the Definition of Protein Quality, Advances in Nutrition, Volume 10, Issue 5, September 2019, Pages 755–764, https://doi.org/10.1093/advances/nmz023 To summarise some of the points authors make (these are citations from the article above): • Prevailing definitions of protein quality are predicated on considerations of biochemistry and metabolism rather than the net effects on human health or the environment of specific food sources of protein. … The popular concept that protein is "good" and that the more the	Part 2 6. Pages 8-9. Cardiovascular diseases and diabetes. (my comments in this point are also relevant for page 10, Mortality) This section on CVD and type 2 diabetes has to be more clearly structured and the evidence needs to be updated with recent large cohort studies. At minimum, the following studies should also be considered, also for mortality chapter: a. (already referred to, but not for cardiovascular disease mortality results) Huang J, Liao LM, Weinstein SJ, Sinha R, Graubard BI, Albanes D. Association Between Plant and Animal Protein Intake and Overall and Cause-Specific Mortality. JAMA Intern Med. 2020 Sep 1;180(9):1173-1184. doi: 10.1001/jamainternmed.2020.2790. PMID: 32658243; PMCID: PMC7358979. b. (already referred to, but not for its cardiovascular disease mortality results)	Thank you for your comments. The text and references have been revised according to the NNR protocol.

		better, coupled with a protein quality definition that favors meat, fosters the impression that eating more meat, as well as eggs and dairy, is desirable and preferable. This message, however, is directly opposed to current Dietary Guidelines for Americans, which encourage consumption of more plant foods and less meat, and at odds with the literature on the environmental impacts of foods, from carbon emissions to water utilization, which decisively favor plant protein sources. • The word "quality" implies superiority, but food sources of "high-quality" protein, as defined by existing metrics, do not reliably improve the quality of the diet or health. For example, consumption of certain animal sources of protein is associated with higher chronic disease risk (12), whereas consumption of protein-rich plant foods and adherence to plant-based dietary patterns are associated with more favorable health outcomes (12–14). • The definition of protein quality is both misleading and antiquated. • ... the rationale for defining protein quality as a function of a food's essential amino acid composition is of questionable validity, at least for the populations of developed countries. • If PDCAAS is replaced by DIAAS in the United States, as proposed by the FAO, eligibility for protein content claims will change for some plant foods; some that	Chen Z, Glisic M, Song M, Aliahmad HA, Zhang X, Moumdjian AC, Gonzalez-Jaramillo V, van der Schaft N, Bramer WM, Ikram MA, Voortman T. Dietary protein intake and all-cause and cause-specific mortality: results from the Rotterdam Study and a meta-analysis of prospective cohort studies. Eur J Epidemiol. 2020 May;35(5):411-429. doi: 10.1007/s10654-020-00607-6. Epub 2020 Feb 19. PMID: 32076944; PMCID: PMC7250948. c. (not referred to, higher plant protein intake was associated with lower total and CVD-related mortality) Budhathoki S, Sawada N, Iwasaki M, Yamaji T, Goto A, Kotemori A, Ishihara J, Takachi R, Charvat H, Mizoue T, Iso H, Tsugane S; Japan Public Health Center–based Prospective Study Group. Association of Animal and Plant Protein Intake With All-Cause and Cause-Specific Mortality in a Japanese Cohort. JAMA Intern Med. 2019 Nov 1;179(11):1509-1518. doi: 10.1001/jamainternmed.2019.2806. Erratum in: JAMA Intern Med. 2019 Oct 1;179(10):1448. PMID: 31682257; PMCID: PMC6714005. d. (not referred to, includes results on cardiovascular mortality) Song M, Fung TT, Hu FB, Willett WC, Longo VD, Chan AT, Giovannucci EL. Association of Animal and Plant Protein Intake With All-Cause and Cause-Specific Mortality. JAMA Intern Med. 2016 Oct 1;176(10):1453-1463. doi: 10.1001/jamainternmed.2016.4182. Erratum in: JAMA Intern Med. 2016 Nov	

		were not eligible will become eligible and vice versa (27). Animal foods will continue to score highly. • In light of this evidence, alternative regulatory frameworks have already been adopted by some other developed countries. … There is no evidence that a policy of ignoring protein quality while prioritizing overall dietary quality has led to any adverse effects on population health status in these countries. • Although it has been argued that the DRIs should be increased for those consuming a vegetarian diet, to account for the reduced digestibility of plant proteins (41), they have not been increased because the findings of a meta-analysis of nitrogen balance studies showed no significant effect of dietary protein source on protein requirements (42). It is also the position of the Academy of Nutrition and Dietetics that vegetarian and vegan diets generally supply adequate protein and essential amino acids when protein is consumed from a variety of plant sources throughout each day and energy needs are met (9).	1;176(11):1728. PMID: 27479196; PMCID: PMC5048552. These studies (and potentially many more) are insufficiently represented and overlooked in the chapter. It is not clear what were the criteria of choosing the references for the chapters on pages 8-11 so that these studies are not referred to? 7. Page 13, Old adult. The sentence starting with "Frailty84 and sarcopenia85" lacks a verb. Proper epidemiological background should be provided - how many old adults are affected by frailty and sarcopenia? Who is particularly at risk and should be wary of their protein intake? 8. Page 13, the title "The reasoning behind the upper intake range" should be changed into "Potential adverse effects of high protein intake". The title "The reasoning behind the upper intake range" can be moved two paragraphs upwards, when you are actually discussing the intake range. I assume you no longer discuss the old adult in these two paragraphs (?), but that is not completely clear for the reader. It would be best to actually conclude with the discussion on the range rather than potential adverse effects of high protein intake, so that discussion on adverse effects comes before. 9. Concluding sentence: "WHO and Institute of Medicine recommendations recognize higher-protein diets as safe in individuals without CKD108,109."	

			The references you are providing here are outdated (18 and 16 years old, respectively) and have to be replaced. Institute of Medicine no longer exists. Also, do you think this statement is still a completely valid conclusion, given your summary of associations between high meat intake, chronic diseases and increased mortality (pages 8-10) and the additional literature on the topic? Or are certain adjustments to this statement, like advising more caution about more specific protein sources, potentially warranted?	
Malén Gudbrandsgard	MatPrat, Opplysnings-kontoret for egg og kjøtt	We appreciate the opportunity to comment on NNR2022s draft chapter on Protein. References to spesific comments: A. D. Conigrave et al. (2006). Dietary Protein and Bone Health: Roles of Amino Acid–Sensing Receptors in the Control of Calcium Metabolism and Bone Homeostasis. Paul B. Pencharz & Ronald O. Ball. (2003). DIFFERENT APPROACHES TO DEFINE INDIVIDUAL AMINO ACID REQUIREMENTS. Chen et al. (2022). Sex as a Biological Variable in Nutrition Research: From Human Studies to Animal Models. https://doi.org/10.1146/annurev-nutr-062220-105852 Australian Government. (2009). Ileal Digestible Amino Acid Values in Feedstuffs for Poultry.	Page 1 introduction, line 7: We suggest revising the text to: “Protein quality is assessed by considering indispensable amino acid content in reference to an amino acid profile and the digestibility of protein or of individual indispensable amino acids and their utilisation (bioavailability)….” Page 2, line 4: We suggest changing the sentence to “…., the protein requirement is assessed from nitrogen losses and defined as the lowest….” Page 2, line 6: We suggest changing the sentence to: “….the protein requirement is assessed by a factorial approach, including replacement of nitrogen losses and additional needs associated with….” Page 2, fourth paragraph, line 1: We suggest changing the sentence to “Traditionally, a nitrogen to protein	Thank you for your comment. The text and references have been reviewed.

			conversion factor of 6,25 is applied….” Page 2, fifth paragraph, line 2 as well as the table on page 2: We ask the authors to change from “non-indispensable” to “dispensable”. Page 2, sixth paragraph, line 1: We suggest changing the sentence to “… although it fulfils the criterion of reducing protein deposition and inducing negative nitrogen balance only when removed from the diet.” Page 2, third paragraph: Typical protein content in animal foods and plant foods are given in this paragraph. We suggest expressing protein content in edible form, as this is more relevant/usable information. The current presentation gives the impression that plant foods contribute with more protein. Also, it is hard to compare animal foods given in wet weight, to plant foods given in dry matter. Page 3, Physiology and metabolism, line 1: We suggest using “hydrolysed” instead of “broken down” Page 3, Physiology and metabolism, line 3: We suggest changing to “…and a partial hydrolysis and cleavage of peptide linkages…” Page 3, Physiology and metabolism, second paragraph, line 3: We suggest writing: “… protein quality is based on amino acid profile and	

			digestibility…" Page 3, Physiology and metabolism, second paragraph, line 7: We suggest adding: "…DIAAS uses ileal digestibility of each amino acid instead of faecal protein digestibility and does not truncate the values artificially to 100 % for individual proteins. Truncation only applies to diets." Page 3, Physiology and metabolism, second paragraph, line 7: "ileal digestibility instead of faecal digestibility": should be: "ileal amino acid digestibility instead of faecal nitrogen digestibility". Page 4 Physiology and metabolism, line 2: After: "…………..limited'. Add: "For lysine, the often first limiting amino acid in diets, the DIAAS method uses the true ileal digestibility of reactive lysine (which is a measure of bioavailable lysine) rather than lysine digestibility. This is important especially for foods that have sustained Maillard type protein damage." From our perspective bioavailability denotes that a nutrient is in a form that it can be digested, absorbed and utilised. Currently it is not made clear in the chapter text that digestibility is an estimate of bioavailability and not a measure of availability. It is suggested that rat and pig ileal digestibility data can be used if data is not available. There is much poultry data available which we suspect would be just as useful.	

			Page 6: Protein intake and health outcomes relevant for Nordic and Baltic countries is written twice in the chapter. The one on page 6 should be omitted. Page 6 and 8: Mention is made of protein deficiency which is unfortunate as we are talking about deficiency of an amino acid. Concerning the reference list: We have identified some references being duplicated. For instance references 54 and 55 in the reference list are identical references. The same go for references 62 an 66. Those are the same studies. We have not looked through the whole list, but ask the authors to verify their references. Page 9: Refer to Mouse al.t al 2020, not available in the reference list.	
Torill Nysted	Animalia	Currently there is a huge emphasis in the public health discourse that we should eat mainly plant-based diets. In this regard it is important to acknowledge amino acids as individual nutrients with unique metabolic functions, just as different vitamins and minerals. Dietary proteins' primary role is as a source of amino acids and nitrogen, and humans have distinct requirements of amino acids. Dietary protein requirement is a proxy for the body's requirement for amino acids and nitrogen. The chapter accurately recognizes these crucial underpinning aspects regarding dietary proteins. Difference in protein quality is described in	According to the authors (p 6, last paragraph), the protein intake among adults is high in the Nordic and Baltic countries. This is incorrect regarding the protein intake in Norway, which is within the recommendations8,9 The protein intake in 2021 was 16 E% at the food-supply level. Thus, it is in fact lower at the ready-to-eat level. We ask the authors to change the sentence both in the text and abstract to "The average intake among adults is within the recommendations in the Nordic and Baltic region". There is also isotope (the IAAO method) work suggesting a higher daily protein	Thank you for your comment. The text and references have been reviewed

		the chapter. However, we question why it is not explicitly written that animal protein foods contribute with high quality protein, that is dietary protein that contains all indispensable amino acids in the right proportion required by the human body. In the chapter a rationale is made that a shift towards more plant protein at the expense of animal protein is favourable and unproblematic. There is no assessment of how such a diet change will affect the supply of indispensable amino acid. Apart from mentioning the elderly, vulnerable groups are not discussed. In the section "recommended intake" it is clearly stated that the assumed daily protein requirement is based on good-quality protein/kg BW per day. FAO states that "in dietary protein quality evaluation, dietary amino acids should be treated as individual nutrients"1. Hence an important aspect is the protein quality of the protein foods recommended. A clearer emphasis of this should be made. According to Norwegian Institute of Bioeconomy Research (NIBIO), approx. 62% of the protein in the Norwegian diet is from animal based foods, while 33% of the protein in the diet is plant-based proteins2. The remaining is a mix. Thus, current food intake provides a good amount of high quality protein. For most people, it might not be a challenge replacing some of the animal-based protein with plant based protein, but we question why the assumption is made without an appraisal of the provision of amino acids. The chapter should provide evidence-based recommendations on how	requirement compared to the current estimate based on N balance. This should be mentioned in the chapter. References: 1. FAO. Dietary Protein Quality Evaluation in Human Nutrition. Report of an FAO Expert Consultation. Vol 92.; 2013. 2. Animalia. Kjøttets Tilstand 2022.; 2022. 3. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. In: Institute of Medicine, Food and Nutrition Board . National Academy Press; 2002. 4. Layman DK. Dietary Guidelines should reflect new understandings about adult protein needs. Nutr Metab (Lond). 2009;6. doi:10.1186/1743-7075-6-12 5. Bauer J, Biolo G, Cederholm T, et al. Evidence-based recommendations for optimal dietary protein intake in older people: A position paper from the prot-age study group. J Am Med Dir Assoc. 2013;14(8):542-559. doi:10.1016/j.jamda.2013.05.021 6. Humayun MA, Elango R, Ball RO, Pencharz PB. Reevaluation of the Protein Requirement in Young Men with the Indicator Amino Acid Oxidation Technique 13.; 2007. https://academic.oup.com/ajcn/article/86/4/995/4649413 7. Rafii M, Chapman K, Owens J, et al. Dietary protein requirement of female adults >65 years determined by the indicator amino acid oxidation technique is higher than current recommendations. Journal of Nutrition. 2015;145(1):18-24.	

		to secure optimal proportions of plant and animal protein. In addition, the authors should acknowledge that a reduction in animal proteins also involves reduced intake of vitamin B12, calcium, zink, iodine, iron and other vitamins and minerals, which must be replaced by other food sources with generally lower content and/or bioavailability or taken as supplements in some cases. Furthermore, the authors refer to RDA as the "daily requirement". The definition of RDA is the minimal protein intake to prevent signs of inadequacy in 97% of healthy, active, young adults[3]. The RDA is the minimum to prevent detectable inadequacy based on short-term nitrogen balance. Thus, it is not necessarily the optimum intake level for good health. U.S. National Academy of Sciences states that a healthy range for protein intake is 0.8 g/kg (RDA) up to >2.5 g/kg (Upper Limit). Research proposes an optimum daily protein intake for adults in the range of 1.2 to 1.6 g/kg[4–7]. We ask the authors to highlight that RDA reflects minimum protein intake needed to prevent signs of inadequacy, and describe the healthy range for protein intake. Lastly, we are enquiring if there should be a clearer emphasis that amino acid requirements are absolute needs based on body weight and is best represented as grams/kilograms of body weight. The chapter repeatedly expresses protein needs as percentage of energy intake (E%). The relationship of protein to E% is inverse. At low energy intakes, the protein	doi:10.3945/jn.114.197517 8. Universitetet i Oslo, Mattilsynet, Helsedirektoratet. Norkost 3 - En Landsomfattende Kostholdsundersøkelse Blant Menn Og Kvinner i Norge i Alderen 18-70 År, 2010-11.; 2011. www.helsedirektoratet.no 9. Utviklingen i Norsk Kosthold 2022 Matforsyningsstatistikk Rapport. 10. Elango R, Ball RO, Pencharz PB. Recent advances in determining protein and amino acid requirements in humans. British Journal of Nutrition. 2012;108(SUPPL. 2). doi:10.1017/S0007114512002504	

		needs to constitute a higher percentage. While at high daily energy intake, the protein needs can be relatively low. The authors should consider to state that protein requirement is a function of body weight and that protein E% presupposes a certain/adequate energy intake level (4).		
Tanja Kalchenko	Physicians' and nutrition association Food for health	Good and in depth overview. But this with protein-quality, digestibility and animal sources vs plant sources is not in line with the last 10 years international scientific publications. Northern guidelines 2023 should be worlds mest modern and updated, not old-fashioned. "Everybody" agrees in 2023 that animal protein is not necessary, and even vegans get more than enough EEA I would like to refer to the following article (David L Katz et al, in Advances in Nutrition,) on this subject, together with its references: David L Katz, Kimberly N Doughty, Kate Geagan, David A Jenkins, Christopher D Gardner, Perspective: The Public Health Case for Modernizing the Definition of Protein Quality, Advances in Nutrition, Volume 10, Issue 5, September 2019, Pages 755–764, https://doi.org/10.1093/advances/nmz023 To summarise some of the points authors make (these are citations from the article above): "Prevailing definitions of protein quality are predicated on considerations of biochemistry and metabolism rather than	Page 5, first paragraph. The following claim is made: “However, protein digestibility and bioavailability may become an issue in protein transition towards more plant-based diets in vulnerable groups such as the elderly, as protein bioavailability is known to decrease with age.” This claim is not supported by relevant evidence. You are using an article referring to developing countries, as well as evidence in rats and/or pigs. Please provide a scientific reference including evidence (not an opinion) that suggests that digestibility and bioavailability are a cause of concern for the elderly in western countries. Page 6-8. Dietary intake in Nordic and Baltic countries. Please provide recommended reference values in the tables so that the reader can compare directly. Page 8, Obesity. You have used a lot of large SR else, but why do you use a cross-sectional study here? And without warning the reader about the limitations of such study design. Pages 8-9. Cardiovascular diseases and	Thank you for your comment. The text and references have been reviewed.

		the net effects on human health or the environment of specific food sources of protein. … The popular concept that protein is "good" and that the more the better, coupled with a protein quality definition that favors meat, fosters the impression that eating more meat, as well as eggs and dairy, is desirable and preferable. This message, however, is directly opposed to current Dietary Guidelines for Americans, which encourage consumption of more plant foods and less meat, and at odds with the literature on the environmental impacts of foods, from carbon emissions to water utilization, which decisively favor plant protein sources. Thus, the message conveyed by the current definitions of protein quality is at odds with imperatives of public and planetary health alike. " "The word "quality" implies superiority, but food sources of "high-quality" protein, as defined by existing metrics, do not reliably improve the quality of the diet or health. For example, consumption of certain animal sources of protein is associated with higher chronic disease risk (12), whereas consumption of protein-rich plant foods and adherence to plant-based dietary patterns are associated with more favorable health outcomes (12–14). " "The definition of protein quality is both misleading and antiquated. … the rationale for defining protein quality	diabetes. This section on CVD and type 2 diabetes has to be more clearly structured and the evidence needs to be updated with recent large cohort studies (also in this section): your source 65 and 68, and these Budhathoki S et al; Japan Public Health Center–based Prospective Study Group. Association of Animal and Plant Protein Intake With All-Cause and Cause-Specific Mortality in a Japanese Cohort. JAMA Intern Med. 2019 Nov 1;179(11):1509-1518. doi: 10.1001/jamainternmed.2019.2806. Erratum in: JAMA Intern Med. 2019 Oct 1;179(10):1448. PMID: 31682257; PMCID: PMC6714005. Song M, et al. Association of Animal and Plant Protein Intake With All-Cause and Cause-Specific Mortality. JAMA Intern Med. 2016 Oct 1;176(10):1453-1463. Page 13, Old adult. The sentence starting with "Frailty84 and sarcopenia85" lacks a verb. Proper epidemiological background should be provided - how many old adults are affected by frailty and sarcopenia? Who is particularly at risk and should be wary of their protein intake? Page 13, the title "The reasoning behind the upper intake range" should be changed into "Potential adverse effects of high protein intake". The title "The reasoning behind the upper intake range" can be moved two paragraphs upwards, when you are actually discussing the intake range. I assume you no	

		as a function of a food's essential amino acid composition is of questionable validity, at least for the populations of developed countries." "If PDCAAS is replaced by DIAAS in the United States, as proposed by the FAO, eligibility for protein content claims will change for some plant foods; some that were not eligible will become eligible and vice versa (27). Animal foods will continue to score highly. Regardless of which method is used, measures of protein quality that consider only content and distribution of essential amino acids can be misleading because they represent the biological value of a single nutrient in isolation, not the net effects of consuming the source of that nutrient. " "In light of this evidence, alternative regulatory frameworks have already been adopted by some other developed countries. … There is no evidence that a policy of ignoring protein quality while prioritizing overall dietary quality has led to any adverse effects on population health status in these countries. " "Although it has been argued that the DRIs should be increased for those consuming a vegetarian diet, to account for the reduced digestibility of plant proteins (41), they have not been increased because the findings of a meta-analysis of nitrogen balance studies showed no significant	longer discuss the old adult in these two paragraphs (?), but that is not completely clear for the reader. It would be best to actually conclude with the discussion on the range rather than potential adverse effects of high protein intake, so that discussion on adverse effects comes before. CONCLUDING SENTENCE: "WHO and Institute of Medicine recommendations recognize higher-protein diets as safe in individuals without CKD108,109." The references you are providing here are outdated (18 and 16 years old, respectively) and have to be replaced. Institute of Medicine no longer exists. Also, do you think this statement is still a valid conclusion, given your summary of associations between high meat intake, chronic diseases and increased mortality (pages 8-10)? Or are certain adjustments to this statement, like advising more caution about certain protein sources, warranted? It is not sufficiently justified why protein quality is used as a measure in this chapter, in spite of the method being highly controversial, and designed to favour the protein of animal origin, which, according to many studies, is associated with increased mortality and chronic disease risk. There is no evidence that would support the assumption that food items with higher protein digestibility are to be preferred in the western diets because their regular intake would result in positive health	

		effect of dietary protein source on protein requirements (42). It is also the position of the Academy of Nutrition and Dietetics that vegetarian and vegan diets generally supply adequate protein and essential amino acids when protein is consumed from a variety of plant sources throughout each day and energy needs are met (9)."	impacts - when compared to foods with lower protein digestibility. If protein quality will be used, it should be highlighted that the PDCAAS and DIAAS can be misleading (see the reference and justifications in general comment). Thus, full disclosure of the method limitations is warranted.	
Jeanette Elander	Sveriges Grisföretagare	Sveriges Grisföretagare, SGF, vill gärna lämna följande synpunkter på kapitel om protein. Det är angeläget att ha en nyanserad och evidensbaserad helhetssyn på olika former av protein och här behöver NNR2022 kunna bidra med reellt stöd. Kapitlets syfte är att beskriva den samlade evidensen för proteiners hälsomässiga betydelse, som bas för att sätta och uppdatera rekommendationer om intag. Kapitlet redovisar, i likhet med NNR2012, i stor utsträckning en balanserad syn på förhållandet mellan växtbaserade och animaliska proteiner och hur de kan kombineras i en sund kosthållning. SGF anser också att det är välkommet att författarna efterfrågar mer avancerade metoder samt långtidsstudier för att utvärdera skillnaderna mellan olika proteinkällor. Vidare är det positivt att författarna uppmärksammar Gilani S. med fleras studie (2018; Impact of Antinutritional Factors in Food Proteins on the Digestibility of Protein and the Bioavailability of Amino Acids and on Protein Quality) och det faktum att upptaget av proteiner (biotillgänglighet) kan bli problematiskt för känsliga grupper	SGF har noterat att studier visat att köttsubstitut som finns tillgängliga på den svenska marknaden har brister i näringsinnehåll och biotillgänglighet, inte minst när det gäller järn och zink. Se C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioaviability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. I frågan om ett grönt proteinskifte och biotillgänglighet finns ytterligare nya studier som bör uppmärksammas i kapitlet. Den låga uppskattade tillgängligheten av järn från extraherat och texturerat åkerbönsprotein bekräftas i en klinisk studie. Absorptionen av icke-hemjärn hos 27 kvinnor i fertil ålder var 4,2 % från måltider med texturerat åkerbönaprotein, 21,7 % och 9,2 % från nötkötts- respektive torskprotein, C. Mayer Labba (2022); Lower Non-Heme Iron Absorption in Healthy Females from Single Meals with Texturized Fava Bean Protein Compared to Beef and Cod Protein Meals: Two Single-Blinded Randomized Trials.	Thank you for your comments. The final chapter (starting at p. 4) now contains a brief review on what happens to the overall quality of a diet and nutritional status when animal-sources proteins are partially replaced with plant-sourced ones, taking into account the other (than protein) nutrient composition in a protein source. Both positive and negative changes occurs, which needs to be taken into account when assesing the healthiness of a diet.

		såsom äldre vid ett ökat intag av plantbaserade proteiner – detta därför att förmågan att tillgodogöra sig bl a protein minskar med stigande ålder. Detta är särskilt relevant i förhållande till risken för frakturer, som kapitlet också behandlar.		

7. Alcohol

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Wossenseged Birhane Jemberie	Umeå University	Hi, thank you for your work on updating the NNR 2022. I read the alcohol section with interest as I am a researcher studying alcohol use (disorder) among middle aged and older persons defined as 50+ years. I was hoping that this time, the recommendation will give a special focus on older persons given the following developments: 1. The Nordic population is ageing and ageing with higher alcohol consumption than previous cohorts 2. Currently, at least in Sweden alcohol consumption (including problematic use) is increasing among those 50+ years, more significantly among those 65 years and older. 4. About two-third of alcohol-related hospitalizations in Sweden are recorded among 50+, and 700 per 100000 people aged 60+ die due to alcohol-related causes 3. Finland has published a separate limit for older persons 65+years which is lower than the general population. 4. RARHA (the EU work group on reducing alcohol related harm, WP5) has reviewed the European guidelines regarding alcohol consumption among older persons and found it lacking 5. the NIAAA guideline states a lower risk drinking level in the US I think it might be useful to include other measures of health outcomes and health	Even if at this stage burden of disease is not included at this stage, some of the statements should be revised before going to the next stage. For example: Page 1 "All-cause mortality is not increased with light to moderate alcohol intake in middle-aged and older adults who do not engage in binge drinking". Page 16 "In conclusion, light to moderate drinking is not associated with increased mortality risk, it is on the contrary likely to be associated with a lower risk among middle-aged and older adults who do not engage in episodes of heavy drinking. " Page 17 "Alcohol consumption is associated with both negative and positive health effects. Current evidence from mainly conventional epidemiological studies suggests that a regular, moderate alcohol consumption confers a modest protective effects against myocardial infarction and possibly type 2 diabetes among middle-aged and older individuals, while alcohol consumption among young adults is detrimental, especially because of the tendency to binge	1. We agree that the Nordic population is ageing. Systematic reviews on how older people´s alcohol drinking and potential health issues have developed in the last decade are, as far as we can see non-existent. There are some recent reports, see for instance Tigerstedt et al (2020) on drinking habits in the Nordic countries. They emphasize the methodological problems but report that the most prominent changes in the trends of frequent drinking (> 2drinks/week) were found in Denmark (2010–2017), where drinking at least twice a week had decreased among 60–69-year-olds men and women, and in Sweden (2004–2017), where especially women had started drinking more frequently. The methodological difficulties, lack of systematic reviews on the interaction between age and the physiological effects of alcohol, and the different trends in the Nordic countries, made us decide to not go further into this issue. We will on the other hand, highly encourage further systematic research in this field. When it comes to the possible beneficial effects of alcohol, the issue gets even more complex. It is obvious, that cardio-benefits do not apply to persons <30 yrs of age while an intake of e.g. one drink per day may lower the risk of coronary heart disease in persons>50. However, when dealing with non-healthy fragile elderly, such 'advice' should of course not be given.

		status than all-cause mortality when talking about older persons and alcohol use. alcohol related morbidity including YLD is high in this population. I think similar rigorous review on older persons physiological changes, medication, drug-drug interaction, alcohol absorption, alcohol-drug interaction, alcohol-disease interaction, negative consequences which might be confused with effects of ageing (such as falling, cataract etc) can benefit the section. The only sentence that exists in the document is "All-cause mortality is not increased with light to moderate alcohol intake in middle-aged and older adults who do not engage in binge drinking." whose alternative formulation appears somewhere in the document. I think this statement is not adequate given that "binge drinking" is not defined within the document either. The statement is also prone to misunderstanding as no other health outcomes are reviewed. I hope the authors and the working group consider to include a more detailed and evidence-based section for older persons and alcohol use in this most important work of theirs. thank you Wossenseged Birhane Jemberie Umeå, Sweden	drinking in this age group." This might be in direct conflict to the result "For populations aged 50 years and older, cancers accounted for a large proportion of total alcohol-attributable deaths in 2016, constituting 27·1% (95% UI 21·2–33·3) of total alcohol-attributable female deaths and 18·9% (15·3–22·6) of male deaths. The level of alcohol consumption that minimised harm across health outcomes was zero (95% UI 0·0–0·8) standard drinks per week" GBD-related article published in Lancet (reference below) Griswold, M. G., Fullman, N., Hawley, C., Arian, N., Zimsen, S. R. M., Tymeson, H. D., Venkateswaran, V., Tapp, A. D., Forouzanfar, M. H., Salama, J. S., Abate, K. H., Abate, D., Abay, S. M., Abbafati, C., Abdulkader, R. S., Abebe, Z., Aboyans, V., Abrar, M. M., Acharya, P., … Gakidou, E. (2018). Alcohol use and burden for 195 countries and territories, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. The Lancet, 392(10152), 1015–1035. https://doi.org/10.1016/S0140-6736(18)31310-2 Moreover a definition for binge drinking, low risk drinking and moderate drinking should be given when writing those statements and specially how do we define those terms for older population group.	2. We certainly recognize that alcohol-related hospitalizations contribute to a substantial burden on the health care system. Our chapter is a description of the current status of knowledge on selected health issues where we use either incidence or mortality data as our outcome variables. The use of health care, because of alcohol-related disorders, is seen as health care research (highly dependent upon allocation of resources i.a.), and outside the main area of this chapter. 3. That is obviously of interest. The fact that the population is growing older, however, and that the proportion of quite healthy elderly is higher than before, makes it difficult to set sharp limits at a certain age. Why 65, and not 70? 4. We agree on that but maintain what we said above on lacking good information on the interaction between age and alcohol effects that have been published in systematic reviews. 5. We agree that a more rigorous review of older age physiology in conjunction with regular alcohol usage is needed. There is at the present no systematic review of this issue that we are aware of. Binge drinking is used as a term in many of the review articles. It is not a standardized entity, but we have included the definition used by CDC. We are of course aware of the Lancet paper by Griswold et al. but do not find that it applies to the present recommendations. The GBD study takes into account the whole population intake (rather poorly measured for countries such

				as the Nordic, who have their own much more specific data, by the way), but not effects on individuals of variations in intake (0, small, heavy).
Anna Maria Karlsen	FoodDrink Norway/NHO Mat og Drikke	The authors state that alcohol consumption is associated with both negative and positive health effects. Also, the strength of evidence for negative health effects varies, as discussed in the chapter. Nevertheless, a specified recommended limit for intake is presented, based on estimates. We ask that the NNR2022 chapter on alcohol should omit to present a limit for intake as this would vary in the population. In our opinion, a better solution would be to promote more general advice on responsible and moderate drinking.	None	There is much to be said for promoting more responsible and moderate drinking, which is already been undertaken by public health authorities, albeit with different emphasis and impetus in the Nordic countries. Indeed, one size does not fit all, but we believe that not setting a general upper recommended limit will lead to immediate demands for such.
Berit Elkjær	Fredensborg Sundhedscenter	This is a general comment on the final advice on alcohol. It must be recommended, that advice is given clearly about the increased risk of breast cancer for women even with a small intake of alcohol. And that you also look into the risk of traffic fatalities, violence etc. in society as a consequence of alcohol. Why not recommend that alcohol is not optimal on a daily basis, but can be included in limited quantities on festive occasions? At the same time, it could be pointed out that a greater availability of non-alcoholic drinks will increase the possibility of smaller amounts of alcohol being consumed.	This is a general comment on the final advice on alcohol. It must be recommended, that advice is given clearly about the increased risk of breast cancer for women even with a small intake of alcohol. And that you also look into the risk of traffic fatalities, violence etc. in society as a consequence of alcohol. Why not recommend that alcohol is not optimal on a daily basis, but can be included in limited quantities on festive occasions? At the same time, it could be pointed out that a greater availability of non-alcoholic drinks will increase the possibility of smaller amounts of alcohol being consumed.	We have not specifically reviewed mental issues, accidents, homicides, and suicides, that are associated with alcohol in this chapter. These causes of death will be encompassed in the all-cause mortality category. A low daily dose of alcohol is according to our report preferable to a high intake (binge drinking) on festive occasions. We agree that general advice on responsible drinking and greater availability of non-alcoholic beverages would be optimal.

Anna Maria Karlsen	FoodDrink Norway/NHO Mat og Drikke	The authors state that alcohol consumption is associated with both negative and positive health effects. Also, the strength of evidence for negative health effects varies, as discussed in the chapter. Nevertheless, a specified recommended limit for intake is presented, based on estimates. We ask that the NNR2022 chapter on alcohol should omit to present a limit for intake as this would vary in the population. In our opinion, a better solution would be to promote more general advice on responsible and moderate drinking.	None	There is much to be said for promoting more responsible and moderate drinking, which is already been undertaken by public health authorities, albeit with different emphasis and impetus in the Nordic countries. Indeed, one size does not fit all, but we believe that not setting a general upper recommended limit will lead to immediate demands for such.
Berit Elkjær	Fredensborg Sundhedscenter	This is a general comment on the final advice on alcohol. It must be recommended, that advice is given clearly about the increased risk of breast cancer for women even with a small intake of alcohol. And that you also look into the risk of traffic fatalities, violence etc. in society as a consequence of alcohol. Why not recommend that alcohol is not optimal on a daily basis, but can be included in limited quantities on festive occasions? At the same time, it could be pointed out that a greater availability of non-alcoholic drinks will increase the possibility of smaller amounts of alcohol being consumed.	This is a general comment on the final advice on alcohol. It must be recommended, that advice is given clearly about the increased risk of breast cancer for women even with a small intake of alcohol. And that you also look into the risk of traffic fatalities, violence etc. in society as a consequence of alcohol. Why not recommend that alcohol is not optimal on a daily basis, but can be included in limited quantities on festive occasions? At the same time, it could be pointed out that a greater availability of non-alcoholic drinks will increase the possibility of smaller amounts of alcohol being consumed.	We have not specifically reviewed mental issues, accidents, homicides, and suicides, that are associated with alcohol in this chapter. These causes of death will be encompassed in the all-cause mortality category. A low daily dose of alcohol is according to our report preferable to a high intake (binge drinking) on festive occasions. We agree that general advice on responsible drinking and greater availability of non-alcoholic beverages would be optimal.

8. Vitamin A

Name	Organization	General comments	Detailed comments	Comment from authors
Rikke Bekker Henriksen	DI Fødevarer / Danish Federation of Food & Drink	Thank you for giving us the opportunity to comment on the NNR 2022 chapters.	In Denmark the authorities (Fødevarestyrelsen) changed their recommendations for retinol/betacarotene bioconversion factor for food supplements some years ago, and last year (2021) also for foods. DK is now in line with Finland (among others) as well as EFSA (report 2015) and WHO/FAD, using the 1:6 conversion factor for both food and supplements. It is therefore very unfortunate for the industry, that the NNR remains to recommend bioconversion factor 1:2 for supplementary betacarotene and 1:12 for dietary. For many manufacturers of food supplements and fortified foods the consequences are, that they can not use the same packaging/labels on products for sale in the Nordic countries, since the nutritional values are different, despite the fact that the products are exactly the same. With this comment, we hope that NNR commitee will reconsider to change this recommendation.	We acknowledge this challenge and because several others have pointed out the confusions around terminology, we use the term RE and have changed the factor to 6:1 in line with recent European legislations.
Liisa Korkalo	University of Helsinki	The previous edition of NNR used the term 'retinol equivalents (RE)' in combined with the bioconversion factor 12 micrograms beta-carotene = 1 microgram of vitamin A. This created confusion because EFSA and WHO/FAO uses the same acronym but a different bioconversion rate and IOM uses the same bioconversion rate but different acronym. In other words, the combination of term+acronym and bioconversion rate used by the NNR was not in line with any of these other institutions. To avoid the continuation of this confusion, I propose		See response to commenter 1. We expect this to be covered by the background chapter on dietary intake in the Nordic and Baltic countries. We have noted the main sources in the Danish population as Danish children have excessive intakes.

		that in the 2022 edition, the NNR starts to use the term 'retinol activity equivalent (RAE)' combined with the bioconversion factor 12 micrograms beta-carotene = 1 microgram of vitamin A. Chapter 'Vitamin A intake in the Nordic and Baltic Countries': It might be useful to discuss not only average intakes in the Nordic and Baltic populations but also the main dietary sources. For example, the FinDiet 2017 study presents the sources for the Finnish adult population. In general, vegetables rich in beta-carotene are an important source for most people. For example, meat, fat-containing dairy products, and butter are relevant sources for those who consume these products, whereas vitamin A fortified margarines and other fat spreads are an important source for those who do not consume animal-source products (or consume them in small qualities), and those who consume fat-free dairy products but little or no other animal-source products.		
Dagny Løvoll Warming	Danish Veterinary and Food Administration	The Danish Veterinary and Food Administration would like to give the following comments as regards the conversion factor for vitamin A and β-caroten: For the purpose of labelling of food, and the declaration of vitamin A content in foods, there is per se not established harmonized conversion factors for vitamin A in the EU legislation. Therefore, we find it necessary to refer to guidance values that are based on established recognized		See response to commenter 1

		scientific evidence. In Denmark we have chosen to refer to the conversion factors established by the latest assessment of EFSA from 2015 - Scientific opinion on dietary reference values for vitamin A. EFSA journal 2015, 13(3):4028 - and therefore recommend the following conversion factors for vitamin A in our official guidance on nutrition declaration: 1 retinol equivalent (RE) = 1 µg retinol or 6 µg β-carotene. We note that the conclusion in this draft chapter of NNR2022 regarding conversion factors for vitamin A still differ from the conclusion of EFSA. As a food authority and management body we find it important that legislative measures and guidance tools are based on the most recent conclusive evidence. Therefore, it is of great interest to us what conclusions on conversation factors different scientific bodies reach and whether a scientific consensus can be established. We would also like to mention that a few issues might arise if food supplements and ordinary foods are to be (or are recommended to be) labelled based on very diverse conversation factors; e.g. in terms of compliance with legislative limits as well as consumer understanding.		

Livsmedelsverket	Livsmedelsverket		We believe that the units RE and RAE should not be interchangeably used in the revised version of the NNR since it contributes to, rather than avoids, confusion. As described in the chapter, to convert all sources of vitamin A into a single unit the terms 'retinol equivalents' (RE) or 'retinol activity equivalents' (RAE) are used. In a practical setting, it is causing a lot of confusion when, suggested by the authors, the unit "RE" is used for both RE (factor 6:1) and RAE (factor 12:1). Depending on what factor is being used you will end up with different values for total Vitamin A, e.g. in food composition tables and databases. When labelling fortified foods the Swedish regulation* calls for the use of RE i.e. a factor 6:1. If a food producer use the "RE" as described in NNR (which is actually the RAE) the value would be half of the actual RE. We get many questions about these issues already and were hoping for clarification in the revised NNR. Since the two terms currently used for Vitamin A activity are based on different conversion factors, there is a need to be very clear with what term is linked to what factor. Since the authors propose to keep the current conversion factor (12:1), the term RAE should be used. * https://www.livsmedelsverket.se/globalassets/om-oss/lagstiftning/berikn---kosttillsk---livsm-spec-gr-fsmp/livsfs-2018-5-kons-2019-5.pdf	See response to commenter 1

Riitta Freese	University lecturer, Department of Food and Nutrition, University of Helsinki, Finland	Since provitamin A carotenoids may be a marked source of vitamin A in plant-based diets, especialy in vegan diets, it could be relevant to include discussion on the use or RE vs. RAE in estimating vitamin A intakes and setting recommendations.	Introduction, Page 4 (especially the first paragraph): The vitamin A terminology used in the Introduction differs from the one used e.g. in nutrition textbooks where vitamin A refers to retinol and related compounds with the biological activity of retinol while the carotenoids that may act as precursors of vitamin A are referred as provitamin A. Although it is clear that retinol has to be oxidized to the active vitamin forms retinal or retinoic acid, classifying retinol as a precursor in the same group with provitamin carotenoids may be confusing. Perhaps the authors could clarify and unify the terminology used in the Introduction. Introduction, Page 4, last lines: the difference between RAE and RE systems is not only in the estimated conversion rates of betacarotene but also the other provitamin carotenoids. Perhaps this could be mentioned here? Introduction, page 5: 'The term RE will be maintained to avoid confusion…' To use the acronym RE with the equivalents calculated based on the conversion factors taken from the RAE system has certainly been a source of confusion in NNRs for a long time. Wouldn't it be finally the time to start to use the acronym RAE to correct the excisting confusion?	1. In the revised chapter we propose that the NNR adopts a conversion factor of 6/12:1 for β-carotene/other carotenoids. Indeed, this would have implications for estimated RE intake from plant sources. In our advice for setting new DRVs to the NNR committee, we have suggested that a clarifying statement is included in the final chapter version. Introduction, Page 4 (especially the first paragraph): The vitamin A terminology used in the Introduction differs from the one used e.g. in nutrition textbooks where vitamin A refers to retinol and related compounds with the biological activity of retinol while the carotenoids that may act as precursors of vitamin A are referred as provitamin A. Although it is clear that retinol has to be oxidized to the active vitamin forms retinal or retinoic acid, classifying retinol as a precursor in the same group with provitamin carotenoids may be confusing. Perhaps the authors could clarify and unify the terminology used in the Introduction. 2. We agree and have clarified. 3. See response to commenter 1.

Johanna Kaipiainen (M. Sc), Charlotta Hyttinen (M. Sc)	Finnish Vegan Association	Some may ask how vitamin A intake and status in vegans are. To our knowledge, retinol levels of adult vegans have been studied in one study. Serum retinol status was significantly lower in the vegan groups as compared to the omnivore group. However, the mean retinol levels in all groups were adequate and beta-carotene levels were higher in the vegan group (Schüpbach et al. 2017). This may be due, among other things, to the fact that the conversion of beta-carotene to retinol depends on the vitamin A needs, as well as to the increased importance of hereditary when retinol is not obtained directly from the diet (Tang 2010, Hendrickson et al. 2012). Beta-carotene levels measured in two other studies have been adequate as well (Waldmann et al. 2005, Elorinne et al. 2016). VItamin A intake has been adequate in most studies (Larsson and Johansson 2002, Waldmann et al. 2005, Sobiecki et al 2016, Elorinne et. al. 2016, Rehn 2019), but it was below the recommended in one danish study (Kristensen et al. 2015). References: Elorinne A-L, Alfthan G, Erlund I, Kivimäki H, Paju A, Salminen I ym. Food and nutrient intake and nutritional status of Finnish vegans and non-vegetarians. PLoS One 2016;11(2): e0148235.doi:10.1371/journal.pone.0148235 Hendrickson SJ, Hazra A, Chen C, Eliassen AH, Kraft P, Rosner BA, Willett WC. β-	Side 4-5: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Side 5: We think it would be better if the same retinol equivalents be used in EU, so in NNR would use same equivalents as in EFSA.	1. We thank Kaipiainen and Hyttinnen for their insight. We do not have reason to believe that vegans are at risk for vitamin A deficiency, and have not discussed this matter in the chapter. Side 4-5: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. 2. Thank you, this has now been clarified. We have kept the IOM abbreviation as the Institute of Medicine are listed as publishers of the Dietary Reference Intakes from 2001. Side 5: We think it would be better if the same retinol equivalents be used in EU, so in NNR would use same equivalents as in EFSA. 3. See response to commenter 1

		Carotene 15,15′-monooxygenase 1 single nucleotide polymorphisms in relation to plasma carotenoid and retinol concentrations in women of European descent. American Journal of Clinical Nutrition 2012;96(6):1379-89. Kristensen NB, Madsen ML, Hansen TH, Allin KH, Hop pe C, Fagt S ym. Intake of macro- and micronutrients in Danish vegans. Nutrition Journal 2015;14:115. Larsson CL, Johansson GK. Dietary intake and nutritional status of young vegans and omnivores in Sweden. American Journal of Clinical Nutrition 2002;76:100-6. Rehn S. Where do they get their protein from? Dietary nutrient intake of children in Helsinki day-care centres eating either vegan or omnivore meals. Pro Gradu. Helsingin yliopisto 2019. https://helda.helsinki.fi/bitstream/handle/10138/310171/Rehn_Sophia_Pro_gradu_2019.pdf?isAllowed=y&sequence=2 Schüpbach R, Wegmüller R, Berguerand C, Bui M, Herter-Aeberli I. Micronutrient status and intake in omnivores, vegetarians and vegans in Switzerland. European Journal of Nutrition 2017;56:283-93. Sobiecki JG, Appleby PN, Brandbury KE, Key TJ. High compliance with dietary recommendations in a cohort of meat		

		eaters, fish eaters, vegetarians, and vegans: results from the European Prospective Investigation into Cancer and Nutrition-Oxford study. Nutrition Research 2016;36:464-77. Tang G. Bioconversion of dietary provitamin A carotenoids to vitamin A in humans. American Journal of Clinical Nutrition 2010;9(5):1468S-1473S. Waldmann A, Koschizke JW, Leitzmann C, Hahn A. Dietary intakes and blood concentrations of antioxidant vitamins in German vegans. International Journal for Vitamin and Nutrition Research 2005;75:28-36.		
Michaela Ramstedt	Svensk Egenvård		Svensk Egenvård (Swedish self-care) is a trade organization that consists of suppliers of food supplements, herbal medicinal products, natural remedies, weight loss products and sports nutrition on the Swedish market. In the introduction section of the document "NNR2022 Vitamin A Public Consultation" (in the last two sentences + the list at the bottom of page 5) it is proposed that the current bioconversion factor for vitamin A:beta-carotene is maintained. Svensk Egenvård believes that the conversion factor 1:6 is more suitable for supplements than the proposed one (1:2) since it is used in, e.g., Denmark. Many companies sell their products (both supplements and foods) to all Nordic countries, label them in several languages and adapts the labelling information according to different national legislations. Therefore, in	See response to comment 1

			this case, it facilitates when the conversion factor is harmonized.	
Plant-food Sweden	Plant-food Sweden	A transition towards more plant-based food systems may become identified as one of the factors that would contribute to the vision of making the Nordic Region the most sustainable region in the world by 2030. It would be helpful to get an expert's opinion on the likely impact on vitamin A intake of transitioning from an animal-based to a healthy plant-based diet.	The authors of this chapter note that vitamin A intake may become excessive among children in some Nordic and Baltic countries, with health consequences such as decreased bone mineral density. Given the anticipated transition towards diverse and healthy plant-based diets, an expert discussion on provitamin A carotenoids as compared to retinyl esters is needed. Q1: What are the risks and benefits with diets predominantly rich in retinol equivalents (from plant-based foods), as compared to diets predominantly rich in retinyl palmitate (from animal foods) – and for which population groups? Q2: What is the expert opinion on fortification with provitamin A or vitamin A of plant-based foods, for example plant-based dairy and meat-analogues? For further reference, we wish to refer to the NNR preliminary Iodine chapter, where similar topics were addressed.	1. We believe this question to be out of scope for the current chapter and is part of larger discussion on dietary patterns with animal vs. plant-based foods. 2. The matter of fortification of plant-based foods with vitamin A is complex and out of scope of the current chapter, but it should be considered that usual intakes are generally adequate or even excessive across in all age groups in the Nordic and Baltic countries. High intakes of such fortified foods could therefore be problematic.

9. Vitamin D

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Merja Soilu-Hänninen	Tyks Neurokeskus	Suositeltava D-vitamiiniannos on liian pieni siihen nähden mitä muissa pohjoisen pallonpuoliskon maissa suositellaan ja millaiset annokset on katsottu turvallisiksi ja mistä on näyttöä esim autoimmuunisairauksien ehkäisyssä. 50 µg/vrk D-vitamiinia 5 vuoden seurannalla vähensi autoimmuunisairauksien ilmaantumista 22 %, linkki tässä: https://www.bmj.com/content/376/bmj-2021-066452. MS-taudin osalta on näyttöä ett' yli 100 nmol/L seerumitasot vähentävät MS-taudin riskiä 40% (Munger et al JAMA Neurol 2006) ja suomalaisesta äitiysneuvola-aineistosta on osoitettu D-vitamiinivajeen 2-kertaistavan MS-taudin riskin äidillä ja jälkeläisillä (Munger KL, Åivo J, Hongell K, Soilu-Hänninen M, Surcel HM, Ascherio A Vitamin D Status During Pregnancy and Risk of Multiple Sclerosis in Offspring of Women in the Finnish Maternity Cohort. . Munger KL. JAMA Neurol. 2016 May 1;73(5):515-9 .Munger ym arvioinut JAMA 2006 tutkimuksen perusteella että 70% MS-tapauksista USA:ssa ja Euroopassa voitaisiin estää nostamalla seerumin 25(OH)D taso väestötasolla ≥ 100 nmol/L. Annos joka tarvitaan nostamaan 25(OH)D lähelle 100 nmol/L on 1000 ja 4000 IU/vrk välissä (25-100 mg/päivä)	MS-taudn Käypä hoito-työryhmä suosittelee MS-taudin tukihoitona D-vitamiinilisää 50–100 mg/vrk:n annoksena. Hoidon tavoitteena on ≥ 100 nmol/l:n S-25(OH)D –taso	No comments due to language

Peter H Cobbold	Emeritus Professor, cell biology, University of Liverpool, UK	The science is out-of-date, grossly incomplete, and hardly worthy of serious consideration. The science of vitamin D embraces ca 5000 papers annually: large areas are completely ignored. D3 acts on several hundred genes in almost every tissue. The section on "physiology" is barely worthy of a 'pass' in an undergraduate examination. As a national guideline it is a disgrace.	The section on 'Physiology' does not embrace the autocrine and paracrine signals exerted by cytoplasmic 1,25(OH)D and its epigenomic activity at thousands of site to modulate expression of hundreds of genes in every tissue. In particular it wide-ranging actions on the immune system are not mentioned. Experts in the science of D3 regard the true, ancestral level of 25(OH)D as 100-150 nmol/L based upon sun-derived D3 in rural near-equatorial populations. Any guidelines that seek to advise lower serum levels should define why human evolution has been ignored. This section is a disgrace and requires extensive corrections and expansion.	As outlined in the manuscript, there is no evidence that recommendations should aim to achieve such high levels of 25(OH)D. We have briefly added some more possible extracellual effects with reference
Lars T. Fadnes	University of Bergen	The chapter provides a comprehensive overview of vitamin D, its physiological aspects, and its associations with morbidity and mortality. The chapter seems to give a good and well-balanced overview of the evidence on these aspects. The chapter argues there is convincing evidence to avoid deficiencies in vitamin and no additional health benefit from increasing the 25(OH)D levels above the sufficient levels (that were set as 25(OH)D <30nmol/l and ≥50nmol/l, respectively). The argument for these sounds reasonable. The discussion related studies looking specifically into the response of serum 25-hydroxyvitamin D concentration to vitamin D supplementation is unfortunately a bit short and limited. One meta-analysis on this aspect was conducted by Mo, Wang et al. (Eur J Clin Nutr 2019, see full reference below). Even though they used ≥75nmol/l as their main	See general comments	We agree, however dose-respons relations will be found in a separate supplement/chapter

		threshold for sufficient levels, they also presented analyses for ≥50nmol/l, and further provides sub-group analyses for high-latitude populations. Based on their findings, might it be reasonable to recommend slightly higher dosages of vitamin D (such as 1600 IU/40 µg/day), particularly in seasons with limited sun exposure? References: Mo M, Wang S, Chen Z, Muyiduli X, Wang S, Shen Y, Shao B, Li M, Chen D, Chen Z et al: A systematic review and meta-analysis of the response of serum 25-hydroxyvitamin D concentration to vitamin D supplementation from RCTs from around the globe. European journal of clinical nutrition 2019, 73(6):816-834.		
Hannu Vierola	Finnish Medical Association	100 % of Finnisn medical Clinicians know D recommendations are wrong and too low in all age groups. Only few has vit D over 70 nmol with these ancient recommendations. Specially oldies and pregnant women with dark skin are risk groups. In Finland and in Sweden somali mothers` children have huge autism. Nordisk D recommendations are risk for public health. At least 1 microg/ kg (Heaney, 2014j. Adults 50-100 microg D,every day. In summer less. Doctors do not follow too low recommendations, we measure D,level and recommend 50-100 microg for our patients! Time to fix recommendations as ,doctors and pharmacologist and pediatricians say.	Maybe Polish new D recommendations will help nutritionists for better understanding on D metabolism and suffiicient daily substitutions! https://www.mdpi.com/2072-6643/15/3/695	Not evidence based statements. As outlined in the manuscript, there is no evidence for such high doses

Puk Holm	Danish Agriculture & Food Council F.m.b.A	Thank you for the opportunity to comment on the chapter on vitamin D.	Page 2 – mid: "Mushrooms are natural sources of D2". The DTU Food database states a content of vitamin D and D2 in "champignon" of 0 micrograms / gram. This statement must refer to free range or otherwise be-lighted productions. Frida - (fooddata.dk) Most of the mushrooms consumed in Denmark is grown in house, and is therefore not, as such, a source of vitamin D.	We have specified so that it is clear in the text that chanterelle is a natural source of vitamin D2
Johanna Kaipiainen (M. Sc, RD), Charlotta Hyttinen (M. Sc)	Finnish Vegan Association	It should be revised, if current recommendation is sufficient to maintain optimal serum 25(OH)D level during winter in Northern latitudes, even in the case that that all vitamin D derived from food is in D2 form (This is the case when a vegan diet is followed). As mentioned in Appendix C, 10 µg/day recommendation in the UK, set by SACN, is based on a serum 25OHD concentration of 25 nmol/l as a target concentration, not on 50 nmol/l which is a target concentration in NNR. Authors of this draft also refer to a systematic review written by Christel Lamberg-Allardt et al. (reference 7). In the end of this review there is a conclusion: "In conclusion, if 97.5 % of the population up to 75 years of age is to maintain the target 50 nmol/l concentration of 25(OH)D, the corresponding intake of vitamin D would be 15 µg/day." It's also worth of noting that vitamin D recommendations in the Northern Hemisphere are often more than current recommendation in NNR (10 µg/day). The EFSA's recommendation for adults is 15 µg/day, and so is a recommendation set by National Academy	Page 2. It's worth of noting here, that so far, all plant-based fortified foods are fortified with vitamin D2, while all animal-based fortified foods are fortified with vitamin D3. Page 2. Plant-based is more proper term than vegetable-based Page 6-7, in chapter "Dietary intake in Nordic and Baltic countries". It should be emphasized here, that all vegans must supplement their diet with vitamin D at least during winter, because vitamin D intake from vegan diet is less than from a typical mixed diet. Reference: Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/) Page 10, 11 and 20. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	Comment regarding Page 2 is incorrect as vitamin D fortification in some Nordic countries are mainly D3. We have changed the word vegetable-based into plant-basede as suggested. Spesific recommendations to vegans is beyond the scope of this chapter.

		of Medicine (formerly Institute of Medicine). Austria, Germany and Switzerland have set a recommendation of 20 µg/day for adults. Reference: Spiro A, Buttriss JL. Vitamin D: An overview of vitamin D status and intake in Europe. Nutrition Bulletin 2014;39:322-50. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4288313/ Besides that, there have been published several RTC:s (in the Northern hemisphere) in which a dose needed for maintaining 50 nmol/l level has been more than 10–15 µg/day. References: Brett NR, Parks CA, Lavery P, Agellon S, Vanstone CA, Kaufmann M et al. Vitamin D status and functional outcomes in children aged 2-8 y: a 6-mo vitamin D randomized controlled trial. American Journal of Clinical Nutrition 2018;107:355-64. Cashman KD, FitzGerald AP, Viljakainen HT et al. Estimation of the dietary requirement for vitamin D in healthy adolescent white girls. Am Jour Clin Nutr 2011;93:549-555. Mortensen C, Damsgaard CT, Hauger H, Ritz C, Lanham-New S, Smith TJ et al. Estimation of the dietary requirement for vitamin D in white children aged 4–8 y: a randomized, controlled, dose-response trial. American Journal of Clinical Nutrition 2016;104:1310-7. Osmancevic A, Demeke T, Gillstedt M, Angesjö E, Sinclair H, El-Gavad GA, Landin-Wilhelmsen K. Vitamin D treatment in Somali women living in		

		Sweden – Two randomized, placebo-controlled studies. Clinical Endocrinology 2016;85:535-43. Smith TJ, Tripkovic L, Damsgaard CT, Mølgaard C, Ritz C, Wilson-Barnes SL et al. Estimation of the dietary requirement for vitamin D in adolescents aged 14–18 y: a dose-response, double-blind, randomized placebo-controlled trial. American Journal of Clinical Nutrition 2016;104:1301-9. Öhlund I, Lind T, Hernell O, Silfverdal SA, Karlsand Åkeson P. Increased vitamin D intake differentiated according to skin color is needed to meet requirements in young Swedish children during winter: a double-blind randomized clinical trial. American Journal of Clinical Nutrition 2017;106:105-12.		
Ann-Kristin Sundin	LRF	Dear NNR committee, Thank you for this opportunity to submit comments on the Vitamin D draft. Here are the comments from LRF: We believe that a further examination of the different effects of vitamin D3 and D2 would be in place. Based on both the reference used in the vitamin D draft (SACN, ref 5), and examples from the other, vast body of studies conducted more recently than the above mentioned reference, our opinion is that there is enough evidence to suggest that vitamin D3 is, indeed, more efficient in increasing the 25(OH)D plasma concentration than vitamin D2, and that 1. vitamin D3 is the preferred form of vitamin D as fortification agent, and 2. the differences between vitamin D3 and	Since the report from SACN is 10 years old, it would be interesting to incorporate more recent references into the Vitamin D draft/chapter, and not limit to only one. Here are a few examples of studies supporting vitamin D3 as being more effective than vitamin D2, dating 2011-2017: Tripkovic L, Lambert H, Hart K, Smith CP, Bucca G, Penson S, et al. Comparison of vitamin D2 and vitamin D3 supplementation in raising serum 25-hydroxyvitamin D status: a systematic review and meta-analysis. Am J Clin Nutr. 2012;95(6):1357-64. Shieh A, Chun RF, Ma C, Witzel S, Meyer B, Rafison B, et al. Effects of High-Dose Vitamin D2 Versus D3 on Total and Free	We will delete the last part of the sentence: ".....however inconsistency in results from studies assessing this have been reported"

		D2 need to be clearly communicated to consumers relying on fortified foods to fulfill their recommended intake of vitamin D. In detail: Page 2: The authors claim that "There is some evidence for D3 being more potent than D2 in raising vitamin D status in humans, however inconsistency in results from studies assessing this have been reported (5)." In reference 5 (SACN), paragraph 2.61, it is indeed stated that "Results from studies that have compared the effectiveness of D2 and D3 in raising serum 25(OH)D concentration have been inconsistent." However, the authors of SACN state that "Conclusions regarding any differences in biological activity between vitamin D2 and D3 could not be drawn from this meta-analysis because of a number of limitations, including: small number and size of studies (n=19-89); variability in 25(OH)D assay methodology (see chapter 4); differences in dose size and frequency and in treatment and follow-up time. Additionally, the doses used in the studies were very high and effects may be different at lower doses." SACN_Vitamin_D_and_Health_report.pdf (publishing.service.gov.uk) Further, the same reference states, in paragraph 2.62, that "Subsequent RCTs support the suggestion that vitamin D3 is more effective than vitamin D2 in raising	25-Hydroxyvitamin D and Markers of Calcium Balance. J Clin Endocrinol Metab. 2016;101(8):3070-8. Logan VF, Gray AR, Peddie MC, Harper MJ, Houghton LA. Long-term vitamin D3 supplementation is more effective than vitamin D2 in maintaining serum 25-hydroxyvitamin D status over the winter months. Br J Nutr. 2013;109(6):1082-8. Heaney RP, Recker RR, Grote J, Horst RL, Armas LA. Vitamin D(3) is more potent than vitamin D(2) in humans. J Clin Endocrinol Metab. 2011;96(3):E447- 52 Further, there is reason to believe that the effects of vitamin D2 and D3 supplements on 25(OH)D concentration are dose, sex, and time dependent, which would be valuable to note in the Vitamin D chapter. Hammami MM, Yusuf A. Differential effects of vitamin D2 and D3 supplements on 25-hydroxyvitamin D level are dose, sex, and time dependent: a randomized controlled trial. BMC Endocr Disord. 2017;17(1):12 Moreover, Tripkovic L et al (2017) conducted a 12 w randomized placebo-controlled food fortification trial, concluding that "Vitamin D3 may therefore be a preferential form to optimize vitamin D status within the general population." Tripkovic L et al. Daily supplementation with 15 µg vitamin D2 compared with vitamin D3 to increase wintertime 25-hydroxyvitamin D status in healthy South	

		serum 25(OH)D concentration. An RCT in New Zealand (Logan et al., 2013), conducted in winter, compared effects of 25 µg/d (1000 IU) of vitamin D2, D3 and placebo over 25 weeks on serum 25(OH)D concentration of adults (n=95; 18-50 y). After 25 weeks, serum 25(OH)D concentrations of participants in the placebo group were significantly lower than those in the vitamin D2 and D3 groups (both $p< 0.001$) and was significantly lower in in the vitamin D2 supplemented group compared with the vitamin D3 supplemented group ($p< 0.001$)." Based on this study from 2013, vitamin D3 is more effective in raising the 25(OH)D concentrations than is vitamin D2.	Asian and white European women: a 12-wk randomized, placebo-controlled food-fortification trial. Am J Clin Nutr. 2017;106(2):481-490.	
Plant-food Sweden and Plantebranchen	Plant-food Sweden and Plantebranchen	Plant-food Sweden and Plantebranchen welcome the opportunity to contribute to the public consultation on the draft NNR chapter on vitamin D. Fortified plant-based alternatives to dairy products are important to fulfil nutritional requirements in the diet of consumers who cannot or do not want to consume traditional dairy (1). Plant-based alternatives to dairy is often fortified with vitamin D2 as this is suitable also for vegan products. We would like to argue that vitamin D2 is equipotent to D3 with regard to raising vitamin D status if consumed on a regular (daily) basis (2). Dairy (both animal and plant-based) is often recommended on a daily basis,	Page 2: We agree on the importance of addressing bioavailability/health effects of vitamin D2 versus D3. We would, however, like to point out our concerns with the following statement (page 2): "There is some evidence for D3 being more potent than D2 in raising vitamin D status in humans, however inconsistency in results from studies assessing this have been reported" This sentence suggests that consumption of traditional milk may be advantageous with respect to vitamin D status. We do not believe that this correctly reflects the totality of evidence (see "general comment"). We, thus, suggest exchanging the old text in the paragraph (see above)	Concerning D2 versus D3, see our comment above. In addition, vegetable -based has been changed to plant-based

		usually 2-4 portions per day (3). There is some evidence of slight differences in bioactivity (2, 4). However, this appears to be of concern only during intermittent therapy such as when administered bi-weekly (2). Moreover, D2 and D3 have generally been considered to be equipotent in terms of rickets prevention and cure (2). Another important aspect is the lack of utility of serum 25(OH)D levels as a measure of bioavailability of vitamin D2 as compared to D3 (2, 5). The problem lies in the immunoassay of the biomarker, which shows lower 25(OH)D concentrations in the presence of 25(OH)D2 compared to D3 (5). Considering the lack of studies on health effects of vitamin D2 versus D3 (6) daily administration of vitamin D2 has been suggested to be equipotent to that of D3 (2). This question of parity when it comes to vitamin D2 and D3 needs to be addressed as a matter of urgency. Failure to consider the totality of evidence with respect to vitamin D2 versus D3 might cause insecurity from a health perspective in the many people who want to consume plant-based alternatives to dairy. Further, messaging that D3 is the preferred form of vitamin D may also negatively influence the speed and degree of the shift to healthy and environmentally friendly, plant-based food systems. In summary, we suggest that the following	for the following: "The bioactivity is slightly lower for vitamin D2 than for vitamin D3, but when taken regularly both forms provide a satisfactory vitamin D status." It is noteworthy that the Swedish Food Agency is currently using this statement (7). We recommend that the same consistent approach is followed. Page 2: We prefer the term plant-based drinks alternatively plant-based alternatives to milk to that used in the guidelines, namely vegetable-based alternatives to milk products, as most drinks are not based on vegetables but on cereals, legumes or nuts.	

		is taken into consideration: 1) Trials using daily supplementation of D2 or D3 are more relevant in the context of these recommendations than those including intermittent dosing and it is, in principal, only the latter (intermittent dosing) that have suggested D3 to be more potent than D2 in raising vitamin D status (2). 2) The lack of comparative trials of vitamin D2 versus D3 on clinical outcomes hampers the conclusion on differences in vitamin D status, given the analytical challenges in using 25(OH)D as a marker of vitamin D status (6). In fact, in clinical observational trials both forms of vitamin D (D2 and D3) have been successfully shown to prevent and cure rickets (2). For our detailed suggestions, see "detailed comments". REFERENCES: 1. Eustachio Colombo, et al. Designing Nutritionally Adequate and Climate-Friendly Diets for Omnivorous, Pescatarian, Vegetarian and Vegan Adolescents in Sweden Using Linear Optimization. Nutrients. 2021 Jul 22;13(8):2507. 2. Bouillon et al. Is Vitamin D2 Really Bioequivalent to Vitamin D3? Endocrinology. 2016: (157): 3384–3387.		

		3. Comerford, et al. Global Review of Dairy Recommendations in Food-Based Dietary Guidelines. Front Nutr. 2021 May 25;8:671999. 4. Balachandar et al. Relative Efficacy of Vitamin D2 and Vitamin D3 in Improving Vitamin D Status: Systematic Review and Meta-Analysis. Nutrients. 2021 Sep 23;13(10):3328. 5. Sara et al. Performance characteristics of six automated 25-hydroxyvitamin D assays: Mind your 3s and 2s. Clinical Biochemistry. 2015: 48: 1089-1096. 6. Wilson et al. Vitamin D deficiency as a public health issue: using vitamin D2 or vitamin D3 in future fortification strategies. Proc Nutr Soc. 2017 Aug;76(3):392-399. 7. https://www.livsmedelsverket.se/livsmedel-och-innehall/naringsamne/vitaminer-och-antioxidanter/d-vitamin (downloaded 2023-01-24)		
Swedish Food Agency	Swedish Food Agency	The chapters in NNR will be used as an important source of information for students and health professionals. Some statements only have a reference, but the detailed information is missing. This would work in a discussion of scientific paper, but if the chapter is used as textbook some more explanations would be useful. For example: Page 6, second para. "There is some evidence that the bioavailability differs between different food sources (6,	Page 4. "The Nordic and Baltic counties are situated within the "vitamin D winter window" where the UVB radiation from the sun is not sufficient for skin produce vitamin D part of the year. This requires oral sources to the vitamin to secure sufficient vitamin D status in the population." Could you please add a reference for this statement or rephrase to make it clear that this is a general assumption.	References have been adjusted as suggested

		7)". Is there any more information on this in these references? Please refer to SACN throughout the text (not SCAN).	Page 6. There is broad consensus that 25(OH)D levels below 25-30 nmol/l indicates vitamin D deficiency (5). Reference 5 is from year 2009. To avoid critique, could you add a more recent reference or rephrase? Page 7. "Concerning infants, EU legislations requires fortification of infant formula. In accordance with EU legislation, cereal-based products for infants/young children are fortified with vitamin D (4)". Please refer to the EU legislation and not ref 4.	
Torgrim Andersen	Privat	There is published a large Mendelian randomization study November 2022 that found that higher vitamin D levels decreased all cause mortality. "Odds of all-cause mortality in the genetic analysis were estimated to increase by 25% (odds ratio, 1.25 [95% CI, 1.16 to 1.35]) for participants with a measured 25-(OH)D concentration of 25 nmol/L compared with 50 nmol/L." https://www.acpjournals.org/doi/abs/10.7326/M21-3324?journalCode=aim The study Conclusion supports a causal relationship between vitamin D deficiency and mortality. Additional research needs to identify strategies that meet the National Academy of Medicine's guideline of greater than 50 nmol/L and that reduce the premature risk for death associated with low vitamin D levels.	If that is the case, shouldn't the available evidence for minimum D-vitamin be updated to also include "all cause mortality" In the Abstract and Introduction. Deficiency is defined less than 25-30 nmol/l. Circulating 25(OH)D is considered to be the most reliable biomarker for vitamin D-status in humans as it captures both dietary intake and cutaneous vitamin D-production. Consensus on cut-offs for defining biomarker-levels for 'sufficient', 'insufficient' and 'deficient', has been somehow hard to reach. However, based on available evidence there is a growing agreement that circulating 25(OH)D above 50 nmol/l corresponds to	Concerning vitamin D and mortality, we are aware of some methodological challenges in this and a similar study questioning the conclusion.

			sufficient level, and less than 25-30 nmol/l indicates deficiency (5-7).	
Torgrim Andersen	Privat	Regarding D-vitamin and calcium, isn't there a growing number of publications were K2 shows a key benefit in that equation? Where K2 plays a role in regulating where the calcium should be deposited. And reduce calcium build up in soft tissue and therefore also reduce risk of vascular damage. Some sample papers regarding vitamin K when it comes to calcium. The Medical Benefits of Vitamin K2 on Calcium-Related Disorders https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7926526/ Proper Calcium Use: Vitamin K2 as a Promoter of Bone and Cardiovascular Health https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4566462/ Vitamin K i norsk kosthold og beinskjørhet https://tidsskriftet.no/2001/09/aktuelt-problem/vitamin-k-i-norsk-kosthold-og-beinskjorhet	Page 5 Metabolism "Its main function is to stimulate the absorption of calcium from the intestine. In concert with parathyroid hormone, it also stimulates release of calcium from bone thereby increasing the concentration of circulating calcium."	Vitamin K 2 is beyond the scope of this chapter

10. Vitamin E

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments of the authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	No general comments.	Pages 3, 9 and 13. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	The Institute of Medicine has now been referred to as the US National Academy of Medicine. The changing of the name has been stated on page 2.
Swedish Food Agency	Swedish Food Agency	No general comments.	Page 2, 2nd paragraph: From this text it may be understood as α-TE should no longer be used, but yet it is mentioned in the chapter's recommendation e.g. for pregant women. Perhaps this paragraph could be revised for clarification.	In the paragraph we did not intend to write that α-TE should no longer be used, as many dietary recommendations around Europe still express the reference values in mg α-TE/day, and there are also differences in the food compositions tables whether a country includes α-tocopherol or α-TE, which has been mentioned by the EFSA (ref: Dietary Reference Values for vitamin E as α-tocopherol). We have now rewritten the paragraph and also continuesly use the expression mg α-TE/day in the recommendations. Please let us know if further clarification is needed.
			Page 3, 2nd paragraph: Consider writing anti-cancerogenic and anti-obesogenic instead of anti-cancer and anti-obesity, respectively.	Page 3, 2nd paragraph: we have now adapted the wording accordingly.
			Page 6, 1st paragraph: Regarding the statement that absorption of tocopherols and tocotrienols partly depend on adequate pancreatic function, would it be possible to expand on this or, alternatively, to give another reference? The current reference did not provide further explanation and neither was such information found in the reference cited in that publication.	We have now rephrased the sentence to make it more clear that pancreatic and biliary secretions are regiured for the formation of micelles, and also refer to the reference from "Traber 2007, Regulatory Mechanisms of Vitamin E". The new sentence reads as follows: "In the gastrointestinal tract,α-tocopherol requires biliary and pancreatic secretions in order to form micelles for subsequent uptake by the intestine"

			Page 10, 2nd paragraph: "In general, all countries reached the NNR2012 levels of reference intakes (RI) of dietary vitamin E, except Danish men." Would it be possible to include the RIs of NNR2012 in the text?	We have now provided the NNR2012 levels of RI in the manuscript, and also made a correction that also Estonian women did not reach the RI levels.
			Page 11, 2nd paragraph: Considering how the sentence is phrased ("Vitamin E deficiency is more frequently found in children"), is it possible to provide any information on how common/uncommon vitamin E deficiency is among children?	Unfortunately, we have not found any dedicated information on the prevalence of vitamin E deficiency in children and could not address this comment.
			Page 11, 3rd paragraph: Would it be possible to present the dose/range of doses of vitamin E supplements for which these drug interactions have been observed?	We have now added the dose information, as reported in the paper by Podszun and Frank, 2014, which refers to doses ≥ 300 mg/d supplemental alpha-tocopherol.
			Page 13, 2nd paragraph: A suggestion is to reconsider the first sentence stating that the evidence of the role of vitamin E supplementation for the prevention of cardiovascular disease and stroke is contradicting. Considering the relatively tight regulation of vitamin E absorption described earlier in the chapter, it may not be unlikely that there are potential beneficial effects for vitamin E intake but not for vitamin E supplementation (perhaps depending on the vitamin E status of study participants)?	We have now rephares the sentence by summarizing the evidence first for dietary alpha-tocopherol intake and focus in the later sections on supplemental alpha-tocopherol.

11. Vitamin K

Name	Organization	General comments	Detailed comments	Comments from authors
Anna Maria Karlsen	NHO Mat og Drikke / FoodDrinkNorway	We have noticed that the paper discusses the lack of knowledge regarding vitamin K, including absorption of dietary vitamin K from different sources such as vegetables vs. meat and dairy products. Nevertheless, the draft concludes that a diet rich in plant-based foods is a sustainable choice to impact vitamin K intakes in the population (page 8, 8. Requirement and recommended intakes – Data gaps for future research). The NNR2022 food-based dietary guidelines will integrate environmental sustainability aspects, and several background papers are under preparation. So far, only the first paper is released for public consultation. It is our opinion that the NNR2022 chapter on vitamin K should avoid concluding sustainability until all background papers are completed.		We have deleted the sentence and wait for the chapters on sustainability to be published.
Karianne Henriksen	Animalia AS og MatPrat/Opplysningskontoret for egg og kjøtt	Key points • Due to limited knowledge on vitamin K and lack of qualified systematic reviews, the evidence is insufficient to conclude that favorable sources of vitamin K are mainly plant-based foods. • It is premature to draw the conclusion that plant-based foods are more sustainable to secure vitamin K intake in the public. This disregards the role of meat and dairy products.	We would like to refer to page 5, "Dietary intake in the Nordic and Baltic countries", lines 5-6: "Dietary sources of menaquinone-4 include animal meats and dairy products." The term «meat» has been defined by the EU regulation on food information to consumers as sceletal muscles of mammalian and bird species recognised as fit for human consumption (3). «Meat» is generally known as the muscles of slaughtered animals meant for human consumption	We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" and wait for the chapters on sustainability to be published. As suggested, we have corrected the term as meat.

		According to the authors of this chapter it is a general lack of knowledge regarding vitamin K. This is also emphasized by the fact that the authors were unable to identify qualified systematic reviews for vitamin K. The authors point out that the number of systematic reviews and meta-analyses on vitamin K is limited. The authors state that little is known about the absorption of dietary vitamin K, and less is known about the absorption of dietary menaquinone than of phylloquinone. Dietary sources of menaquinone include meat and dairy products. According to the authors, there is little information on the content of menaquinone from meat and dairy products. Bovine meat in Norway has been analyzed for total vitamin K, phylloquinone, K1, menaquinone, MK4, and menaquinone MK7 (1). The study found a relatively high variation in content of the different forms of vitamin K. The results showed that almost half of the samples had a high enough content of total vitamin K to be labelled «a source of vitamin K». It has been shown that vitamin K in bovine meat can be increased by supplementation of feed (2). Thus, there is a potential to make meat products an even more important source of vitamin K. The chapter states that phylloquinone is generally regarded as the predominant form of vitamin K in the Western diets.	(4). Thus, we find the most correct term is «meat», not «animal meat». Alternatively, «meat» and the name(s) of the animal species from which it comes. References 3. European Parliament and the Council of the Euorpean Uniion. REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. 2011. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011R1169#ntr2-L_2011304EN.01005101-E0002. Accessed July 6, 2022. 4. Store norske leksikon. Kjøtt. https://snl.no/kjøtt. Published 2020	

		However, the limited knowledge on menaquinone content in foods complicates the dietary intake assessment. We therefore find the conclusion "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" is in significant contrast to the limited knowledge on vitamin K. The authors conclude that: "More knowledge is needed in order to give more evidence-based recommendations for vitamin K intake." Based on the limited number of studies on the content of vitamin K in food, we believe it is premature to disregard meat and dairy products as a source of menaquinone. We therefore suggest that the authors reconsider these statements. Moreover, the conclusive remarks which allege that sustainable vitamin K sources are plant-based, is lacking evidence but is also premature as the chapters and work on environmental sustainability are not completed. References 1. Egelandsdal B, Oostindjer M, Hovland EM, et al. Identifying labelling and marketing advantages of nutrients in minced beef meat: A case study. Meat Sci. 2020;159. doi:10.1016/j.meatsci.2019.107920 2. Haug A, Vhile SG, Berg J, Hove K, Egelandsdal B. Feeding potentially health promoting nutrients to finishing		

		bulls changes meat composition and allow for product health claims. Meat Sci. 2018;145(June):461-468. doi:10.1016/j.meatsci.2018.07.015		
Jette Jakobsen	DTU Food	Its always nice to read a review.	Abstract -do not mention the scarce information on vitamin K2 even this is mentioned several times in different section e.g. , the estimation of dietary intake of enaquinones is challenging as the food composition databases have limited information on menaquinone contents (introduction) and "Generally, little is known about differences between the different vitamin K forms with regard to their physiological functions. It is not clear whether menaquinones are more effective than phylloquinone in terms of their capacity for carboxylation (activation) of VKDPs (Psysiology). -The statement: "Phylloquinone is generally regarded as the predominant form of vitamin K in the Western diets; however, the limited knowledge on menaquinone contents in foods complicates the dietary intake assessment" is taken from the section: Dietary intake in Nordic and Baltic countries. However, this statement has NO reference, and no former justification is shown. Due to the very limited/scarce data on the menaquinones in food, "general regarded" I find ishould not be provided in NNR. The reason is sole because we have so scarce information on vitamin K2 in food. Which is stated in the	we have added the “limited information on menaquinones contents on foods” in the abstract.We have added the missing reference (line 161).It is not possible to report separately vitamin K1 and K2 or menaquinones. This is said in the recommendations part, lines 262-263. We use term DRV, not “average requirement”.Thank you for the suggestions to on toxicity part. We have edited the sentence to keep the original meaning. We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes” and wait for the chapters on sustainability to be published.

			Section for Dietary intake: Results on dietary intake should be interpreted cautiously as food composition databases may have limitations and vitamin K content data mostly include only phylloquinone, not menaquinones . Method - In the litterature seach I miss words which will capture new data for vitamin K in food Dietary intake -This text these to specify K1, and which MKs are included in the referred studies. E.g. …Intake is estimated to be 115 µg/d in adult men and 110 µg/d in adult women in Finland; … estimated to be 286 µg/d in adult men and women in Latvia…..availability of vitamin K (phylloquinone + menaquinone-4) was estimated to be 184 µg/d. Not possible to differentiate between K1 and MK4?. -It seems to be omitted that for vitamin K it is not possible to set an average requirements etc due to lack of information. Therefor the use of "adequate intake". This information should be added. Toxicity - last sentence refer to SCF. I find there is a discrepancy between the conclusion in the report from SCF and the text in NNR: SCF concluded that there was no appropriate evidence to derive a tolerable upper intake level	

			(UL) for vitamin K. The Panel notes that revising the UL for vitamin K is not within the scope of the present Opinion". Gaps - The statement: Sustainable food choices favouring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes. I find should be reworded. If a person have a sole plant-based diet, the person omit the vitamin K in product of animal origin in which we know has high amount of the longer MKs e.g. cheese.	
Lena Leder	Kappa Bioscience AS		Page 6: In the section "Toxicities" it is written that "Menaquinone-7 (MK-7) has been evaluated to be safe when ingested as a dietary supplement with doses ranging from approximately 50 µg/d up to 600 µg/d" [1]. This sentence is, however, misleading as these numbers are related to what product labels typically recommend and not a toxicity level. EFSA has not set a tolerable upper intake level (UL) for vitamin K [2]. In rats, the NOAEL for MK-7 is 10 mg/kg body weight/day, which was the highest dose tested. MK-7 was administered orally to the animals for 90 days [3]. In a human intervention study, no	We agree that EFSA has not set UL for vitamin K. The sentence considered to be misleading, does not tell about toxicities, instead safety. Vitamin K is available as supplements in Nordic countries which supports including the sentence. We would not use the ref #4 by De Vriese et al. in the chapter as the study was done in hemodialysis patients, in whom the vitamin K metabolism may differ from that in heathy adults.This meta-analysis was not included in the review as it assessed the combination of vitamin K and vitamin D, not vitamin K alone.

			adverse events related to the intake of 2000 µg MK-7 thrice weekly during an 18-months study period were reported [4]. This dosage corresponds to ~857 µg MK-7 per day. The most abundant dietary source of MK-7 is natto, a traditional Japanese food, which contains ~1 mg MK-7/100 g [5]. Thus, there is a history of human consumption of MK-7, supporting the general safety of this vitamin K2 compound in humans. Page 7: Update on the literature: In the section "Osteoporosis" a more recent meta-analysis with RCTs should be included. This meta-analysis of RCTs shows that the combination of vitamin K and D can significantly increase the total bone mineral density and significantly decrease undercarboxylated osteocalcin [6] References 1. Marles, R.J., A.L. Roe, and H.A. Oketch-Rabah, US Pharmacopeial Convention safety evaluation of menaquinone-7, a form of vitamin K. Nutr Rev, 2017. 75(7): p. 553-578. 2. Turck D, et al., Scientific Opinion on the dietary reference values for vitamin K. EFSA Journal, 2017. 15(5): p. 4780. 3. Pucaj, K., et al., Safety and	

			toxicological evaluation of a synthetic vitamin K2, menaquinone-7. Toxicol Mech Methods, 2011. 21(7): p. 520-32. 4. De Vriese, A.S., et al., Multicenter Randomized Controlled Trial of Vitamin K Antagonist Replacement by Rivaroxaban with or without Vitamin K2 in Hemodialysis Patients with Atrial Fibrillation: the Valkyrie Study. J Am Soc Nephrol, 2020. 31(1): p. 186-196. 5. Schurgers, L.J. and C. Vermeer, Determination of phylloquinone and menaquinones in food. Effect of food matrix on circulating vitamin K concentrations. Haemostasis, 2000. 30(6): p. 298-307. 6. Kuang, X., et al., The combination effect of vitamin K and vitamin D on human bone quality: a meta-analysis of randomized controlled trials. Food Funct, 2020.	
Christiane Hoffmann	Kjøtt- og fjørfebransjens Landsforbund	KLF supports the scientifically relevant input from Animalia / MatPrat. We would like to point out again, that whether plant-based foods are more sustainable isn't concluded yet. Therefore, the role of meat and dairy products shouldn't be disregarded, also with regards to vitamin K intake of the public.		We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" and wait for the chapters on sustainability to be published.
Rikke Bekker Henriksen	Danish Federation of Food & Drink (DI Fødevarer)	Thank you for the opportunity to commend on the NNR 2022.	We have one short comment on page 8, in chapter "Data gaps for future research". It is mentioned several times in the report, that there is limited knowledge on vitamin K and lack of qualified systematic reviews. Therefore, we find that the evidence is	We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" and wait for the chapters on sustainability to be published.

			insufficient to conclude that favorable sources of vitamin K are mainly constituted by plant-based foods. It is also concluded that plant-based foods are a more sustainable source to vitamin K intake. Since the NNR 2022 will integrate sustainability in a later stage (according the disclaimer to the chapter), the conclusions on sustainable diets in this chapter should be avoided until sufficient evidence is available.	
Puk Maia Ingemann Holm	Danish Agriculture and Food Council		• According to the Abstract: "Menaquinones contribute less to vitamin K intake in Western diets" - This statement is not documented in the text. It is mentioned multiple times that information on dietary intake of K2 is scarce due to very limited knowledge of the content of K2 in food. Should be deleted regarding the intake i.e. aligned with the text. • According to the paragraph Dietary intake in Nordic and Baltic countries: The estimated intake needs to specify weather it covers vitamin K1 and K2 or only K1. Further, it seems to be omitted that for vitamin K it is not possible to set an average requirement etc. due to lack of information. Therefore, the use of "adequate intake". This information should be added to the text. • According to the paragraph about Toxicity: The SCF concluded that there was no appropriate evidence to derive a tolerable upper intake level (UL) for vitamin K. The Panel notes that revising the UL for vitamin K is not within the	We have edited the abstract by adding "limited information on menaquinones contents on foods".the dietary intake is reported as total intake, unfortunately there is no separate information on VK1 and VK2. The limitations to set average requirements (DRV) is mentioned in the Recommendations part, lines 262-263. This is clarified in the text.the word used in NNR2012 is a provisional recommended intake.We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" and wait for the chapters on sustainability to be published. We have not included other suggested functionalities of vitamin K in the review due to limited evidence. The limited

			scope of the present opinion. This should be appropriately corrected in the text. • According to the paragraph Recommendations: "In NNR 2012 a provisional recommended intake of 1 µg phylloquinone/kg bodyweight per day…." – is recommended the correct word? Maybe replaced by adequate. • According to the conclusions: Due to the limited knowledge on vitamin K, mentioned too several times in the text, and upon that lack of qualified systematic reviews, the evidence is clearly insufficient to conclude that favorable sources of vitamin K are mainly constituted by plant-based foods. We also find it premature to draw the conclusion that plant-based foods are a more sustainable source to vitamin K intake in the Nordic populations. This disregards the role of meat and dairy products. The authors state that little is known about the absorption of dietary vitamin K, and less is known about the absorption of dietary menaquinone than of phylloquinone. Dietary sources of menaquinone include meat and dairy products. • It should be added to the text that recent testing of menaquinones has suggested that K1 and K2 have different and further functionalities than previously known. In addition, new methods of testing the vitamin in it´s different forms have been tested and found valid.	knowledge of menaquinone content in foods is mentioned a couple of times in chapter and more information would be needed to edit the text.

			References: Mehta et al. Vitamin K (2021) chapter under Books https://www.intechopen.com/chapters/78499 Xueyan et al. Measurement of Multiple Vitamin K Forms in Processed and Fresh-Cut Pork Products in the U.S. Food Supply (2016) J Agric Food Chem https://pubmed.ncbi.nlm.nih.gov/27191033/ Jensen, M. B., Ložnjak Švarc, P., & Jakobsen, J. (2021). Vitamin K (phylloquinone and menaquinones) in foods - Optimisation of extraction, clean-up and LC-ESI-MS/MS method for quantification. Food Chemistry, 345, [128835]. https://doi.org/10.1016/j.foodchem.2020.128835	
Ellen Ulleberg	Norwegian Dairy Council		The overall message in the vitamin K chapter seems to be that there is a general lack of research on the absorption and metabolism of different vitamin K variants. Analysis of vitamin K content of different food sources (eg. for food of animal origin) is also missing, and the information found in the food composition databases are therefore of limited use. Due to this lack of data for vitamin K, we find it premature to conclude in the abstract that vitamin K from animal sources contributes little to the overall vitamin K intake. As stated in the chapter, limited data on the vitamin K	We have edited the abstract by adding "limited information on menaquinones contents on foods". We would not point specifically fermented dairy and cheese in the dietary intake part. One US paper has reported that milk also contains menaquinones (Fu X, et al. Multiple Vitamin K Forms Exist in Dairy Foods. Curr Dev Nutr. 2017 Jun 1;1(6):e000638. doi: 10.3945/cdn.117.000638.). We acknowledge that cheese contains higher amounts, but as the consumption amounts of

			content of food weakens the overall estimations of vitamin K intakes in the Nordic and Baltic countries. More extensive mapping of the vitamin K content of food, including bioavailability and absorption from different sources is needed to close this knowledge gap. As an example, the ability of substances to inhibit vitamin K metabolism, such as tocopherylquinone, a vitamin E metabolite that is similar in structure to vitamin K, should be taken into consideration (1). In section 6. Dietary intake in Nordic and Baltic countries it should be specified that vitamin K from dairy products is found in certain fermented dairy such as particular types of cheese and fermented milk. Several recent articles have showed that the vitamin K content of different cheese types vary (2-4). As for the health effects of vitamin K, EFSA concluded that "a cause and effect relationship has been established between the dietary intake of vitamin K and the maintenance of normal bone and normal blood coagulation" (5). This should be mentioned in the chapter. Finally, in the disclaimer it is mentioned that sustainability is a topic that will not be covered until later. Nevertheless, in section 8, Requirement and recommended intakes under Data gaps	liquid dairy can be high (at least in Finland), they can contribute to the total intake. Regarding bone health and blood coagulation we rely on newer systematic reviews that our literature search gave, and did not therefore mention the health claim assessment of EFSA. We have deleted the sentence "Sustainable food choices favoring plant-based foods and production methods like fermentation may beneficially impact vitamin K intakes" and wait for the chapters on sustainability to be published.

			for future research, plant-based foods and production methods are mentioned as sustainable food choices that may provide vitamin K to the diet. This assumption is made even though no data on such products are covered in the review and is nevertheless premature as the background papers on sustainability are not yet published. References 1. Food Safety Authority of Ireland (2020) The safety of vitamins and minerals in food supplements – establishing tolerable upper intake levels and a risk assessment approach for products marketed in Ireland. ISBN 978-1-910348-10-9. 2. Jensen MB, Daugintis A, Jakobsen J. Content and Bioaccessibility of Vitamin K (Phylloquinone and Menaquinones) in Cheese. Foods. 2021; 10(12):2938. https://doi.org/10.3390/foods10122938 3. Walther, B, Guggisberg, D, Schmidt, RS, Portmann, R, Risse, M-C, Badertscher, R, Chollet, M Quantitative analysis of menaquinones (vitamin K2) in various types of cheese from Switzerland. Int. Dairy J. 2020, 112, 104853. 4. Lundberg HE, Glasø M, Chhura R, et alEffect on bone anabolic markers of daily cheese intake with and without vitamin K2: a randomised clinical trialBMJ Nutrition, Prevention & Health 2022;e000424. doi: 10.1136/bmjnph-2022-000424	

			5. EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA); Scientific Opinion on the substantiation of health claims related to vitamin K and maintenance of bones (ID 123, 127, 128 and 2879), blood coagulation (ID 124 and 126), and function of the heart and blood vessels (ID 124, 125 and 2880)pursuant to Article 13(1) of Regulation (EC) No 1924/2006 on request from the European Commission. EFSA Journal 2009; 7 (9): 1228. [20 pp.]. doi:10.2903/j.efsa.2009.1228. Available online: www.efsa.europa.eu	

12. Thiamin

Name	Organization	General comments	Detailed comments	Comment from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 4, Chapter "Dietary intake in Nordic and Baltic countries". Maybe the high prevalence of people with intake below EAR should be mentioned here. According to Nutrition in Finland – The National FinDiet 2017 Survey 25 % of women and 36 % of men had thiamin intake below EAR. Valsta L, Kaartinen N, Tapanainen, Männistö S, Sääksjärvi K. Ravitsemus Suomessa – FinRavinto 2017 -tutkimus [Nutrition in Finland – the National FinDiet 2017 Survey]. Institute for Health and Welfare (THL). Helsinki, Finland 2018. Available: https://www.julkari.fi/handle/10024/137433	This report is only available in Finnish, except for a summary. Since EAR is an average, some data will be represented as below average per definition. Lower intake (LI) should also be considered in order to assess population intake. However, since the report is written in Finnish I have not been able to find this. Have the other vitamins mentioned as below EAR recieved the same or a similar comment? If that is the case, a suggestion is that the responses to these comments are coordinated for these chapters.
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for the opportunity to give feedback on the Thiamin draft. Here are the comments from LRF Sweden. The authors state how important animal foods are as sources of thiamin. Referring to this, and other drafts on various nutrients and dietary factors, we would like to emphazise the importance of animal foods in the diet in the Nordic and Baltic countries, and rely on the NNR Committee to see to that this observation is reflected in the NNR 2022 in such a way as to recognize animal foods as nutritious and healthy parts of a balanced, varied and healthy diet.	Under Dietary intake in Nordic and Baltic countries, it is stated that "major food sources of thiamin in the Nordic diet are cereals and cereal products, meat and meat products, and milk and dairy products." However, in the last paragraph of Introduction, it is stated that "good dietary sources are most meats, eggs, fruits and vegetables. Rich dietary sources are yeast, organ foods and lean pork as well as pulses, nuts, wheat bran, oatmeal and whole-grain cereals. Milk, however, has a relatively low content of thiamin." Since milk and dairy are among the major food sources of thiamin in the Nordic and Baltic countries, we would suggest the following formulation instead: "Rich dietary sources are yeast, organ foods and lean pork as well as pulses, nuts, wheat bran, oatmeal and whole-grain cereals. Good dietary sources are most meats, eggs, fruits	Considered and adjusted. We find this comment relevant and of course the amount of food consumed matters for intake. Suggestion for a new phrasing is introduced in the chapter on this, where *content* is used instead of *source* and a sentence on consumption is added.

			and vegetables. Another dietary source is milk. Even though milk has a relatively lower content, it is still one of the major sources in the diet."	
Johanna Eén	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment upon the thiamin draft. Please find below the comments from Svenskt Kött (´Swedish Meat´).	As mentioned in the draft, only a few studies have explored relationships between thiamin intake and function, and few studies have examined the effects of supplements on various clinical or biochemical outcomes. Although the studies do not provide guidance for new recommendations, the authors clearly describe the importance of thiamin for the metabolism as well as the major food sources in the Nordic diet (cereals, meat and meat products, milk and dairy products, mentioning eggs, fruits and vegetables as other good sources). Thiamin deficiency can cause severe conditions. We therefore call upon the NNR Committee to further emphasize the importance of a balanced and healthy diet including foods of animal origin.	Considered. Thiamin is one of many micronutrients where animal-source food is an important contribution in the (current) diet. Since there are many thiamin-rich sources we should refrain from giving specific recommendations regarding one specific source in this chapter.

13. Riboflavin

Name	Organization	General comments	Detailed comments	Comments from authors
Evy Peltola, Johanna Kaipiainen, Charlotta Hyttinen	The Finnish vegan society	"Riboflavin is also present in foods of plant origin and should be mentioned also here: e.g. almonds, mushrooms, soy and fortified plant based milk alternatives. Plant based milk alternatives are widely fortified with riboflavin."		Adjusted according to comment
Elisabet Rytter	Swedish Food Federation		On page 7 (line 4) it says: "It has been reported that vegan diets, in particular, may not be able to supply sufficient amounts of riboflavin (26), although intake has also been reported to be similar between omnivores, vegetarians, and vegans, suggesting that the concern may not be very severe (27).". The expression "not very severe" is not in line with the two references (26 and 27). Reference 26 shows veganism is associated with low intake (not deficiency), reference 27 shows adequate intake. To lump together this into, on average, "not very severe" is in our mind not correct. There is neither no assessment of which of the two reviews that is more valid. Given that both reviews are equally valid, a more balanced and fair statement would be: "It has been reported that vegan diets, in particular, may not be able to supply sufficient amounts of riboflavin (26), although intake has also been reported to be similar between omnivores, vegetarians, and vegans (27). These divergences may reflect differences in diets in the different study	Adjusted according to comment

			populations*, and also suggests that it is possible to adequatly meet the requirement of riboflavin with vegan diets." * One of the studies (reference 26) looked at European populations only, whereas the other included all regions including North-american and Asia (reference 27).	
Livsmedelsverket	Livsmedelsverket		Page 5, figure 3: It is not clear, neither from the figure nor the legend, how riboflavin metabolism interacts with the presented environmental factors. Would it be possible to clarify this? Page 2, second paragraph, line 2: In the first sentence, the term "vitamin B2" is used, whereas the earlier parts of the chapter mainly uses "riboflavin". Is this discrepancy intended? Page 5, second paragraph, lines 2-3: "The need may also increase with age due to impairment in absorption." At about what age does absorption start to decline? Even if it is not possible to give an exact age, it would be informative to indicate whether this starts around middle age, older age, etc. Furthermore, this decline is however not pronounced enough to recommend higher intakes among older people? Page 8, first paragraph, lines 1-2: The relative risk estimate and 95% CI are presented twice within the same sentence, most likely a typo.	Adjusted according to comment

14. Niacin

Name	Organization	General comments	Detailed comments	Comments from authors
Elisabet Rytter	Swedish Food Federation		At page 3, under heading "Physiology", the following foods are mentioned as rich dietary sources of niacin; meat, eggs, fish, dairy, legumes and some cereals (in that order). At page 4, under heading "Dietary intake in Nordic ad Baltic countries" is written that niacin occurs in foods such as meat, fish and pulses. We suggest that the foods mentioned as rich dietary sources of niacin (at page 3) also should be mentioned at page 4. Now, for example, dairy and cereals are mentioned as a rich dietary source at page 3, but are not included in foods where niacin occurs, at page 4. If there is sufficient data, the foods should be mentioned in descending order (according to their contribute to intake of niacin), both at page 3 and 4.	Considered
Ann-Kristin Sundin	LRF Mjölk	Dear NNR committee, Thank you for the opportunity to comment on the nutrient chapters within the open consultation frame. Niacin chapter: On page 3, dairy is mentioned as a rich dietary source of niacin, whereas at page 4, dairy is not mentioned as a food group containing niacin. This may lead to some confusion, and we therefor		- the lists of niacin-rich foods on pages 3 and 4 have been unified (+bakers yeast mentioned in ref 18 added)

		suggest dairy is mentioned also as a food group containing niacin also on page 4. Best regards, LRF Dairy Sweden		
Johanna Kaipiainen, Charlotta Hyttinen, Evy Peltola	Finnish Vegan Association		Page 2 (Chapter "Methods") and page 4 (Chapter "Physiology"): You have considered one systematic review as relevant (Bakaloudi et al. 2021) when searching studies about vegan/vegetarian diets. A review written by Neufingerl and Eilander (2022) should be consider as relevant too: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8746448/. This review include 141 studies altogether, and 63 studies included vegan participants. Data might be more reflective on the current situation, because all studies in this review were published between years 2000–2020. As seen in figure 3 and mentioned in review, mean niacin intake was adequate and similar among all dietary patterns and no niacin deficiency was reported.	the systematic review of Neufingerl 2021 included.

15. Vitamin B6

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	No general comments. Look detailed comments.	Page 2. Potato is not the only plant-based source of vitamin B6. Also fruits, specially bananas, whole grain cereals and vegetables are good source on vitamin B6. Page 3 and 7. The lower bioavailability of vitamin B6 from plant-based foods is mentioned here. So, it is also important to mention how are the intake and status of vitamin B6 in plant-based diets. According to a recent systematic review average vitamin B6 intake tended to be higher in vegans compared to vegetarians and meat-eaters. Average vitamin B6 levels were similar for all dietary patterns (vegans, vegetarians, meat-eaters). (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/)	Thank you, the list of foods containing vitamin B6 has been corrected and the referanrence has been added.
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the vitamin B6 draft. Given the many critical functions of vitamin B6 across the human life span, and given the fact that animal based foods are such major sources of vitamin B6 in the diet, we welcome the recognition of the same in this context. The nutrition density and food matrix, including the high bioavailability of vitamin B6 (and other nutrients) found in meat, milk, and dairy, justify animal based foods in a healthy, varied, and		Thank you, no comment

		balanced diet for the general population. This is particularly true also for vulnerable subgroups such as children, adolescents, women of fertile age, and the elderly and frail.		
Johanna Eén	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment on the vitamin B6 draft. Please find below the comments from Svenskt Kött. The draft is well-written. It highlights new research data and provides an in-depth description of vitamin B6´s importance for critical functions. Svenskt Kött welcomes the authors´ clear recognition of animal based foods as major sources of vitamin B6, as well as the nutrition density and food matrix including the high bioavailability found in meat, milk and dairy products. Since prolonged vitamin B6 deficiency can cause severe conditions and at least specific subgroups have a probable increased requirement, the authors could further emphasize the benefits of meat as well as offal, milk and dairy products in a varied and healthy diet.	-	Thank you, no comment
Malén Gudbrandsgard	MatPrat, Norwegian Egg and Meat Council	The authors state that major sources of vitamin B6 in the Nordic diets are fish, meat, offal, potatoes, and milk and dairy products. Wholegrains is also a considerable source of vitamin B6. In Norway the daily mean intake of bread and cereals is 179 – 272 grams, and 17 % of the vitamin B6 comes from bread and cereal products (Norkost 3, 2011;	no comment	1. Thank you, bread and cereals have been added. 2. This has been clarified. 3. Generally, bioavailability is better from supplements than food.

		Warensjö Lemming and Pitsi, 2022). The intake of bread and cereal products is also high in the other Nordic countries, ranging from 111 - 249 grams per day. The mean daily intake of potatoes in the Nordic countries is 50 – 133 grams (Warensjö Lemming and Pitsi, 2022). We question why cereals is not mentioned as a good source of vitamin B6. The description of the bioavailability of vitamin B6 from foods is unclear and confusing. In one paragraph it is mentioned that the bioavailability from animal foods is quite high, reaching 100 % for many foods. A paragraph later on states that the bioavailability of B6 from animal foods is approximately 50 %. In that same sentence it is written that bioavailability of vitamin B6 in plant foods varies from 0-80 %. Leaving an impression that plant foods seems to be a better source of B6 than animal foods, which is unfortunate as that is not the case. The chapter is lacking clarity on NNR2022 point of view on bioavailability of vitamin B6. Furthermore, this statement is made three times in the chapter: "In a mixed Western diet the bioavailability of vitamin B6 is estimated to be >75% from food and >90% from supplements(5)". This without any comment or discussion of implications, and it may be interpreted as if it is better to get vitamin B6 from supplements rather than foods. Meeting the requirements of B6 by consuming		

		foods in stead of supplements should be emphasized in the chapter. The main literature search for the chapter was performed November, 2019. We question why a more recent literature search is not performed? The nutrition science field is rapidly developing, and new science is published every day. Hence there may be some updated knowledge on vitamin B6 the last three years.		
Swedish Food Agency	Swedish Food Agency	The current version of the abstract may not fully represent all relevant parts and conclusions of the chapter.	Page 2, 3rd paragraph: The first sentence reads: "Current recommendations for vitamin B6 intake is based on the concept that a plasma PLP concentration of 30 nmol/L is considered to be an optimal vitamin B6 status." Would 'sufficient' be a more appropriate word than 'optimal' in this context? Page 3, 2nd paragraph, line 4: It would be helpful for the reader if a sentence is added to introduce/explain the compound pyridoxine-glucoside and how common it is in various plant foods. This would also be relevant for the issue with reduced bioavailability of B6 in plant foods discussed in the same paragraph. Page 3, 3rd paragraph: Can PLP from these body stores be utilized in situations of low B6 intake from foods? Page 7, 2nd paragraph: Please specific type of diabetes, as they are quite different in pathophysiology as well as patient groups. Page 8, 2nd and 3rd paragraphs: It is	1. Thank you, this has been changed 2. This has been expanded 3. We have checked the literature, but the association with low vitamin B6 merely refers to diabetes and to any specific diabetes type: (Type 1, 2 and gestional diabetes). Corrected

			mentioned that "A varied omnivore diet is reported to provide a daily amount of 6-9 mg vitamin B6, considered to be adequate for adults." It is of interest to specify in which population this has been reported, since the range of 6-9 mg/d is considerably higher than the intake levels reported for the Nordic and Baltic countries. It may also be valuable to expand on what is meant by the statement "considered to be adequate for adults", as, e.g., the AR and PRI levels in the EFSA opinion is lower. Page 12, 2nd paragraph: The Pregnancy paragraph lacks references for the statement on recommendations; "Accordingly, the recommended additional B6 intake varies from 0 to 0.7 mg/day, and total recommended intake varies from 1.2 to 2.0 mg/day."	

16. Folate

Name	Organization	General comments	Detailed comments	Comment from authors
Swedish Food Agency	Swedish Food Agency	In the chapter, the suggested changes in the recommendations are not fully clear to the reader. This refers to the recommended intake levels of folate, but also whether the chapter authors suggest that the revised NNR recommendations should be expressed as microgram dietary folate equivalents (DFE) instead of microgram folate. Most Nordic food databases are currently expressing folate content of foods in micrograms of folate (as a total, i.e., not distinguishing between different forms) and not in micrograms DFE. It would also be informative to already in the abstract mention whether there are any suggestions of changing the recommendations or if the suggestion is to keep the current recommendations both in terms of intake levels and in preferred unit (micrograms folate or micrograms DFE). The term 'decision limit' is being used throughout the chapter, but is this an established term to use in this context? The chapter would benefit from a grammar and spelling check. Also make sure that abbreviations (eg., NTD) used are being explained when appearing in the chapter for the first time.	Abstract, line 11: Should probably read 'red blood cell' instead of 'red cell'. Introduction, page 2, third paragraph, line 4-6: The sentence leaves the reader wondering about reasons why mandatory folate fortification has not been implemented in most Nordic countries despite it being presented as safe and cost-effective. Would it be possible to present reason for why? (even though it is mentioned later in the chapter, about how it may link to promoted cancer tumor growth). Introduction, page 2, fourth paragraph, line 5: Should be a '>' sign in front of 906 nmol/L à '> 906 nmol/L', since the recommendation is not to have exactly 906 nmol/L but levels above. Methods, page 2-3: The method is not fully clear; The abstract mentions that "Both de novo and qualified systematic reviews along with identified relevant literature have been used for this chapter." but there is no mentioning of any de novo systematic review in the chapter (neither in methods not anywhere else). What was the specified outcomes for the de novo SR and have these results been incorporated in the chapter? Physiology, page 3, second paragraph, lines 1-2: The following sentence is difficult to understand: "Folates taken up by the intestinal mucosal cell are reduced to THF, which can either be transferred to the portal circulation without further metabolism." Should the word	1. this was not allowed 2. Yes. 3. We have explained NTD and performed a spelling check: 1 correction was made. 4. Red cell folate is correct 5. I am not sure that this is the only reason. Not changed. 6. This has been changed. 7. As the quantity of folic acid in formula milk may differ among countries, this will impact infant folate status. 8. This has been changed.

			'either' be removed is there some part missing? Physiology, pages 4-5, Infants' section: This section appears non-coherent and is somewhat difficult to grasp. If the conclusion from the section should be that we still don't know whether breast-fed or formula-fed infants display the highest plasma folate concentrations, this may be expressed more clearly. Assessment of nutrient status, page 6, third paragraph, line 9: Based on the numbers presented, the mean serum folate in Norway was 40% (39%) lower than the mean presented for Brazil, not 60% as is stated in the text?	
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 7, chapter "Dietary intake in Nordic and Baltic countries" and page 12, chapter "Pregnant women": It is worth of mentioning, that vegans tended to have higher folate intake than in meat-eating persons. In a recent systematic review thirty-four studies reported on folate intake (1). In this review vegans had average folate intake 490 µg/d, vegetarians had 403 µg/d and meat-eaters had 331 µg/d. It would be justified to consider if amount of recommended folic acid supplementation during pregnancy be less for vegan pregnant women than for meat-eating women. 1. Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/	Only 400 micrograms folic acid added to a normal diet have been proved to reduce the risk for NTD, so we disagree with the suggestion.
Plant-food Sweden	Plant-food Sweden	The review was clear and transparent, using sound methodology. Plant-based drinks are often fortified. We suggest that this is mentioned as an	We appreciate the quality work done. We have only one comment, that concerns "Pregnant women", on page 12 (last sentence under this headline).	we agree that necessary vitamins and minerals through regular food should be prioritized before dietary supplements. However, vitamin B12 enriched plant-

		alternative to supplements for pregnant vegan women.	Current text: "This recommendation applies especially to women who are vegans and not currently taking a B12 supplement (112)." Comment: Getting the necessary vitamins and minerals through regular food should be prioritized before dietary supplements. Regarding B12, plant-based drinks are often enriched with B12. We suggest that this is mentioned as an alternative to supplements for pregnant vegan women.	based drinks is a form of vitamin supplementation.
Ann-Kristin Sundin	LRF Mjölk	Dear NNR committee, Again, we thank you for the opportunity to submit comments on the NNR draft chapters. Here are the comments on Folate from LRF Dairy Sweden. 1. We miss a general summary of the intakes and sources in the Nordic and Baltic countries. 2. Accordingly to Riksmaten för vuxna 2010-11 and Riksmaten Ungdom 2016-17, milk and dairy products contribute to 9% plus 3% from cheese, and 21% plus 2% from cheese, respectively. Therefore, our opinion is that milk and dairy ought to be mentioned among the dietary sources of folate, at least in Sweden. 3. We miss a general summary of the subpopulations at risk of deficiency, although some are mentioned in the draft. As a suggestion, a summary would make it more comprehensive.		1. We believe this is given in a separate chapter 2. I have checked the Norwegian Matvaretabellen, and it turns out the level of folate differs a lot in various types of milk and cheese. Is this due to supplementation of folic acid in dairy products? If yes, is this done in all the Nordic countries? 3. As written in the abstract and repeated in the main document: Higher folate requirements are found in infants, children, pregnant and lactating women and in patients with intestinal disease, severe skin diseases, hemolytic anemia, patients taking antiepileptic medications and in people with certain gene polymorphisms.

17. Vitamin B12

Name	Organization	General comments	Detailed comments	Comments from authors
Ebba Nexo	Aarhus University Hospital, Institute of Clinical Medicine, Aarhus, Denmark	Nomenclature needs attention, so that the same komponent is always given the same name. I miss a list of abbreviations employed. Miss that the manuscript has indications of lines, which would allow for easier reference for specific comments.	I have returned a version of the pdf file including all my detailed comments. to Anne Høyer	Considered
Christian Koeder	Research Institute for Plant-Based Nutrition (IFPE), Germany	I think, this sentence ". Green and purple lavers (Nori) may contain some vitamin B12 and can be used by humans" should be reassessed. To the best of my knowledge, the amounts of true vitamin B12 in seaweeds are very low and they cannot be considered (unfortunately) a reliable relevant source of vitamin B12 for humans (particularly vegans). RE: "the body will actively regulate the uptake in ileum, and there is no evidence that intakes up to 100 µg/d from foods and supplements represent a health risk(12)" ... Maybe "long-term intake" could be added. Even 1000 µg/d or more appear to be safe. But cases of acne-like skin problems have been reported in some cases of high-dose vitamin B12 supplements. "As vitamin B12 only occur in foods of animal origin". Strictly speaking, vitamin B12 also occurs in fortified foods. Thank you and kind regards, Christian Koeder		Thank you for good comments, which have been implemented in the paper.
Marit Kolby	Oslo New University College	Excess intake of B12 supplements, combined with other B-vitamins, might pose a health threat. General advice should be to get B12 from foods, and to use oral supplements with	In the toxicity section of the chapter (p.11), it is stated: "There are no known adverse effects of excess vitamin B12(12)." However, long term supplementation of high	1. We totally agree with the WHO advice: meet nutritional needs through diet alone. This is however not possible with the

		caution. This is in line with advice from World Cancer Reserach Fund: "Aim to meet nutritional needs through diet alone".	doses with B12 combined with other B-vitamins has been associated with increased risk of cancer in studies. As more supplements are often combined in groups consuming little or no natural sources of B12, the wording in the chapter might encourage the use of supplements over foods, with increased risk of adverse health effects as a result. This is unfortunate, and should be considered in the finalisation of the chapter. References: Colon cancer: Oliai Araghi S, Kiefte-de Jong JC, van Dijk SC, Swart KMA, van Laarhoven HW, van Schoor NM, de Groot LCPGM, Lemmens V, Stricker BH, Uitterlinden AG, van der Velde N. Folic Acid and Vitamin B12 Supplementation and the Risk of Cancer: Long-term Follow-up of the B Vitamins for the Prevention of Osteoporotic Fractures (B-PROOF) Trial. Cancer Epidemiol Biomarkers Prev. 2019 Feb;28(2):275-282. Lung cancer: Brasky TM, White E, Chen CL. Long-Term, Supplemental, One-Carbon Metabolism-Related Vitamin B Use in Relation to Lung Cancer Risk in the Vitamins and Lifestyle (VITAL) Cohort. J Clin Oncol. 2017 Oct 20;35(30):3440-3448. Ebbing M, Bønaa KH, Nygård O, Arnesen E, Ueland PM, Nordrehaug JE, Rasmussen K, Njølstad I, Refsum H, Nilsen DW, Tverdal A, Meyer K, Vollset SE. Cancer incidence and mortality after treatment with folic acid and vitamin B12. JAMA. 2009 Nov 18;302(19):2119-26. doi: 10.1001/jama.2009.1622.	increasing amount of people who have a low intake of animal food/ vegetarian/vegan diets. 2. Thank you for valuable comments, we have however not changed the chapter base on this comment

Titta Salopuro, Tomi Virtanen	HUS Diagnostic Center, Clinical chemistry, Helsinki, Finland	In Finland, the national recommendation for the first test to be done, is active vitamin B12 (S -B12-TC2, holoTC). For example, in HUS-area (Helsinki/ Uusimaa) since the year 2016 the proportion of B12-TC2 has been 99% of all vitamin B12 -tests. Several articles have shown the strengths of B12-TC2 assay; here are some of them (these should be included): Hvas AM, Nexo E. Holotranscobalamin--a first choice assay for diagnosing early vitamin B deficiency?. J Intern Med. 2005;257(3):289-298. doi:10.1111/j.1365-2796.2004.01437.x Nexo E, Hoffmann-Lücke E. Holotranscobalamin, a marker of vitamin B-12 status: analytical aspects and clinical utility. Am J Clin Nutr. 2011;94(1):359S-365S. doi:10.3945/ajcn.111.013458 Herrmann W, Obeid R. Utility and limitations of biochemical markers of vitamin B12 deficiency. Eur J Clin Invest. 2013;43(3):231-237. doi:10.1111/eci.12034 Murphy MJ, Brandie F, Ebare M, et al. Personalising laboratory medicine in the 'real world': Assessing clinical utility, by clinical indication, of serum total B12 and Active-B12® (holotranscobalamin) in the diagnosis of vitamin B12 deficiency. Ann Clin Biochem. 2021;58(5):445-451. doi:10.1177/00045632211003605 Edward Valente, John M Scott, Per-Magne Ueland, Conal Cunningham, Miriam Casey,	Page 7, paragraph 1: "Serum vitamin B12 is the primary marker of vitamin B12 status in both children, adults, and pregnant women (2). The assays used to analyze human samples are widely available, cheap, and specific for biologically active cobalamins." This is not true. At least in Finland the primary marker is holoTC (= active B12!!), which is also not more expensive than vitamin B12, and is more widely available. Page 7, paragraph 4: "All vitamin B12 markers are decreased during pregnancy, so specific decision limits must be used." However, in page 8 paragraph 1, it is said: "While the other biomarkers change during pregnancy, holoTC has been reported to be unaffected" We suggest, that controversial information in page 7 is changed: "All other vitamin B12 markers, except holoTC which stays unaffected, are decreased during pregnancy, so specific decision limits must be used." Page 7, paragraph 5: "However, there is a lack of knowledge regarding factors influencing holoTC homeostasis, and the diagnostic value may thus be questioned (1)." There really is enough of knowledge already!; please use some other reference than this number 1.	Thank you for the comments! We have changed the section for HoloTC, based on your comments. We do not consider holoTC as the main assay for vitamin B12 evaluation. HoloTC has several pitfalls, including missing decision limits for pregnant women and children. Concerning the price question which has been raised: According to Abbott Norge AS, which is currently providing this assay, the price of the active B12 assay is 4 to 8 times higher than total vitamin B12 assay, which is about 0.39 Euro. According to Tomi Virtanen the price of both analytes in his laboratory are in the range of 10-15 euros, which is a rather big difference from the prices in Norway.

		Anne M Molloy. Diagnostic accuracy of holotranscobalamin, methylmalonic acid, serum cobalamin, and other indicators of tissue vitamin B_{12} status in the elderly. Clin Chem 2011 Jun;57(6):856-63. doi: 10.1373/clinchem.2010.158154. Epub 2011 Apr 11. Saila Loikas LT, Annukka Paju FT, Kari Koskela LL, Timo Kouri LKT. B12-vitamiinin puutteen parempaan diagnostiikkaan (Finnish). Suomen Lääkärilehti 15/2016 vsk 71, 1065-1072. This is our recommendation in HUS (as well as in other areas in Finland too): B12-TC2 is the primary test to be used! If B12-TC2 < 20 pmol/l à treatment with B12 If B12-TC2 > 50 pmol/l à no deficiency If B12-TC2 is 20-50 pmol/l à start treatment OR measure Hcyst or MMA OR control B12-TC2 in 2-3 months	Page 7, paragraph 5: "...the assay for HoloTC is less widely available, more expensive..." This is not true (at least in Finland); quite the contrary actually, so we suggest that this should be left out or changed.	
Ann-Kristin Sundin	LRF Mjölk	Dear NNR Committee, Thank you for the opportunity to comment on the vitamin B12 draft. This draft underlines the fact that the intake levels that are recommended in the NNR 2012 are too low. Since only animal foods contain active vitamin B12 (with a few and rather insignificant exceptions), this draft supports our opinion that meat, milk and dairy is a part of a balanced, varied, and healthy diet in such sufficient amounts to meet the need for vitamin B12 as well as many other nutrients. In addition, there is the positive health effect that meat, milk and dairy products represent, e.g. a healthy iron status, bone health, and a		Thank you for the comments!

		decreased risk of diseases such as cardiovascular diseases including diabetes type 2, hypertension, and several cancer types.		
Lars T. Fadnes	University of Bergen	The chapter provides a comprehensive overview of vitamin B12, its physiological aspects, and aspects related to measurements. The chapter seems to be less precise in its description of groups at risk of low intakes of vitamin B12 (see more details below).	The chapter provides a comprehensive overview of vitamin B12, its physiological aspects, and aspects related to measurements. The chapter seems to be less precise in its description of groups at risk of low intakes of vitamin B12. For example, the chapter writes that "Vegetarian diets, especially vegan diets, tend to contain low or no amounts of vitamin B12 and these diets are associated with an increased risk of vitamin B12 deficiency (22, 57-60)" (p9). This is not in line with the systematic reference that you cite by Neufingerl et al. [1]. They note that intake from food alone is low people with vegan diets. Although, they write that "In studies that assessed intake from foods and supplements, all dietary patterns had a mean vitamin B12 intake above the EAR" (including vegan diets). They also note that "Vitamin B12 status was assessed in 48 studies based on serum or plasma vitamin B12 levels. Out of these, 26 studies excluded supplement users." In other words, selecting studies excluding vegetarians and vegans using supplements severely biases the picture. It is important to acknowledge that several of the primary studies referenced (and included in the systematic review and meta-analysis), are based on data collected more than twenty years ago in a time with less knowledge about micronutrients. Recent studies have generally shown that most eating plant-based diets have recognition of the need for supplementing with vitamin B12. Some studies including a recent study on attitudes [2], combine former and current vegetarians/vegans and thus might not be able to detect the shift in recognition. It is also	Thank you for the comments! We have revised some sentences and have ncluded the last ref.

			worthy to mention a recent study with information on intake and supplements as well as biochemical markers among people eating vegetarian and vegan diets in Norway [3], could be particularly relevant to depict the current situation in the Nordic countries. This study show generally overlapping picture with what would be expected in a general population in terms of vitamin B12. The current sections on people with vegetarian and vegan diets is now imprecise as it does not take into consideration use of supplements. Some of this can be balanced by slightly rephrasing the sentences to "for people with vegetarian and vegan diets not taking vitamin B12 supplements…", and also adding that "Recent studies indicate that people eating vegetarian and vegan diets who include supplements of vitamin B12, generally seem to have adequate levels and low risks of vitamin B12 deficiencies." The same thinking is also kept in the abstract where it is stated that "Vitamin B12 is found in animal food and as vegetarian diets are increasingly popular in Western countries, one might expect a higher prevalence of vitamin B12 deficiency in the Nordic population." Keeping the above-mentioned references in mind, this argument is questionable, and the sentence does not seem to be justified. References: 1. Neufingerl N, Eilander A: Nutrient Intake and Status in Adults Consuming Plant-Based Diets Compared to Meat-Eaters: A Systematic Review. Nutrients 2021, 14(1). 2. Sanne I, Bjørke-Monsen A: Lack of nutritional knowledge among Norwegian medical students concerning vegetarian diets. Journal of Public Health: From Theory to Practice 2022, 30:495–	

			501. 3. Henjum S, Groufh-Jacobsen S, Allen LH, Raael E, Israelsson AM, Shahab-Ferdows S, Hampel D: Adequate vitamin B12 and folate status of Norwegian vegans and vegetarians. Br J Nutr 2022:1-20.	
Ulrika Åkesson	Food Frame Sweden AB	Det är viktigt att framhålla att forskare idag inte med säkerhet kan säga att mätmetoder är helt tillförlitliga. Det finns också antaganden bland forskare som säger att dagens rekommendationer förmodligen ligger i underkant. Eftersom aktivt vitamin B12 i princip endast återfinns i animaliska livsmedel ger kapitlet stöd åt uppfattningen att kött, mjölk och mjölkprodukter bör ingå i en sund och balanserad kost som bidrar till ett tillräckligt intag av såväl vitamin B12 som övriga essentiella näringsämnen, inte minst järn och zink. Eftersom aktivt vitamin B12 i princip endast finns i animaliska livsmedel behöver den som helt utesluter dessa i sin kosthållning komplettera med kosttillskott eller berikade livsmedel. Nya näringsrekommendationer behöver bli tydliga om riskerna för brist på B12 för de som utesluter animaliska livsmedel i sin kost. Bristsymptom kan upptäckas först eller flera år av vegetarisk diet, vilket kan medföra långa utredningar och lidande hos individen, även vid måttlig brist. Kosttillskott kan vara en lösning, men även här finns outforskade perspektiv om risker med kosttillskott, som också behöver lyftas fram. Även animaliernas Food Matrix bör uppmärksammas. Eftersom NNR strävar efter ett mer holistiskt synsätt på näring och hållbarhet vore det önskvärt med en analys av		Thank you for the comments!

		hur berikning och kosttillskott både produceras samt näringssätter. Att enbart konstatera att en kosthållning utan animaliska produkter kräver tillskott är en alldeles för grund slutsats som kräver fördjupning. Vidare har studier av s k PBMA, Plant-Based Meat Analogues, visat att de substitut som saluförs på den svenska marknaden sällan är berikade med vitamin B12 (Susanne Bryngelsson m fl).		
Per Christian Henden	Veganere i Norge	Thanks for improving upon the last NNR edition. We see the opportunity for some small adjustments in order to make the chapter provide safer information on vegan diets. It’s important and correct to clearly state that B12 supplements are necessary on (near) vegan diets, like you do. That's an important message to spread. Thank you for doing so.	A formatted version of the text below is available from https://bit.ly/nnr2022-b12 References are listed at the bottom. □ Page 9, chapter 6, paragraph 1 and 2 Input 1: While it is technically true that Nori may contain biologically active B12, the claim that B12 is available from non-animal foods (other than supplements/fortified foods) is problematic. Such claims may lead people to believe that they can improve their vitamin B12 status by eating seaweeds (Nori). This can cause serious harm, as discussed in our previously accepted NNR2012 B12 feedback[1]. Large scale studies on vitamin B12 absorption from particular plant foods must be performed in order to determine if these can be reliable sources of the vitamin. There are at this time no studies that show that a particular plant food, including Nori and Chlorella seaweed, obtained from multiple regions, consistently improves vitamin B12 status via the lowering of MMA-levels. Input 2: In your chapter 8, page 15, section “Vegetarian and vegan diets”, a conflicting statement to chapter 6 paragraph 1 is made,	Thank you for the comments! We have included some of the suggestions.

Ch6: “With a few exceptions, only animal foods contain cobalamin”
Ch8: “As vitamin B12 only occur in foods of animal origin”
Suggested phrase to use in both locations: “vitamin B12 only occurs in foods of animal origin and in fortified foods”. The phrase's logic is consistent with the facts because we do not count Nori etc as a true source of B12, given the above-mentioned missing evidence (ref input 1 text and link).
Alternative phrasing: “vitamin B12 only occurs in foods of animal origin”.

□ Page 9, chapter 6, paragraph 2
Regarding the phrase “Some plant-based milk substitutes might be fortified with vitamin B12 and might be an important source of vitamin B12 in vegans”
Input 3: It’s factually correct and more accurate to say that some plant-based milks are fortified and that they can be an important source. The word “might” is not accurate in its use here.
The use of ‘can’ implies the possibility of adequate uptake, which is achieved by 2-3 servings to get at least 3µg of B12 a day, according to The Vegan Society [1], who references among others the 2018 study of Damayanti et al. [2].

□ Page 2, chapter 2, paragraph 3
Regarding the claim of “substantial amount of nutritional knowledge is needed to achieve an optimal vegetarian diet with regard to vitamin B12 intake and status”.

Input 4: This isn’t accurate given today's easy access to vitamin supplements and fortified foods. It does not require specialized knowledge to take a daily vitamin pill containing 100% of the RDI of B12. As page 3 paragraph 1 states, 100µg/d intake is considered safe, making it easy to avoid a too high intake.
Granted, there are people with B12 uptake shortcomings, but they are not protected from this shortcoming by following a non-vegan diet alone. If there's a reason to recommend people test their B12 status after some time living on a (near) vegan diet, I recommend the chapter to do exactly that.

□ Page 17, chapter 8, section “Children”, final paragraph.
Input 5: There is a gap between the two ranges mentioned.

References

[1] Feedback on NNR2012 chapter on B12, url https://bit.ly/nnr2012-b12

[2] The Vegan Society, What Every Vegan Should Know About Vitamin B12, visited 2022-11-04, url https://www.vegansociety.com/resources/nutrition-and-health/nutrients/vitamin-b12/what-every-vegan-should-know-about-vitamin-b12

[3] Damayanti D, Jaceldo-Siegl K, Beeson WL, Fraser G, Oda K, Haddad EH. Foods and Supplements Associated with Vitamin B12 Biomarkers among Vegetarian and Non-Vegetarian Participants of the Adventist Health

			Study-2 (AHS-2) Calibration Study. Nutrients. 2018 Jun 4;10(6):722	
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association		Pages 1-2: There is widely available also vitamin B12-fortified foods, for example plant-based milk and yogurt alternatives. Vegan Associations worldwide inform the importance of supplementation in vegan diet, and most vegans are aware of this. In a recent systematic review, in studies that assessed intake from both foods and supplements, all dietary patterns – vegans, vegetarians and meat-eaters – had a mean vit B12 intake above the EAR (2,0 µg/d), although the median vit B12 in vegans was below the EAR (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/) Chapter "Assesment of nutrient status", pages 5-7: Finland has been a pioneer in measuring vitamin B12 status by B12 bound to transcobalamin. B12 bound to transcobalamin (TC) is the preferred method of measuring vitamin B12 status. References from HUS (Helsinki University Hospital) website: Loikas S, Koskinen P, Irjala K, ym. B12-vitamiinin puutteen toteaminen. Suomen Lääkäril 2005,60:1271-6 (in finnish). Herrmann W, Obeid R. Utility and limitations of biochemical markers of vitamin B12 deficiency. Eur J Clin Invest 2013,43 :231-7. Stabler SP. Vitamin B12 deficiency. N Engl J Med 2013,368: 149-60. Page 9: VEGANS/VEGETARIANS: Algae or seaweed are not reliable sources of vitamin B12. Despite the trace amounts of vit B12 perhaps found in some raw seaweeds, for example in nori,	Thank you for the comments! We have included some of the suggestions.

it can be changed into harmful inactive B12 analogues by drying. Seaweeds also tend to be high in iodine, which can cause problems at high intakes. More information from vitamin B12 in algae, seaweeds and other plant foods can be found in this article, written by Jack Norris (RD): https://veganhealth.org/vitamin-b12/

Three important point about supplements and vegan diets:

1. There is a growing trend in favoring methylcobalamin as a form of vitamin B12 supplementation; it is advertised as a ”natural” form. But studies do not support this trend. There is still a wide consensus among nutrition experts who are specialized in vegan nutrition, that cyanocobalamin is a well-studied, reliable and also inexpensive form on vitamin B12 supplement. Read more: https://veganhealth.org/vitamin-b12/
2. It should be emphasized, that nutrition recommendations which are targeted to mixed-eaters, are based the situation when vitamin B12 is obtained from various foods during the day. The situation is different in vegans, when the vitamin B12 is obtained from supplement once a day or once/twice a week. Many vegan organizations have set a detailed instructions for taking a supplement. The main principle is the less often the vit B12 supplement is taken, the greater the dose taken must be. This principle is based the fact, that the greater the dose is, the smaller percentage about it is absorbed.
3. One of most frequent questions from vegan parents had been: at what age the vitamin B12 -supplement should started? There is a wide consensus among nutrition experts who are

			specialized in vegan nutrition: the supplement must start at age 6 months, when a vegan baby is introducing to solid foods. It would be useful to mention this in nutrition recommendations too. Page 15: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Page 15: "Strict vegan": A word "strict" is unnecessary and also a little bit prejudiced, because a word "vegan" is unambiguous, meaning a person who do not use any animal products.	
Puk Maia Ingemann Holm	Danish Agriculture & Food Council	Thanks to the NNR committee for the opportunity to comment this chapter. This RC underpins that Nordic intake of vitamin B12 is too low, according to recommendations in NNR 2012. Vitamin B12 is essential in many aspects of human health and plays a key role for normal metabolic function. Even moderate deficiency can cause negative health outcomes. As the only sources to active vitamin B12 are animal sourced foods (apart from in-significant plant-based fermentation and dirt contamination) this article supports our argument that meat, eggs, dairy and fish should be part of a healthy, balanced and varied diet. In addition animal sourced foods in a healthy, balanced diet supply other important nutrients along with whole food matrices that support a healthy iron status, skeletal health and reduced risk of NCD´s such as CVD, T2D and several types of cancers. A de novo systematic review will be conducted in 2022. We are wondering why the chapter on		Thank you for the comments!

		vitamin B12 is out on public hearing before this review is published?		
Plant-food Sweden	Plant-food Sweden	We welcome the opportunity to comment on this chapter. We appreciate the quality work done. We wish to share some detailed comments and references on the sections on vegans/vegetarians.	Page 9: Vegans/Vegetarians Current text: "Vegetarian diets, especially vegan diets, tend to contain low or no amounts of vitamin B12 and these diets are associated with an increased risk of vitamin B12 deficiency (22, 57-60). Plant foods might contain trace amounts due to bacterial or soil contamination or as a result of fermentation. Green and purple lavers (Nori) may contain some vitamin B12 and can be used by humans, whereas blue-green algae or cyanobacteria (Spirulina) contain biologically inactive B12 analogues (2, 61). Some plant-based milk substitutes might be fortified with vitamin B12 and might be an important source of vitamin B12 in vegans." Comments: We would like to add AND in the first sentence: "Vegetarian diets AND, especially, vegan diets tend to…" (as vegan diets are not "part of" vegetarian diets). Third sentence: It may not be warranted to give such a detailed description of different algae. A small cross-sectional study suggested that vegans who supplemented with cyancobalamin had normal vitamin B12 status based on holotranscobalamin (median 150 pmol/l). In contrast, use of natural products (algae, kombucha, or other fermented products) was insufficient to raise the levels of holotranscobalamin (Ref below).	Thank you for the comments! We have changed the section about Green and purple lavers (Nori)

			Ref: Zugravu CA, Macri A, Belc N, Bohiltea R. Efficacy of supplementation with methylcobalamin and cyancobalamin in maintaining the level of serum holotranscobalamin in a group of plant-based diet (vegan) adults. Exp Ther Med. 2021 Sep;22(3):993. Last sentence. "Some plant-based alternatives ARE fortified with vitamin B12.....". We also think it is important to add one more sentence, informing that vegan meals that include fortified dairy and meat substitutes can be nutritionally adequate (ref below), to show that there are modern vegan foods that are offer the daily dose of B12. Hence, it is becoming easier to ensure a sufficient B12 intake as compared before, e.g., when choices were restricted to algea, which had variable nutrient content depending on type (here the algea references are more appropriate). Ref: Eustachio Colombo P, Elinder LS, Lindroos AK, Parlesak A. Designing Nutritionally Adequate and Climate-Friendly Diets for Omnivorous, Pescatarian, Vegetarian and Vegan Adolescents in Sweden Using Linear Optimization. Nutrients. 2021 Jul 22;13(8):2507. Page 15: Vegetarian and vegan diets Current text: "As vitamin B12 only occur in foods of animal origin, strict vegan diets will eventually result in vitamin B12 deficiency unless supplemented. However, lower intake and status is also observed with less restrictive diets limiting animal food (96). It should be emphasized that symptoms of deficiency may not occur until	

			years after adopting such diets. As repleting the body stores through supplements would take a long time, initial treatment with injections is warranted once symptoms of deficiency are present." Comment: We would like to add AND in the second sentence: "… with less restrictive diets limiting animal food AND supplied with non-fortified plant protein products (96)", as this was a study to see the natural course when not using supplements or fortified foods. There are vast differences when adequately fortified products are used. Also, again we think it is of importance to add that vegan meals that include fortified dairy and meat substitutes can be nutritionally adequate (ref below). Ref: Eustachio Colombo P, Elinder LS, Lindroos AK, Parlesak A. Designing Nutritionally Adequate and Climate-Friendly Diets for Omnivorous, Pescatarian, Vegetarian and Vegan Adolescents in Sweden Using Linear Optimization. Nutrients. 2021 Jul 22;13(8):2507. The last two sentences do not seem warranted here. This would appear true for other conditions associated with B12 deficiency as well, e.g., deficiencies with other etiologies, such as poor apetite in elderly. As this is a general statement it belongs elsewhere (also not related to th…	
Swedish Food Agency	Swedish Food Agency	It is very good that a profound revision of the recommendations on vitamin B12 has been done and we look forward to reading the SR when it will be published.	Page 5: Specific groups Infants, children and adolescents: The last sentence needs clarification. Is it a recommendation to give premature and LBW	Thank you for the comments!

		We appreciate the detailed description of the absorption and transport of vitamin B12. This may explain at least partly why hight doses of supplemental vitamin B12 is not absorbed to the same extent as vitamin B12 from food. It would however be very helpful with more specific information on the absorption of vitamin B12 from supplements versus food. The term 'animal food' is used throughout the chapter, however, 'animal-based foods' may be a term more commonly used in the literature.	infants formula to increase their intake of vitamin B12? Page 6: "Most inborn errors of vitamin B12 metabolism are rare, and the most common mutation is CblC which has been reported in >500 patients" – are the 500 patients worldwide or in the Nordic/Baltic countries, and during which time-period? Page 9: Vegans/Vegetarians: are there any data on B12 intakes or B12 status in these populations in the Nordic and Baltic countries that could be included or are there no data at all? Page 11 Toxicity: The paragraph on toxicity is very inexplicit. What is "moderate"? Page 14, Eye disease: The abbreviation AMD is not explained. Also, the text may benefit from some clarification on whether it is AMD that is associated with decreased B12 levels or the other way around. Page 14, Last paragraph: It would be valuable to provide the the important message that the estimated vitamin B12 requirement of 3.8-20.7 micrograms needed to compensate for daily losses should be interpreted with caution also earlier in the chapter (at first mentioning of the estimation). Page 15: The rational that the same intake as for younger	

			adults is recommended for elderly despite lower absorption rate due to the fact that a higher recommended intake is unlikely sufficient is not clear. Is it possible to further discuss whether such intake is likely to be adequate also for elderly or if a higher intake should be recommended due to lower absorption (how this is managed needs to be handled by each country)?	
Nina Cathrine Johansen	Plantebasertkosthold.no		Input 1: Page 2, chapter 2, paragraph 3 Regarding the claim of "substantial amount of nutritional knowledge is needed to achieve an optimal vegetarian diet with regard to vitamin B12 intake and status". Comment: Substantial amount of nutritional knowledge is unlikely to be necessary for something as simple as taking a a supplement of B12 daily or weekly, or to include foods in the diet that provide the recommended amount. The vitamin supplement can be taken in low doses (eg 25 micrograms) daily, or in higher doses weekly (500-1000 micrograms). B12 is also added to most of the plant- based milks and some other vegan substitutes for dairy products, like plant -based yoghurts. About half a liter of fortified plant- based milk substitute will supply the amount of B12 (1). I will also argue that it is commonly known among vegans that B12 supplement is required. A recent Norwegian study also suggest this, as B12 status was found to be adequate in both vegans and vegetarians according to the combined indicator cB12 (Serum B12, plasma total homocysteine [tHcy] and plasma methylmalonic acid [MMA].) These (cB12)	Thank you for the comments Some of the suggestions have been included.

			calculations indicated that none of participants had low B12.(2) The incidence of vitamin B12 deficiency in the general population has not been investigated in Norway, but in contrast to the vegan/vegetarian study, there are international studies that suggest that as much as 26% of the population may suffer from subclinical B12 deficiency.(3) Input 2: chapter 6, page 9, section "Dietary intake in Nordic and Baltic countries. "With a few exceptions, only animal foods contain cobalamin" Comment: I suggest that the exceptions are specified: Only animal foods and B12 fortified food items contain cobalamin. Input 3: chapter 6, page 9, section: Vegans/Vegetarians "Some plant-based milk substitutes might be fortified with vitamin B12 and might be an important source of vitamin B12 in vegans" Comments: I suggest using a more clarifying and specific sentence: Most of the non-organic plant-based milk substitutes are fortified with B12. If consumed in sufficient amounts (about 5 dl) daily this is an important source of B12 in vegans. Referanser: (1) Helsenorge.no. Vegetar og vegankost: Næringsstoffer du bør følge med på – vitamin B12 https://www.helsenorge.no/kosthold-og-	

			ernaring/vegetarisk-kosthold/pass-pa-naringsstoffer-vegetar/#vitamin-b12-(kobalamin) (2) Henjum, S., Groufh-Jacobsen, S., Allen, L., Raael, E., Israelsson, A., Shahab-Ferdows, S., & Hampel, D. (2022). Adequate vitamin B12 and folate status of Norwegian vegans and vegetarians. British Journal of Nutrition, 1-20. doi:10.1017/S0007114522002987 (3) Mouland, et al. (2022). Fylkesforskjeller i utredning og behandling av vitamin B12-mangel Tidsskr Nor Legeforen 2022 doi: 10.4045/tidsskr.21.0749 https://tidsskriftet.no/2022/09/kort-rapport/fylkesforskjeller-i-utredning-og-behandling-av-vitamin-b12-mangel?	
Tanja Kalchenko	PAN Norge	Vitamin B12 deficiency is usual among wide publicum. More research and food enrichment may be necessary Severe vitamin B12 deficiency is rare, but internationally it is reported that up to 26% of the general population may have subclinical vitamin B12 deficiency. The occurrence of it has not been investigated widely and well enough in Norway (1,2,3). Only animal or enriched foods contains vitamin B12. At the same time, animal food is the biggest source of environmental toxins in the Norwegian diet. The recent report by the Science Committee for Food and Environment, VKM, says: "The Norwegian population is exposed on average to more dioxins and dioxin-like PCBs		Thank you for the comments.

		from food than the tolerance limit." And "The food groups that contribute the most are fatty fish, milk and dairy products and meat." (4) In contrast to toxins, there are no disadvantages to fortification. Report Development in Norwegian diet 2021 from the Directorate of Health, (5 - page 9, 40, 41) says that it is dairy (cheese, whole milk) and red meat that are the main sources of saturated fat. Saturated is the type of fat that 80% of Norwegians eat in harmful for health amounts, acc. to the Action plan for a better diet (6 - page 13 and 56). (5,6) To hope that animal foods are a robust source of B12 for the general population may be not correct. This is: 1. Not safe (26% of public are estimated to have subclinical B12 deficiency, in addition to many pregnant and lactating women) 2. Not healthy (the main source of environmental toxins and high in saturated fat) 3. Not good for the environment or sustainable food production (The Norwegian Directorate of Agriculture's concentrate feed statistics (Kraftfôrstatistikk) shows that huge amounts of food are used to feed livestock). (7) A recent study on Norwegian vegans, on the other hand, shows that all of them have a good B12 status. (8)		

		This shows that 1) the use of fortified foods, 2) increased attention to possible B12 deficiency and 3) use of B12 as a dietary supplement are important not only for vegans but for the general population - on a broad basis. Both vitamin D and iodine are difficult to get enough of without supplementation (see reports of The Norwegian Nutritional Council), and B12 should be considered as one of such "difficult" nutrients. (9,10). Content of, among other things, vitamin B12 in various plant milks and meat substitutes, see Table 5 page 17. (11) It is also listed in the official Norwegian matvaretabellen.no (12). The enrichment can therefore be extended to other foods. 1. Mouland G, Lie Berg C, Nouri Sharikabad M, Thode Sommerschild H. Fylkesforskjeller i utredning og behandling av vitamin B12-mangel. Tidsskr Nor Legeforen 2022 doi: 10.4045/tidsskr.21.0749 2. Green R, Allen LH, Bjørke-Monsen AL et al. Vitamin B12 deficiency. Nat Rev Dis Primers 2017; 3: 17040. 3. Carmel R. Prevalence of undiagnosed pernicious anemia in the elderly. Arch Intern Med 1996; 156: 1097–100. 4. VKM. Dioksiner i maten til den norske befolkningen. Risk assessment of dioxins, furans, and dioxin-like PCBs in food in Norway 5. Helsedirektoratet. Utviklingen i norsk kosthold. Oslo: Helsedirektoratet; 2021. P. 9,40,41 6. Helse- og omsorgsdepartementet. Nasjonal		

		handlingsplan for bedre kosthold (2017–2021). Oslo: Helsedirektoratet; 2017. S. 13 og 56 7. Landbruksdirektoratet. Kraftfôrstatistikk 8. Henjum, S. et al. (2022). Adequate vitamin B12 and folate status of Norwegian vegans and vegetarians. British Journal of Nutrition, 1-20. doi:10.1017/S0007114522002987 9. Nasjonalt råd for ernæring, 2016. Risiko for jodmangel i Norge. Identifisering av et akutt behov for tiltak. 10. Nasjonalt råd for ernæring. (2018). Vitamin D i Norge: Behov for tiltak for å sikre god vitamin D-status?. 11. Rapport: Analyser av næringsstoffer og uønskede stoffer i plantebaserte middagsprodukter og drikker 2021. Havforskningsinstituttet. 12. Mattilsynet, Hel...		
Malén Gudbrandsgard	MatPrat	Vitamin B12 plays a key role in many aspects of health and is essential for normal metabolic function. Even moderate deficiency can cause negative health outcomes. Eating a nutritious balanced diet contributes to meet the recommendations. Vitamin B12 is naturally ocurring in animal products, and only animal foods contain active vitamin B12. Since the prevalence and interest in vegetarian and vegan diets are increasing in the Nordic countries, the authors state that increased incidence of vitamin B12 deficency is to be expected. Deficicency is known in vulnarable groups, such as pregnant women, infants and elderly according to the chapter authors. Recommendation for vitamin B12 is difficult to set due to several different factors. Meeting the requirements of B12 by consuming foods rather		Thank you for the comments We do not know the reason for this.

		than supplements should be emphasized in the chapter. Moreover, eating meat, eggs, seafood, dairy and other animal foods containing B12, can contribute to positive health outcomes, e.g. a healthy iron and iodine status. In groups limiting or avoiding animal sourced foods containing B12, different supplements are often combined in order to meet several nutrient needs. The recommendations should caution excess intake of B12 supplements, and also encourage foods over supplementation for those who eat a varied diet. A de novo systematic review will be conducted in 2022. We question why the chapter on B12 is out on public hearing before the review is published.		
Merete Myrup Christensen	Danish Dairy Board	Dear NNR committee, Thank you for the opportunity to comment on this draft. From the Danish Dairy Board we would like to add some comments in relation to the chapter on vitamin B12. We find it relevant to highlight some evidence on the bioavailability of vitamin B12 when supplied from different food sources, and differences between natural (HO-B12) found in food and synthetic (CN-B12) ordinarily used in supplements. Vitamin B-12 appears to be more bioavailable from dairy/milk products, examples from popula-tion-based studies: In the Hordaland Homocysteine study (Vogiatzoglou 2009), investigation of 5937 subjects in 2 age groups (47-49 and 71-74 years), revealed a significant association between total dietary in-take of B12 and		Thank you for the comments! Some of the references have been included.

		plasma concentration of B12. Plasma vitamin B-12 was related to the vitamin B-12 intake from dairy products (especially from milk) and from fish, but not from meat and eggs. In the B-PROOF Study (Brouwer-Brolsma 2015), investigating 600 Dutch community dwelling adults (+65 years), it was found that higher intakes of dairy, meat, and fish and shellfish were sig-nificantly associated with higher serum B12 concentration, meat and dairy -predominantly milk- were the most potent sources. Matte et al (Matte 2012) hypothesized that the provision of vitamin B12 from milk is more efficient-ly absorbed than the synthetic form used in vitamin supplements. Using a pig model to asses in-testinal B12 absorption after ingestion, via net fluxes of vitamin B12 across the portal-drained vis-cera (PDV; an indicator of intestinal absorption), they found that B12 from cows milk is substan-tially more available than the most commonly used synthetic form of vitamin B12. Based on the Danish SKOT-I and -II (mother and child) cohorts, it was recently shown that vitamin B12 status at 36 mth of age was positively associated with the cognitive function score ASQ-3 (Larnkjær 2022). In these children, despite overall normal B12 levels, the quartile with the lowest B12 status, had lower cognitive function (ASQ-3). In addition, intake of dairy products was posi-tively associated with current vitamin B12 concentration at 36 months, which was not the case for intake of meat. A 100 g increase in dairy products per day was associated with 30 pmol/l higher vitamin B12 concentration ((95 % CI 0·11, 0·48), P =		

		0·002). The synthetic form of vitamin B12 (CN-B12) was compared with the natural form found in food (HO-B12) in a rat model by Greibe et al 2018, where they found that when ingesting the natural B12 form (HO-B12) vs CN-B12, more B12 was converted to bioactive co-enzymes in the tissues, arguing that HO-B12 may provide a better tissue supply of B12 than CN-B12.		
Anna Maria Karlsen	NHO Mat og Drikke/FoodDrink Norway	It is stated in the chapter that an increased incidence of vitamin B12 deficiency is to be expected in the years to come, mainly due to rising interest in vegetarian and vegan diets in Nordic countries. However, eating a balanced diet, where animal products with naturally occurring vitamin B12 are included, would help to reduce the risk for deficiency. We ask that the NNR recommendations primarily promote eating a nutritious, balanced diet rather than relying on nutritional supplements. We also ask why this chapter is on public consultation prior to the ongoing de novo NNR2022 systematic review (ref. page 1).		Thank you for the comments! We do not know.
Theres Strand	Svenska Köttföretagen AB	• Författarna konstaterar att det idag saknas konsensus om optimal status för så kallade biomarkörer för vitamin B12 – men också att de nivåer av intag som idag rekommenderas sannolikt är för låga. Eftersom aktivt vitamin B12 i princip endast återfinns i animaliska livsmedel ger kapitlet stöd åt uppfattningen att kött, mjölk och mjölkprodukter bör ingå i en sund och balanserad kost som bidrar till ett tillräckligt intag av såväl vitamin B12 som övriga essentiella näringsämnen, inte minst järn och zink.		Thank you for the comments! We have added the last reference.

		• Eftersom aktivt vitamin B12 i princip endast finns i animaliska livsmedel behöver den som helt utesluter dessa i sin kosthållning komplettera med kosttillskott eller berikade livsmedel. Det är bra att författarna påtalar att en strikt vegankost så småningom kommer att resultera i brist om man inte tar tillskott, att brister även kan observeras vid en mindre restriktiv kost liksom att symptomen på brist kan uppstå först efter flera år med en kost utan animalier – och att även en måttlig brist kan påverka hälsan negativt. • Här vore det dock lämpligt att ytterligare framhålla fördelarna med en blandad kost samt att föra en fördjupad diskussion om de betänkligheter som kosttillskott generellt kan medföra, bland annat när det gäller biotillgänglighet. Att författarna håller för sannolikt att vitamin B12-brist kommer att bli än mer utbrett i befolkningen som ett resultat av vegetariska dieter bör betraktas som ytterst allvarligt – inte minst för att brister redan idag påträffas inom känsliga grupper och att skadorna kan bli irreparabla. Detta förstärker ytterligare de näringsmässiga fördelarna med en kost som innehåller animalier, och vikten av att lyfta fram dessa. Även animaliernas Food Matrix bör uppmärksammas. Eftersom NNR strävar efter ett mer holistiskt synsätt på näring och hållbarhet vore det önskvärt med en analys av hur berikning och kosttillskott både produceras samt näringssätter. Att enbart konstatera att en kosthållning utan animaliska produkter kräver tillskott är en alldeles för grund slutsats som		

		kräver fördjupning. Vidare har studier av s k PBMA, Pant-Based Meat Analogues, visat att de substitut som saluförs på den svenska marknaden sällan är berikade med vitamin B12 (Susanne Bryngelsson m fl).		
Tanja Kalchenko, MD (on behalf of the organization)	Physicians Association for Nutrition Norway	Plant based diets, despite lower content of vitamin B12, are more healthy and sustainable than western diets (which means with our high consumption of meat and dairy that are good B12-sources). Sources about diets and health and sustainability: World Health Organization. Regional Office for Europe. (2021). Plant-based diets and their impact on health, sustainability and the environment: a review of the evidence: WHO European Office for the Prevention and Control of Noncommunicable Diseases. WHO. Regional Office for Europe. https://apps.who.int/iris/handle/10665/349086 License: CC BY-NC-SA Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT Lancet Commission on healthy diets from sustainable food systems [published correction appears in Lancet. 2019 Feb 9;393(10171):530] [published correction appears in Lancet. 2020 Feb 1;395(10221):338] [published correction appears in Lancet. 2020 Oct 3;396(10256):e56]. Lancet. 2019;393(10170):447-492. doi:10.1016/S0140-6736(18)31788-4 Altomkost.dk. Fødevarestyrelsen. De officielle	Chapter 6, Vegans/Vegetarians We (at Physicians Association for Nutrition Norway) suggest that the whole text changes to the following: Vegan diets do not contain vitamin B12 except of fortified foods and supplementation. Vegetarian diets that contains dairy and eggs on regulary basics, may supply enough amounts of Vitamin B12. Vegan and vegetarian diets were (before 2000 - 2020) associated with an increased risk of vitamin B12 deficiency (22, 57-60). But a recent study on Norwegian vegetarians and vegans (Henjum 2022), on the opposite, shows that all of the study-participants have a good B12 status. This shows that following: 1) appropriate information and communication (that Norwegian Directorate of Health did already from 2015 https://www.helsenorge.no/kosthold-og-ernaring/vegetarisk-kosthold/) 2) the use of fortified foods, 3) awareness about possible B12 deficiency and 4) use of B12 as a dietary supplement will give good results, when animal foods are excluded og reduced significantly in the amount.	Thank you for the comments Some of the suggested changes have been included.

		Kostråd – godt for sundhed og klima. Spis mindre kød – vælg bælgfrugter og fisk. https://altomkost.dk/raad-og-anbefalinger/de-officielle-kostraad-godt-for-sundhedog-klima/spis-mindre-koed-vaelg-baelgfrugter-og-fisk/ USDA. Scientific Report of the 2020 Dietary Guidelines Advisory Committee. Advisory Report to the Secretary of Agriculture and Secretary of Health and Human Services. First Print: July 2020 https://www.dietaryguidelines.gov/2020-advisory-committee-report Canada's food guide. Healthy food choices https://foodguide.canada.ca/en/healthy-food-choices/ Food and Agriculture Organization of the United Nations Food-based dietary guidelines – Belgium https://www.fao.org/nutrition/education/food-based-dietaryguidelines/regions/countries/belgium/en/ Springmann M, Godfray HCJ, Rayner M, Scarborough P. Analysis and valuation of the health and climate change cobenefits of dietary change. Proc Natl Acad Sci U S A. Published online March 21, 2016. Rinaldi S, Campbell EE, Fournier J, O'Connor C, Madill J. A Comprehensive Review of the Literature Supporting Recommendations From the Canadian Diabetes Association for the Use of a Plant-Based Diet for Management of Type 2 Diabetes. Canadian Journal of Diabetes. 2016.	Plant foods might contain trace amounts due to bacterial or soil contamination or as a result of fermentation. Green and purple lavers (Nori) may contain some vitamin B12 and can be used by humans, whereas blue-green algae or cyanobacteria (Spirulina) contain biologically inactive B12 analogues (2, 61). All these are not any good sources and should not be mentioned/discussed as reliable sources of vitamin B12. Plant-based milks and other dairy substitutes are as a rule fortified/enriched with vitamin B12 (with exception of biologic/ecologically produced plant milks). These dairy substitutes may be a source of vitamin B12 in vegans, but because of varying absorption in the intestine they may be not enough to satisfy the requirements, especially at children, pregnant and lactating women. Therefore, vegans should get recommendation to take supplements of/with B12 vitamin in adequate doses. Plant-based diets (which means considerably reduces intake of animal foods compared to Western (including Nordic) diets) are generally better for health and the environment. Public health strategies should therefore facilitate the transition to a balanced diet with more diverse nutrient-dense plant foods through consumer education, food fortification and possibly supplementation. Animal foods are also the biggest source of environmental toxins in the Norwegian diet. The recent (2022) report by the Science Committee for Food and Environment, VKM, says:	

		Marteau, T. M., Chater, N., & Garnett, E. E. (2021). Changing behaviour for net zero 2050. BMJ (Clinical research ed.), 375, n2293. https://doi.org/10.1136/bmj.n2293 Martin C. Parlasca and Matin Qaim. Meat Consumption and Sustainability. Annual Review of Resource Economics. Annu. Rev. Resour. Econ. 2022. 14:6.1–6.25 https://doi.org/10.1146/annurev-resource-111820-032340 Norwegian sources: Helsedirektoratet. Bærekraftig kosthold – vurdering av de norske kostrådene i et bærekraftperspektiv https://helsedirektoratet.no/publikasjoner/berekraftig-kostholdvurdering-av-de-norske-kostradene-i-et-berekraftperspektiv Helsedirektoratet. Utviklingen i norsk kosthold. Oslo: Helsedirektoratet; 2021. Helse- og omsorgsdepartementet. Nasjonal handlingsplan for bedre kosthold (2017–2021). Oslo: Helsedirektoratet; 2017 Kreftforeningen.no. Kosthold og kreft https://kreftforeningen.no/forebygging/kosthold-og-kreft/	«The Norwegian population is exposed on average to more dioxins and dioxin-like PCBs from food than the tolerance limit.» And «The food groups that contribute the most are fatty fish, milk and dairy products and meat.» In contrast to toxins, there are no disadvantages to fortification. Therefore supplementation should be considered as the best choice/source of vitamin B12. Source: Henjum, S. et al. (2022). Adequate vitamin B12 and folate status of Norwegian vegans and vegetarians. British Journal of Nutrition, 1-20. doi:10.1017/S0007114522002987 Helsenorge.no Vegetarian Diet https://www.helsenorge.no/kosthold-og-ernaring/vegetarisk-kosthold/ Vegetarian and vegan diet - expert opinion from the National Council for Nutrition. Chapter 2. What kind of supplements should adults on a vegetarian or vegan diet take? https://www.helsedirektoratet.no/rapporter/vegetar-og-vegankost-ekspertuttalelse-fra-nasjonalt-rad-for-ernaering/hva-slags-kosttilskudd-bor-voksne-med-et-vegetarisk-eller-vegansk-kosthold-ta VKM. Dioksiner i maten til den norske befolkningen. Risk assessment of dioxins, furans, and dioxin-like PCBs in food in Norway https://vkm.no/risikovurderinger/allevurderinger/dioksinerimatentildennorskebefolkningen.4.413ea92416707dc4375a0a18.html	

			Miljøgifter i norsk mat. Henrik S. Huitfeldt, Bjørn J. Bolann Tidsskr Nor Legeforen 2021 doi: 10.4045/tidsskr.21.0499 https://tidsskriftet.no/2021/07/debatt/miljogifter-i-nors...	
Anne Bærug	Norwegian Institute of Public Health, Breastfeeding Unit	This comment relates to the parts of the text that is about infants, breastfeeding and breastmilk, for example here: Abstract "In addition, the assumption that breast milk contains sufficient vitamin B12 for optimal health and neurodevelopment during the first 6 months of life does not comply with high prevalence of insufficient vitamin B12 status in this age group." Comment: Based on two Norwegian studies: Hay et al. (2008) Folate and cobalamin status in relation to breastfeeding and weaning in healthy infants and Henjum et al. (2020) Vitamin B12 concentrations in milk from Norwegian women during the six first months of lactation., maternal B12 status, human milk B12 concentrations, and B12 status of breastfed infants are likely sufficient. Low cobalamin status is a characteristic finding in breastfed children. The data from Hay et al 2008 suggest that relatively low serum cobalamin and holoTC and high serum MMA concentrations are normal findings in breastfed infants. Reference limits according to the age of the child and the breastfeeding status should be used and are provided in the paper. This paper by Hay et al 2008 should be referred to in the chapter. It is referred to in the systematic review by Obbagy et al (2019).		Thank you for the comments. The suggested articles show that low cobalamin status is common in Norwegian infants. The assumption that a low cobalamin status is normal in infants is however wrong, based on the following: • Observational studies show that even moderate cobalamin deficiency in infants are associated with clinical deficiency symptoms and signs, as well as impaired neurodevelopment. • Randomized controlled intervention studies show that cobalamin supplementation to both moderate and severely deficient cobalamin deficient infants are associated with improved neurodevelopment.

		Complementary feeding and micronutrient status: a systematic review, which is one of the systematic reviews behind the new American recommendations. According to information from WHO, Department of Nutrition and Health, a systematic review on timing of introduction of complementary foods will be published later this year or early 2023. This systematic review will inform revision of the WHO Guidelines on introduction of complementary foods. References: Hay et al. Folate and cobalamin status in relation to breastfeeding and weaning in healthy infants. Am J Clin Nutr 2008;88:104-14. Henjum et al. Vitamin B12 concentrations in milk from Norwegian women during the first six months of lactation. Eur J Clin Nutr 2020; 74:749-756. Obbagy et al. Complementary feeding and micronutrient status: a systematic review. Am J Clin Nutr 2019;109 (Suppl_7):8525-8715.		
Elisabet Rytter	Livsmedelsföretagen Service i Sverige AB		Page 9: Vegans/Vegetarians Current text: "Vegetarian diets, especially vegan diets, tend to contain low or no amounts of vitamin B12 and these diets are associated with an increased risk of vitamin B12 deficiency (22, 57-60). Plant foods might contain trace amounts due to bacterial or soil contamination or as a result of fermentation. Green and purple lavers (Nori) may contain some vitamin B12 and can be used by humans, whereas blue-green algae or cyanobacteria	Thank you for the comments! Some of the suggestions have been included.

			(Spirulina) contain biologically inactive B12 analogues (2, 61). Some plant-based milk substitutes might be fortified with vitamin B12 and might be an important source of vitamin B12 in vegans." Comments: First sentence should be changed to: "Vegetarian diets AND, especially, vegan diets tend to…" (as vegan diets are not "part of" vegetarian diets). Third sentence: It may not be warranted to give such a detailed description of different algae. A small cross-sectional study suggested that vegans who supplemented with cyancobalamin had normal vitamin B12 status based on holotranscobalamin (median 150 pmol/l). In contrast, use of natural products (algae, kombucha, or other fermented products) was insufficient to raise the levels of holotranscobalamin (Ref below). Ref: Zugravu CA, Macri A, Belc N, Bohiltea R. Efficacy of supplementation with methylcobalamin and cyancobalamin in maintaining the level of serum holotranscobalamin in a group of plant-based diet (vegan) adults. Exp Ther Med. 2021 Sep;22(3):993. Last sentence. "Some plant-based alternatives ARE fortified with vitamin B12…..". We think it is important to add one more sentence, informing that vegan meals that include fortified dairy and meat substitutes can be nutritionally adequate (ref below), to show that there are modern vegan foods that offer the daily dose of B12. Hence, it is becoming easier to ensure a sufficient B12 intake as compared before, e.g., when choices were	

			restricted to algea, which had variable nutrient content depending on type (here the algea references are more appropriate). Ref: Eustachio Colombo P, Elinder LS, Lindroos AK, Parlesak A. Designing Nutritionally Adequate and Climate-Friendly Diets for Omnivorous, Pescatarian, Vegetarian and Vegan Adolescents in Sweden Using Linear Optimization. Nutrients. 2021 Jul 22;13(8):2507. Page 15: Vegetarian and vegan diets Current text: "As vitamin B12 only occur in foods of animal origin, strict vegan diets will eventually result in vitamin B12 deficiency unless supplemented. However, lower intake and status is also observed with less restrictive diets limiting animal food (96). It should be emphasized that symptoms of deficiency may not occur until years after adopting such diets. As repleting the body stores through supplements would take a long time, initial treatment with injections is warranted once symptoms of deficiency are present." Comment: Second sentence: "… with less restrictive diets limiting animal food AND supplied with non-fortified plant protein products (96)", as this was a study to see the natural course when not using supplements or fortified foods. There are vast differences when adequately fortified products are used. Also, again we think it is of importance to add that vegan meals that include fortified dairy and meat substitutes can be nutritionally adequate (ref below).	

			Ref: Eustachio Colombo P, Elinder LS, Lindroos AK, Parlesak A. Designing Nutritionally Adequate and Climate-Friendly Diets for Omnivorous, Pescatarian, Vegetarian and Vegan Adolescents in Sweden Using Linear Optimization. Nutrients. 2021 Jul 22;13(8):2507. The last two sentences do not seem warranted here. This would appear true for other conditions associated with B12 deficiency as well, e.g., deficiencies with other etiologies, such as poor apetite in elderly. As this is a general statement it belongs elsewhere (also not related to the other text, i.e., reference 96).	
Johanna Eén	Svenskt Kött	The authors state that there is currently no consensus on the optimal status of biomarkers for vitamin B12, but also that the recommended levels of intake probably are too low. Since active vitamin B12 basically is only found in foods of animal origin, the chapter provides support for the conclusion that meat and milk products should be included in a healthy and balanced diet contributing to a sufficient intake of both vitamin B12 and other essential nutrients, such as iron and zinc. Since vitamin B12 is mainly found in animal food, consumers who exclude these foods from their diet are dependent on supplements or fortified foods. It is therefore positive that the authors point out that a strict vegan diet eventually results in deficiency, and that this might appear even with a less restrictive diet. The fact that symptoms can appear after several years with a diet excluding animal foods and that even moderate deficiency can affect health negatively is important information.		Thank you for the comments! This last reference has been added.

		It would be appropriate to further emphasize the advantages of a mixed diet and to have an in-depth discussion about the concerns that supplements might generally entail, including bioavailability. The fact that the authors consider it likely that vitamin B12 deficiency will become even more widespread in the population as a result of vegetarian diets should be considered extremely serious. Vitamin B12 deficiency is already found in sensitive groups and the damage to health can be irreparable. This further reinforces the nutritional benefits of a diet containing meat, milk and milk products, and the importance of highlighting their advantages. Attention should also be paid to the Food Matrix of animal food. Since NNR strive for a holistic approach to nutrition and sustainability, an analysis of how fortification and food supplements are produced as well as the nutritional quality of the supplements is needed. Simply stating that a diet without foods of animal origin requires supplements is far too basic and a more profound analysis is crucial. Furthermore, studies of PBMAs, Plant-Based Meat Analogues, have shown that "surprisingly few" products are fortified with vitamin B12 (Bryngelsson et al).		

18. Biotin

Name	Organization	General comments	Detailed comments	Comment from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association		Page 4. Bread baked with yeast, soy, nuts, and almonds are good plant-based sources of biotin and should be mentioned here.	Thank you for the comment. These dietary sources have now been added to the chapter.
Johanna Eén	Svenskt Kött	Dear NNR Commitee, Thank you for the opportunity to comment upon the biotin draft. Please find below the comments from Svenskt Kött (´Swedish Meat´). As stated in the draft, data providing an estimate of biotin requirements are limited, and no DRVs are given in NNR 2022. Although overt biotin deficiency is uncommon it can cause severe conditions, including developmental delays in infants and children. Biotin is found in most foods, and liver and egg yolk are particularly good sources. We therefore call upon the NNR Committee to further emphasize the importance of a varied and healthy diet including foods of animal origin.		Thank you for the comments. To our knowledge few studies have evaluated vegetarian/vegan diets and biotin status and given that biotin is also found in non-animal derived foods such as yeast, soy, nuts and some vegetables, and we have decided not to emphasize the importance of omnivore diet in this chapter.

19. Pantothenic acid

Name	Organization	General comments	Detailed comments	Comment from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 2: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	Adjusted according to comment
Ann-Kristin Sundin	LRF Mjölk	Dear NNR committee, Thank you for the valuable opportunity to comment on the NNR chapter drafts. On pantothenic acid, LRF Dairy Sweden would like to comment as follows: Milk and dairy, at least as cheese, is suitable in the list of sources of pantothenic acid. The sources to this vitamin that are now included in the list are both more and less rich sources, compared to milk and dairy.		Adjusted according to comment

20. Choline

Name	Organization	General comments	Detailed comments	Comment from authors
Åke Nilsson	Lund University, Department of Clinical Sciences Lund, Medicine/Gastroenterology.	I am glad that recommendations on choline intake are now given. They have been needed for some time. Generally the chapter is well written. Regarding pathology of choline deficiency experimental studies demonstrating renal damage and effects on lung function could be mentioned. Obese patients with progressive NAFLD have average renal and and lung functions below normal average and it is hard to know what optimal choline intake in these patients are. A main point in the detailed comments below is that lyso-phosphatidylcholine (PC) in my opinion is a main transport form for choline to tissues.	In the part "Physiology and metabolism" it could be emphasized that normally the amount of phosphatidylcholine (PC) secreted in bile via the ABCB4 transporter far exceeds the amount in the diet. The description of transporters for choline which participate in in intestinal absorption could mention that much of the choline is absorbed as lyso-PC which is either degraded further or reacylated into chylomicron phosphatidylcholine in the intestinal epithelial cells. The partitioning to chylomicron phosphatidylcholine increases with the amount of fat in the diet. Whereas the high affinity pathway for intestinal absorption of free choline is saturated at rather low concentration the uptake of lyso-PC has a high capacity. Furthermore, absorption as lyso-PC avoids release of free choline in the gut lumen and thereby the possibility for bacterial conversion to TMA. In addition to the pancreatic phospholipase A2, a brush border phospholipase B can hydrolyze both fatty acid esters of phosphatidylcholine. The first pass uptake and reincorporation of choline in liver phospholipids are extremely efficient and newly synthesized PC preferentially used for bile PC secretion ABCB4. So, there is an extensive indirect enterohepatic recirculation of choline (For ref see ref 1). Regarding the transport to tissues the text describes the transporters for free choline well but does not mention that uptake by	1. The description of transporters for choline which participate in in intestinal absorption could mention that much of the choline is absorbed as lyso-PC which is either degraded further or reacylated into chylomicron phosphatidylcholine in the intestinal epithelial cells. The partitioning to chylomicron phosphatidylcholine increases with the amount of fat in the diet. Whereas the high affinity pathway for intestinal absorption of free choline is saturated at rather low concentration the uptake of lyso-PC has a high capacity. Furthermore, absorption as lyso-PC avoids release of free choline in the gut lumen and thereby the possibility for bacterial conversion to TMA. In addition to the pancreatic phospholipase A2, a brush border phospholipase B can hydrolyze both fatty acid esters of phosphatidylcholine. The first pass uptake and reincorporation of choline in liver phospholipids are extremely efficient and newly synthesized PC preferentially used for bile PC secretion ABCB4. So, there is an extensive indirect enterohepatic recirculation of choline (For ref see ref 1). 2. We thank Dr. Nilsson for the input on bile phospholipids and lyso-phosphatidylcholine as important sources of choline for human. Given the limited space we have on choline physiology, we now included several brief statements to cover the aspects raised in the comments.

			the tissues of plasma lyso-PC may significantly exceed the uptake as free choline (For ref see ref 2). A significant uptake to the brain of both polyunsaturated fatty acids and choline occurs as lyso-PC via the mfsd2a transporter(3). In pregnant rats a remarkably high proportion of intravenously injected radiolabeled lyso-PC is taken up by placenta which also expresses mfsd2a (for ref see ref 2). Lyso-PC is formed by LCAT and is also secreted by the liver. We tend to discuss LCAT only in relation to cholesterol transport and to neglect the role of the enzyme in lyso-PC formation and choline transport (For ref see ref 2). Obese patients with NAFLD tend to have low HDL and low plasma lyso-PC. Cystic fibrosis patients have low plasma lyso-PC and may be improved by choline or choline phospholipid supply. The choline transport with lyso-PC may thus be an important and clinically significant link between lipoprotein metabolism and choline supply to tissues. 1.Nilsson A, Duan RD. Pancreatic and mucosal enzymes in choline phospholipid digestion. Amer J Physiol Gastroint Liver 2019; 316:G425-G445. https://doi.org/10.1152/ajpg.00320.2018. 2. Nilsson A, Duan RD, Ohlsson L Digestion and absorption of milk phospholipids in newborn and adults. Front. Nutr., 18 August 2021 | https://doi.org/10.3389/fnut.2021.724006 3. Nguyen LN, Ma D, Shui G, Wong P, Cazenave-Gassiot A, Zhang X, et al.	

			Mfsd2a is a transporter for the essential omega-3 fatty acid docosahexaenoic acid. Nature. (2014) 509:503–6. doi: 10.1038/ nature13241	
Charlotta Hyttinen	Nutritionist (MSc) at Finnish Vegan Association		Page 6, lines 16-18 Diets with vegetarian tendency, and especially vegan diets, are rich in folate and betaine. Vegan diets are also rich in vitamin B12 as a result of supplementation. All of these nutrients interact in choline metabolism, some e.g. as methyl donors, which diminishes the need for dietary choline as compared to diets with low intake of the before mentioned nutrients. This is indicated later in the Choline-chapter on page 12 lines 21-24, though the information is relevant to mention specifically when discussing vegetarian diets and choline requirements, as argumented above. Choline deficiency, or symptoms related to, haven't been reported in vegans or vegetarians, nor in vegan or vegetarian children or infants. It is also notable that most research done on choline intake and health outcomes have been conducted on omnivores with low folate intake (e.g. Ylilauri et.al. 2019, ref. no. 60). Insufficient choline intake seem to be especially harmful when intake of other methyl donors active in choline metabolism are insufficient too. "The global trend to reduce animal-source foods in order to attain sustainability goals implies that it may be difficult to achieve AIs of choline, especially in vulnerable	1. Plant-based diets are usually higher in folate compared with more animal-based diets and intakes of betaine may be higher; however, to our knowledge no studies have reported habitual dietary intake of betaine in vegans or vegetarians. Vegan diets are sufficient in vitamin B12 if supplementation is used; however, reported habitual vitamin B12 intake and status, regardless of if supplementation were included or not, tends to be lower in vegans compared to omnivores [1, 2]. In addition, vegans and vegetarians have a lower intake of methionine [3]. Also, sufficient dietary folate and betaine do not replace choline as they are unavailable as substrates for phospholipid synthesis. There is no sufficient evidence of intakes of total methyl-group donors (methionine, choline, betaine, folate) and co-factors (vitamin B2, B6, B12) in relation to choline sufficiency in vegans and vegetarians. We do know that, in the very few studies that have reported on choline intake, choline intake tends to be lower in [4, 5]. Choline deficiency, or symptoms, have not been reported nor specifically studied in vegans or vegetarians. This is in addition hampered with the lack of markers of choline status. Yes, most research performed on choline intake and health have been conducted on omnivores. Consequently, we know very little of choline intake and status in relation to

			population groups such as young women and infants. A "vegetarian tendency" dietary pattern was associated with lower intake coefficients for choline in women of childbearing age (34)." It is relevant to add that vegetarian and vegan diets do not effect choline breast milk concentrations (Perrin et.al. 2020), which indicates that lactating vegetarian and vegan women have sufficient intakes, as well as their infants. Page 8, line 30: The Perrin study compared water-soluble breast milk choline concentrations between mothers adhering to omnivorous, vegetarian or vegan diets. It didn't find differences between diet groups, which indicates that breast-fed infants of vegetarian and vegan mothers as well as breastfeeding vegan and vegetarian mothers have sufficient choline intakes, and that vegetarian diet patterns are not risk factors for low choline breast milk. This is worth a mention in the chapter on page 8 or on page 6. See: Perrin MT, Pawlak R, Allen LH, Hampel D. Total Water-Soluble Choline Concentration Does Not Differ in Milk from Vegan, Vegetarian, and Nonvegetarian Lactating Women. J Nutr. 2020:1;150(3):512-517. doi: 10.1093/jn/nxz257.	health in vegans/vegetarians; therefore, speculations of choline sufficiency in vegans/vegetarians are premature. A sentence has been added to section 6 Dietary intake in Nordic and Baltic countries. 2. Perrin et al. reported that the content of water-soluble choline in breast milk were similar in vegans (n=26) and vegetarians (n=22) compared with omnivores (n=26) [6]. However, this is not evidence that women with a habitual vegan or vegetarian diet have sufficient choline intake to supply it in the milk and for their own body requirements. This study did not measure mother depletion (e.g fatty liver) and there is a lack of evidence for or against mother depletion. Animal studies has shown that choline deficiency during lactation not only caused more severe choline-depletion in the liver, but also caused accumulation of triglycerides in the liver (while triglycerides did not accumulate in liver of pregnant rats on the choline deficient diet) [7]. No change in text. References 1. Kent G, Kehoe L, Flynn A, Walton J: Plant-based diets: a review of the definitions and nutritional role in the adult diet. Proc Nutr Soc 2022, 81:62-74. 2. Neufingerl N, Eilander A: Nutrient Intake and Status in Adults Consuming Plant-Based Diets Compared to Meat-Eaters: A Systematic Review. Nutrients 2021, 14. 3. Schmidt JA, Rinaldi S, Scalbert A, Ferrari P, Achaintre D, Gunter MJ, Appleby PN, Key TJ, Travis RC: Plasma concentrations

				and intakes of amino acids in male meat-eaters, fish-eaters, vegetarians and vegans: a cross-sectional analysis in the EPIC-Oxford cohort. Eur J Clin Nutr 2016, 70:306-312. 4. Lecorguille M, Lioret S, de Lauzon-Guillain B, de Gavelle E, Forhan A, Mariotti F, Charles MA, Heude B: Association between Dietary Intake of One-Carbon Metabolism Nutrients in the Year before Pregnancy and Birth Anthropometry. Nutrients 2020, 12. 5. Wallace TC, Blusztajn JK, Caudill MA, Klatt KC, Natker E, Zeisel SH, Zelman KM: Choline: The Underconsumed and Underappreciated Essential Nutrient. Nutr Today 2018, 53:240-253. 6. Perrin MT, Pawlak R, Allen LH, Hampel D: Total Water-Soluble Choline Concentration Does Not Differ in Milk from Vegan, Vegetarian, and Nonvegetarian Lactating Women. J Nutr 2020, 150:512-517. 7. Zeisel SH, Mar MH, Zhou Z, da Costa KA: Pregnancy and lactation are associated with diminished concentrations of choline and its metabolites in rat liver. J Nutr 1995, 125:3049-3054.

21. Vitamin C

Name	Organization	General comments to the chapter	Specific comments to the chapter	Authors comments
Johanna Kaipiainen (M.Sc, RD)	Finnish Vegan Association	No general comments	Page 2 and 13: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Page 14. Despite the average intake of vitamin C being sufficient, maybe the high prevalence of people with intake below the recommended current vitamin C recommendation should be mentioned here. According to Nutrition in Finland – The National FinDiet 2017 Survey only 75 % of women and 62 % of men reached the current recommended intake of 75 mg/day. Valsta L, Kaartinen N, Tapanainen, Männistö S, Sääksjärvi K. Ravitsemus Suomessa – FinRavinto 2017 -tutkimus [Nutrition in Finland – the National FinDiet 2017 Survey]. Institute for Health and Welfare (THL). Helsinki, Finland 2018. Available: https://www.julkari.fi/handle/10024/137433	We have adjusted the manuscript according to the suggestions

22. Calcium

Name	Organization	General comments	Detailed comments	Comments from authors
Ellen Kathrine Ulleberg	Norwegian Dairy Council	Thank you for the opportunity to comment on the NNR chapter on calcium. We would like to make the following remarks: In the section «Dietary intake in the Nordic and Baltic countries" the intake of calcium for adults is described but there is no mention of the calcium intake among children and adolescents. In Norway the last nationwide dietary survey among students in 4th and 8th grade, Ungkost 3, showed that while the 13-14 year old boys reached the recommended intake on average, the 13-14 year old girls did not. Their intake was on average 753 mg, compared to the recommendation of 900 mg (1). When comparing data from Ungkost 2000 (2) and Ungkost 3 we see a reduction in the consumption of milk for both 13-14 year old boys and girls, but the reduction is largest among the girls. As we know that women are more at risk for e.g osteoporosis, this issue should be adressed. We would also like to point out that it would have been nice to have an overview of dietary sources of calcium in the introduction or at least in the part describing the dietary intakes in the Nordic and Baltic countries. This is		We have added: The mean intake of calcium among children and teenagers in Lithuania is below the recommended intake and among girls in the age of 10 to 17 years in Estonia. Available data from Norway and Sweden shows that the average calcium intake is close to or above the recommended intake (900 mg) for children and teenagers, although data from Norway shows lower calcium intake on average compared to Sweden (Lemming and Pitsi, Food Nutr Res 2022). (Page 8) Most of the dietary calcium in comes from dairy products, but some non-dairy products can also contribute notably, e.g., vegetables, starchy foods, dried fruits and water. Calcium-fortified foods are also widely used and can help people to fill calcium gaps in their daily diets (Shkembi, B.; Huppertz 2022).

		now placed at the end of the chapter under "Requirements and recommended intakes". In the same section (Requirement and recommended intake) we suggest adding a reference, namely Shkembi B, Huppertz T. Calcium Absorption from Food Products: Food Matrix Effects. Nutrients. 2022; 14(1):180. https://doi.org/10.3390/nu14010180 (3) 1) Helsedirektoratet, UNGKOST 3 Landsomfattende kostholdsundersøkelse blant elever i 4. -og 8. klasse i Norge, 2015 2) Helsedirektoratet, UNGKOST-2000 Landsomfattende kostholdsundersøkelse blant elever i 4.-og 8. klasse i Norge, 2002 3) Shkembi B, Huppertz T. Calcium Absorption from Food Products: Food Matrix Effects. Nutrients. 2022; 14(1):180. https://doi.org/10.3390/nu14010180		
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 2 and 4. It is worth of noting, that a risk for low calcium intake in plant-based diets is now lower than earlier. Fortified foods, for example plant-based milk alternatives, are widely available and use of them have improved calcium intake in plant based diets. In a recent systematic review, in which all studies were published between years 2000–2020, average calcium was 895 mg/d in vegetarians, 838 mg/d in vegans and 858 mg/d in meat-eaters (1).	We have reworded the paragraph and added some references (page 4, last par.): Plant-based diets can lead to lower intakes of nutrients, such as calcium, vitamin D, and some B-vitamins (26). As well, different protein sources (plant and animal) with varying amino acid profiles may have diverse effects on BMD and bone turnover. Recent studies have suggested that vegans have higher levels of circulating bone turnover

			1. Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/	markers compared to omnivores, which may in the long-term lead to poorer bone health (Ho-Pham et al. 2009; Hansen et al. 2018; Ma et al. 2021 ; Neufingerl and Eilander 2022). (27). However, more prospective research is needed to clear the impact of plant-based diets on bone health.
Plant-food Sweden	Plant-food Sweden	A transition towards a more plant-centric food system may become identified as one of the factors that would contribute to the vision of making the Nordic Region the most sustainable region in the world by 2030. We greatly appreciate that not only animal-based, but also a healthy plant-based diet, is represented in the chapter.	We appreciate the quality work done, that plant-based diets are mentioned, and that the effects of dietary versus supplementary calcium is clearly disentangled in this review. However, on page 4. (""Recent studies have suggested that vegan diet…. (27)") we think it is unfortunate the way the Itkonen-study is taken to represent vegan diet in terms of "calcium intake and bone metabolism". Firstly, it only partially substituted animal foods for plant-based foods so it is actually not vegan. Secondly, it focused on the effect of animal- versus plant protein sources on bone metabolism. Calcium was merely one of many confounders that were not adequately controlled for. We do not see the relevance of discussing this study, given that it does not answer to the effect of calcium on bone metabolism. It is also not difficult to control for calcium and other nutrients by use of fortified plant-based foods and/or supplement. Calcium fortified drinks are an important source of calcium in the vegan diet. Further, we think it is misleading to write "Recent studies" when there is one single, unrepeated study. Possibly it could be	In the abstract of Neufingerl et al. it is said: "Intake and status of vitamin B12, vitamin D, iron, zinc, iodine, calcium and bone turnover markers were generally lower in plant-based dietary patterns compared to meat-eaters. Vegans had the lowest vitamin B12, calcium and iodine intake, and also lower iodine status and lower bone mineral density. Meat-eaters were at risk of inadequate intakes of fiber, PUFA, α-linolenic acid (ALA), folate, vitamin D, E, calcium and magnesium. There were nutrient inadequacies across all dietary patterns, including vegan, vegetarian and meat-based diets. As plant-based diets are generally better for health and the environment, public health strategies should facilitate the transition to a balanced diet with more diverse nutrient-dense plant foods through consumer education, food fortification and possibly supplementation." All kind of dietary patterns can be inadequate, as well as nutrionally balanced. However, more research is needed how to get people put into practice a well-balanced diet, never mind if vegan or omnivorous. We have

			included in the protein chapter, if there is more data on various protein sources and bone health to support this result and preferably with actual BMD measurements.	reworded the paragraph and added some references (page 4, last par. includin Neufingerl et al.): Plant-based diets can lead to lower intakes of nutrients, such as calcium, vitamin D, and some B-vitamins (26). As well, different protein sources (plant and animal) with varying amino acid profiles may have diverse effects on BMD and bone turnover. Recent studies have suggested that vegans have higher levels of circulating bone turnover markers compared to omnivores, which may in the long-term lead to poorer bone health (Ho-Pham et al. 2009; Hansen et al. 2018; Ma et al. 2021 ; Neufingerl and Eilander 2022). (27). However, more prospective research is needed to clear the impact of plant-based diets on bone health.
Ann-Kristin Sundin	LRF Mjölk	Dear NNR Committee, Again, thank you for the opportunity to submit comments to the NNR draft chapters. Here are the comments from LRF Dairy Sweden on Calcium: 1. We would like to bring the authors' attention to Iuliano et al (2021), which – with its elegant design – clearly points to a protective effect of dairy on risk of falls and hip fractures among older adults. Iuliano S, Poon S, Robbins J, Bui M, Wang X, De Groot L et al. Effect of dietary sources of calcium and protein on hip fractures		1) We have not missed the paper of Iuliano et al. A recent large two-year cluster randomized controlled trial showed that supplementation using high calcium, high protein dairy foods reduced falls and fractures in vitamin D replete older adults in aged care (Iuliano et al, 2021) (Page 9 and Table 3). 2) Bioavailability of fortified foods in pregnancy is an interesting question and need to be studied, but it was not within the scope of this review. 3) We have deleted the reference to EAT Lancet. 4) According to a paper by Lemming & Pitsi [32] the Nordic and Baltic countries share both similarities and differences

		and falls in older adults in residential care: cluster randomised controlled trial BMJ 2021; 375 :n2364 doi:10.1136/bmj.n2364 2. We are missing the bioavailability aspects to fortified foods under Pregnancy related outcomes. 3. The authors specifically mention the reference diet proposed by the EAT Lancet Commission in 2019 under Requirement and recommended intakes. This diet has been widely and heavily criticized due to the lack of scientific support. It would, therefor, be unsuited to mention this study in general and reference diet in particular without also mentioning the criticism, as the authors have done with other studies in this draft. 4. We miss a more general summary of the calcium intake in the Nordic and Baltic countries. 5. We miss a clarification under Requirement and recommended intakes on the risk that vegetarian and vegan diets make regarding calcium deficiency, as is presented under Physiology of calcium metabolism and bone growth. 6. We miss a clear summary of identified risk groups for a low intake of calcium, although children and young adults, as well as elderly, are		in food culture, which in turn reflect differences in average food consumption and nutrient intakes across countries. Relating to calcium intake, the consumption of dairy product ranges between the lowest of 124 grams in Lithuanian women to the highest of 480 grams in Finnish men. Available data for the Nordic countries using either 24-hour recall or food record, shows calcium intake with the average daily intake ranging from 811 mg among women in Norway to 1188 mg among men in Denmark. However, mean calcium intake remains below the recommendations in the Baltic countries with the average calcium intake ranging from 546 mg among women in Lithuania to 768 among men in Estonia and Latvia. The mean intake of calcium among children and teenagers in Lithuania is below the recommended intake and among girls in the age of 10 to 17 years in Estonia. Available data from Norway and Sweden shows that the average calcium intake is close to or above the recommended intake (900 mg) for children and teenagers, although data from Norway shows lower calcium intake on average compared to Sweden [32] 5) We have reworded the chapter and added some references (page 4, last paragraph): Plant-based diets can lead to lower intakes of nutrients, such as calcium, vitamin D, and some B-vitamins (26). As well, different protein sources (plant

		mentioned. 7. Lastly, we kindly remind the authors that the preferred term is "soy drink", not "soy milk", according to EU regulations.		and animal) with varying amino acid profiles may have diverse effects on BMD and bone turnover. Recent studies have suggested that vegans have higher levels of circulating bone turnover markers compared to omnivores, which may in the long-term lead to poorer bone health (Ho-Pham et al. 2009; Hansen et al. 2018; Ma et al. 2021 ; Neufingerl and Eilander 2022). (27). However, more prospective studies are needed to clear the impact of plant-based diets on bone health.
Elisabet Rytter	Swedish Food Federation		We welcome that plant-based diets are mentioned, and that the effects of dietary versus supplementary calcium is clearly disentangled in this review. However, on page 4. (""Recent studies have suggested that vegan diet…. (27)") it should be evaluated if the study presented in reference (27) is representative for vegan diet in terms of "calcium intake and bone metabolism" since it; - only partially substituted animal foods for plant-based foods and is not actually vegan - focused on the effect of animal- versus plant protein sources on bone metabolism (calcium was merely one of many confounders that were not adequately controlled for). In our opinion it is not relevant to discuss this study in the chapter Calcium as it does not answer to the effect of calcium on bone metabolism. It is misleading to write "Recent studies" when there is one single, unrepeated	We have reworded the chapter and added some references (page 4, last paragraph): Plant-based diets can lead to lower intakes of nutrients, such as calcium, vitamin D, and some B-vitamins (26). As well, different protein sources (plant and animal) with varying amino acid profiles may have diverse effects on BMD and bone turnover. Recent studies have suggested that vegans have higher levels of circulating bone turnover markers compared to omnivores, which may in the long-term lead to poorer bone health (Ho-Pham et al. 2009; Hansen et al. 2018; Ma et al. 2021 ; Neufingerl and Eilander 2022). (27). However, more prospective research is needed to clear the impact of plant-based diets on bone health. We have reworded the chapter and added some references (page 4, last paragraph):

			study. Maybe the reference 27 could be included in the protein chapter if there is more data on various protein sources and bone health to support this result and preferably with actual bone mineral density measurements.	

23. Phosphorus

Name	Organization	General comments	Detailed comments	Comment authors
Johanna Kaipiainen (M.Sc, RD), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 4. The lower bioavailability of phosphorus from plant-based diets is mentioned here; so, it should also mention how is phosphorus intake and status in plant-based diets. According to a recent systematic review average phosphorus intake was similar between dietary patterns (meat-eaters, vegetarians, and vegans). Phosphorus status have been studied in only two studies, vegetarians, and meat-eaters. Phosphorus levels were similar in both groups. (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/) Page 9. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	Page 4: For clarity, we have removed the first sentence ("There are specific questions related to plant-based diets and bioavailability of phosphorus.") because the point is on plant-based foods, not diets. We do not find it necessary to add information on phosphorus intake in plant-based diets in this context. Page 9: We have reorganised the the sentence.
L.M. Granskog	concerned citizen	It would appear that one way to avoid excessive phosphorous would be to avoid commercially processed food, or to read ingredient labels carefully.	comments on page 1 Plant based diets are not more sustainable as implied on page one of this chapter. The world's diets, including those in western countries are apparently already plant based.https://www.nationalgeographic.com/what-the-world-eats/ Most crops are produced with tillage and there is nothing sustainable about repeated tillage. https://theconversation.com/its-time-to-rethink-the-disrupted-us-food-system-from-the-ground-up-139708 Tillage has also been a major source of ghg emissions.https://doi.org/10.1016/j.still.2018.02.001 What is or is not sustainable is dependent on how food is produced. Ruminants can produce food without fossil fuel inputs, pesticides, artificial fertilizers or	We have edited the abstract and the current version is: "The scoping review aims is to describe the totality of evidence for the role of phosphorus for health related outcomes as a basis for setting and updating DRVs. Phosphorus is needed in many biological processes such as cellular metabolism and bone mineralization. Dietary phosphorus intake exceeds the current recommendations 2-3-foldly in the Nordic countries. Intake from food additives is unknown but may play a significant role because the use of phosphate additives is common in the food industry. Bioavailability of phosphorus in plant-based products is lower than in animal-based products. Nevertheless, bioavailability of phosphorus additives is higher. The main phosphorus related health outcomes concern high phosphorus intake mainly from

			the destruction of entire ecosystems above and below ground. In many places they do. Phosphorus contents in plant-based products are always not lower than in animal-based products. One hundred grams of roast beef which supplies 25 grams of high quality protein with a DIAAS score of ca 1.1 has 160 mg of phosphorous. https://www.matvaretabellen.no/roastbiff-skiver-03.354 https://en.wikipedia.org/wiki/Digestible_Indispensable_Amino_Acid_Score One hundred grams of dried peas, which supplies ca. 22 grams of poorer quality protein has 300 mg of phosphorous. https://www.matvaretabellen.no/erter-toerre-06.029 The DIAAS score for cooked peas is ca. 0.6 https://en.wikipedia.org/wiki/Digestible_Indispensable_Amino_Acid_Score The RDA for phosphorous is 700 mg for adults over age 19 https://ods.od.nih.gov/factsheets/Phosphorus-HealthProfessional/. A person could apparently eat 400 grams of roast beef a day and still not exceed the RDA for phosphorous. One hundred grams of boiled eggs (ca. 2) has about 193 mg of phosphorous. A person could eat several boiled eggs a day and still not exceed the RDA.	food additives with potential adverse effects on kidney, bone and cardiovascular health."
Malén Gudbrandsgard	MatPrat	The paper clearly shows that there is no evidence that a higher intake than recommended is associated with any risks for healthy adults. Patients with kidney or heart diseases etc should of course be taken care of by specialists regarding intake and consequences. But for the healthy public in general, recommendations of foods, not supplementations should be clear. As is written in the paper, phytate in plants may inhibit the bioavailability of some	Abstract: Line 7: “However, a transition towards more sustainable, plant-based diets may decrease the phosphorus load because bioavailability of phosphorus as well as the phosphorus contents in plant-based products are lower than in animal-based products”. We find this claim biased and does not reflect the findings in the chapter. According to the authors, there is a lack of SRs, meta-analysis and RCTs on phosphorus. Also, the chapter reveals that the	We have edited the abstract and the current version is: "The scoping review aims is to describe the totality of evidence for the role of phosphorus for health related outcomes as a basis for setting and updating DRVs. Phosphorus is needed in many biological processes such as cellular metabolism and bone mineralization. Dietary phosphorus intake exceeds the current recommendations 2-3-foldly in the Nordic countries. Intake from food additives is unknown but may play a significant role because the use of phosphate additives is

		nutrients. It is not clear if and how this has to be taken into consideration with the whole diet, when a shift from animal-based diet to plant-based diet is insinuated. The consequences this may have on nutrients like iron, B12, protein is not clear. Neither is the effect on the interactions between phosphorus, calcium and vitamin D. Even though the intake of phosphorus exceeds the recommended intake, the latter two does not. The intake of these two nutrients are already low in several population groups in the Nordic countries. Reducing the sources of these (animal-based foods) could lead to increased risk other deficiencies such as iron or B12. The amounts and use of additives should be studied instead of reducing important food groups that are good sources of phosphorous, as this might have more negative effects than the positive of reducing phosphorus.	evidence on phosphorus on health outcomes, is either lacking or related to groups with health concerns such as hyperparathyroidism or kidney disease. The chapter refers to EFSA, who has considered phosphates to be of low acute oral toxicity and that the panel has stated that normal healthy individuals can tolerate phosphorus intakes up to at least 3000 mg/day without adverse systemic effects. The intake in the Nordic countries is far below this intake. Thus, to decrease the "phosphorus load" does not seem to be a concern, and the evidence to support the benefits of a transition to a more plant-based diet is missing. The abstract should be clear on these aspects and change the content accordingly. When referring to «dietary phosphorus» it is not clear whether this includes foods with additives or not. This is mentioned in the abstract, line 3, in "Dietary intake in Nordic and Baltic countries line 1 and several other parts of the document.	common in the food industry. Bioavailability of phosphorus in plant-based products is lower than in animal-based products. Nevertheless, bioavailability of phosphorus additives is higher. The main phosphorus related health outcomes concern high phosphorus intake mainly from food additives with potential adverse effects on kidney, bone and cardiovascular health." We added the following sentence to the section "Dietary intake in Nordic and Baltic countries": "Food composition databases do not contain updated and complete information on food additive phosphates (Calvo & Tucker 2013)."
Johanna Eén	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment upon the chapter on phosphorus. Please find below the comments from Svenskt Kött. It may not be stated in the abstract that "a transition towards more sustainable, plant-based diets may decrease the phosphorus load." What constitutes a sustainable diet is highly complex and includes environmental as well as social and economic aspects. How production takes place and to what extent the diet provides us with sufficient nutrients are two aspects, among others, that need to be considered. The authors may not give the impression that it would be a given choice, regardless of context. The position taken does		We have edited the abstract and the current version is: "The scoping review aims is to describe the totality of evidence for the role of phosphorus for health related outcomes as a basis for setting and updating DRVs. Phosphorus is needed in many biological processes such as cellular metabolism and bone mineralization. Dietary phosphorus intake exceeds the current recommendations 2-3-foldly in the Nordic countries. Intake from food additives is unknown but may play a significant role because the use of phosphate additives is common in the food industry. Bioavailability of phosphorus in plant-based products is lower than in animal-based products. Nevertheless, bioavailability of phosphorus additives is higher. The main phosphorus related health outcomes

		not belong in the chapter´s abstract. As mentioned, phosphorus is needed in biological processes such as metabolism and bone mineralization. It is positive that the chapter discusses the differences in absorbability and bioavailability, and the benefits of a well-balanced, varied and healthy diet including animal foods could be further clarified. Furthermore, it is good to call for quality research data and evidence.		concern high phosphorus intake mainly from food additives with potential adverse effects on kidney, bone and cardiovascular health."

24. Magnesium

Name	Organization	General comments to the chapter	Comments from the authors
Ann-Kristin Sundin	LRF	Dear NNR Committee, We thank you for this opportunity to comment on the Magnesium draft. Here are our comments: Milk, whole grain cereals, starchy roots, vegetables and legumes are mentioned as the best sources of magnesium in a mixed diet. Since the content of magnesium in other dairy products, such as yoghurt and cheese, are as high or even higher than the sources accounted for in the draft, we kindly suggest the authors mention "milk and dairy products" instead of only "milk", together with the other dietary sources.	Thanks you for this comment, we have changed the text according to your suggestions
Johanna Eén	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment upon the Magnesium draft. Please find below the comments from Svenskt Kött. Although the draft highlights a mixed diet, it does not mention meat, nor fish or shellfish. As these are important sources of magnesium, it would be relevant to mention them specifically. Meat and fish also contribute several other important nutrients. Since yogurt and cheese, among other dairy products, are good magnesium sources, we encourage the authors to mention "milk and dairy products" instead of only "milk" among the other dietary sources. We appreciate that the authors discuss differences in bioavailability (Pardo M.R. et al 2021; Bioavailability of magnesium food supplements: A systematic review). Furthermore, the study´s conclusion that food supplements might not cover the needs of older people or those with illness is of interest as well and underlines the benefits of a mixed and healthy diet.	Thanks you for this comment, we have changed the text to "mild and dairy åproducts" , and added a sentence about meat and fish. The main point in the Pardo-paper is cited in the text, reference (6). Unfortunately, we cannot og in details regarding limitations with magnesium-supplemets to old people and those with illness, as these issues are beyond the aim of the NNR-project.

25. Sodium as salt

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Mikael Fogelholm	University of Helsinki	It would be good here (and in most other chapters, as well!) to use more tables in summarizing facts. This is particularly relevant for the part summarizing present intake in Nordic countries. It is now very cumbersome to follow the text with countries, gender and intake numbers, all only in the text.	Just wanted to be sure: was it really so, that the effect of sodium in DASH study was independent of the two fruit & veg intake levels? If I remember correctly, a higher F & V intake was associated with lower BP. This could be explained by high potassium levels in F & V.	1. comment: I agree. An uniform summarizing table of nutrient intakes would helpful for the reader. However, the intake figures may not be easily comparable because of differences in methods and accuracy of the assesment of sodium intake. 2. comment: This is an important notice. DASH diet modulates the effect of sodium on BP probably mainly by increased potassium intake. The findings are presented in the first DASH paragraph (page 12, lines 21-28) and discussed thoroughly in the second DASH paragraph on page 13
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc),	Finnish Vegan Association	No general comments.	Page 23. Associated with stomach (91) probably should be associated with stomach cancer (91).	This has been corrected
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Sodium draft. Here are the comments from LRF. There is a great need of recognizing food matrix science in this chapter, as well as others, in order to avoid the reductionistic nutritional view on health and nutrients. There is also a need to acknowledge the difficulty to use old diet surveys for new recommendations.	P 5, under Dietary intake in the Nordic and Baltic countries, row 1-2, it is stated that the main sources of sodium in the diet are, among other sources, cheese and meat, as well as ready meals such as pizza, pie, and soups. According to Riksmaten, the contribution of sodium from cheese are 4%, whilst pizza, pie and pasty contributes to 6%. In relation, cheese is among the smaller contributors to sodium in the diet. Considering the many health benefits of cheese, such as high content of readily bioavailable nutrients and a lowered risk of	1. In Finland 10 % of sodium in men and 13 % in women comes from milk and dairy products, and a half of this comes from cheese. 24 % of dietary sodium in men and 24 % in women comes from meat dishes and 9 % in men and 6 % in women from cold cuts and sausages. Approximately 30 % of sodium intake comes from bread, bakery and cereal products. Lowering population sodium intake is not possible without lowering sodium in processed food and in foods served outside home. I have now made minor changes in the text and order of the products. 2. P 12 rows 10 - describe only DASH-diet, in which the use

			several CVD:s, including high blood pressure, it also seems counterproductive to point out cheese as a source in a negative sense. The food matrix science (several studies have been referred to by LRF in previous chapters) needs to be acknowledged in the NNR drafts/chapters and background papers in order to avoid the reductionistic nutrition view on food, thus overlooking the fact that whole foods often show other health outcomes than do single nutrients. As previously pointed out by LRF and others, it is necessary to emphazise that the intake data is, in Sweden's case, more than 10 years old, thus is not reflecting the consumption pattern of today. The same reasoning goes for meat and meat products. Consumption data from the Swedish Board of Agriculture indicate that the consumption of meat has decreased over the past few years in Sweden. This further implies that the sodium intake from meat and meat products are likely not 7 and 6%, as is stated in Riksmaten 2010-11, but lower. Meat is a group of nutrient dense foods with many health benefits, that need to be acknowledged in order to give an objective view. We therefor strongly suggest that food matrix studies be included in this, as well as other, chapters of the NNR as part of the reference list. We equally strongly suggest that the authors recognize the outdated data as insufficient to point out	of low-fat diary products were increased as part of the diet. This resulted in a decrese in the intake of total and saturated fats. Nothing is said of the monounsaturated fats. The effects on serum lipids of the DASH were presented. DASH-study was not targeted to study effects of specific fatty acids.

			the major sources of sodium in the diet, as well as the difficulties basing food based dietary guidelines upon the same. P 12, second paragraph, row 10: The authors state that "energy derived from fat /…/ reflecting decreased intake of saturated and monounsaturated fats. The failure to point out that stratifying the fatty acids, recognizing the sources and their different health impacts, perpetuates the reductionistic opinion that all saturated fats are unhealthy. There is good evidence to suggest that this opinion is too crude to hold true. Food matrix science indicate that some food sources rich saturated fatty acids (e.g. cheese and full fat yoghurts), but not all (e.g. ghee), are part of a diet decreasing the risk of CVD:s such as hypertension, but also overweight and obesity.	

26. Potassium

No comments received

27. Iron

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Ulrika Åkesson	Food Frame Sweden	Kapitlet innehåller bra information samtidigt som författarna lyfter kunskapsbrister, t ex den generella bristen på långtidsstudier av hög kvalitet.. Kapitlet är tydligt med animalier som viktig källa till hemjärn och där framhålls skillnader i järnupptag och biotillgänglighet. Man lyfter fram riskgrupper och påpekar att kostundersökningarna i de nordiska länderna (i Sverige Riksmaten Ungdom från 2018) visar att den järnmängd som unga kvinnor får i sig ligger under rekommenderat intag. Man är vidare tydlig med vilka risker som järnbrist innebär. NNR har ett stort ansvar i att tydligt uppmärksamma det faktum att omkring en tredjedel av unga tjejer har järnbrist, vilket tyder på att de har ett järnintag som är lägre än det rekommenderade (RI). Det är uppskattat att man pekar på kunskapsbrist gällande motsvarande studier hos äldre personer.	Kapitlet behöver komplettera med nya, relevanta studier som publicerades under 2022; se C. Mayer Labba (2022); Nutritional Limitations of a Green Protein Shift with Focus on Iron; C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. Viktigt att lyfta fram vetenskapliga publikationen: The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext). Den visar att en kosthållning med lågt innehåll av kalcium, mjölk och fibrer, liksom låg fysisk aktivitet och övervikt, är de främsta riskfaktorerna kopplade till tjock- och ändtarmscancer (efter alkohol och rökning). En kosthållning med ett högt intag av rött kött respektive ett högt intag av processat kött utgjorde rapportens lägsta riskfaktorer. Även det faktum att The World Cancer Research Fund (WCRF) inte förespråkar att kött utesluts från kosthållningen då det är en värdefull källa till näringsämnen såsom järn, zink och vitamin B12 bör nämnas, https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/.	Thank you for this comment. We have now included the Mayer-Labba and Bryngelsson references in the text. We have also extended the information about red meat, processed meat as well as heme iron when cancer risks are reported and added the Lancet paper about colorectal cancer.

Maria Häger	HKScan Sweden AB	Det är positivt att författarna tydligt lyfter fram att betydande delar av befolkningen i de nordiska och baltiska länderna löper risk för järnbrist till följd av ett högre behov, och att specifika grupper är särskilt utsatta (små barn, kvinnor fram tillr menopaus, gravida samt vegetarianer), liksom att järnbrist kan leda till allvarliga tillstånd inklusive försämrad mental utveckling hos barn – och att det därför ska vara av hög prioritet att förhindra järnbrist (IDA) hos små barn. Det är vidare positivt att författarna är tydliga med betydelsen av kött, kyckling, fisk och skaldjur för intaget av järn i en blandad kost, och författarna nyanserar avgörande frågor om hemjärn vs. icke-hemjärn, antinutrienter, köttfaktorn, järnupptag och biotillgänglighet på ett förtjänstfullt sätt. Kapitlet behöver dock kompletteras med nya, relevanta studier som publicerades under 2022; se C. Mayer Labba (2022); Nutritional Limitations of a Green Protein Shift with Focus on Iron; C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market.	Det är bra att författarna uppmärksammar Livsmedelsverkets kostundersökning bland unga (Riksmaten Ungdom 2018) som bland annat visar att omkring en tredjedel av unga tjejer har järnbrist, men också att man konstaterar att detta tyder på att de har ett järnintag som är lägre än det rekommenderade (RI), liksom att man noterar att det saknas nyare studier över järnstatusen hos äldre personer. Författarna gör en balanserad redovisning av studier som undersökt kopplingen mellan intaget av järn och cancer. I sammanhanget kan också nämnas den Lancet-publicerade studien The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext) som lyfter fram en kosthållning med lågt innehåll av kalcium, mjölk och fibrer, liksom låg fysisk aktivitet och övervikt, som rapportens främsta riskfaktorer kopplade till tjock- och ändtarmscancer (efter alkohol och rökning). En kosthållning med ett högt intag av rött kött respektive ett högt intag av processat kött utgjorde rapportens lägsta riskfaktorer. Även det faktum att The World Cancer Research Fund (WCRF) inte förespråkar att kött utesluts från kosthållningen då det är en värdefull källa till näringsämnen såsom järn, zink och vitamin B12 bör nämnas, https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/.	Please read the answer to Reviewer 1

			Kapitlet är välbalanserat och samlar viktig kunskap om järnupptag- och källor. Det är angeläget att denna kunskap får genomsyra NNR-arbetet och arbetet med de framtida kosträden.	
Hans Agné	Konsument	Det är positivt att författarna tydligt lyfter fram att betydande delar av befolkningen i de nordiska och baltiska länderna löper risk för järnbrist till följd av ett högre behov, och att specifika grupper är särskilt utsatta (små barn, kvinnor fram tillr menopaus, gravida samt vegetarianer), liksom att järnbrist kan leda till allvarliga tillstånd inklusive försämrad mental utveckling hos barn – och att det därför ska vara av hög prioritet att förhindra järnbrist (IDA) hos små barn. Det är vidare positivt att författarna är tydliga med betydelsen av kött, kyckling, fisk och skaldjur för intaget av järn i en blandad kost, och författarna nyanserar avgörande frågor om hemjärn vs. icke-hemjärn, antinutrienter, köttfaktorn, järnupptag och biotillgänglighet på ett förtjänstfullt sätt. Kapitlet behöver dock kompletteras med nya, relevanta studier som publicerades under 2022; se C. Mayer Labba (2022); Nutritional Limitations of a Green Protein Shift with Focus on Iron; C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. Det är bra att författarna uppmärksammar	Författarna gör en balanserad redovisning av studier som undersökt kopplingen mellan intaget av järn och cancer. I sammanhanget kan också nämnas den Lancet-publicerade studien The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext) som lyfter fram en kosthållning med lågt innehåll av kalcium, mjölk och fibrer, liksom låg fysisk aktivitet och övervikt, som rapportens främsta riskfaktorer kopplade till tjock- och ändtarmscancer (efter alkohol och rökning). En kosthållning med ett högt intag av rött kött respektive ett högt intag av processat kött utgjorde rapportens lägsta riskfaktorer. Även det faktum att The World Cancer Research Fund (WCRF) inte förespråkar att kött utesluts från kosthållningen då det är en värdefull källa till näringsämnen såsom järn, zink och vitamin B12 bör nämnas, https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Kapitlet är välbalanserat och samlar viktig kunskap om järnupptag- och källor. Det är angeläget att denna kunskap får genomsyra NNR-arbetet och arbetet med de framtida kosträden.	Please read the answer to Reviewer 1

		Livsmedelsverkets kostundersökning bland unga (Riksmaten Ungdom 2018) som bland annat visar att omkring en tredjedel av unga tjejer har järnbrist, men också att man konstaterar att detta tyder på att de har ett järnintag som är lägre än det rekommenderade (RI), liksom att man noterar att det saknas nyare studier över järnstatusen hos äldre personer.		
Anna Jamieson	Sveriges Nötköttsproducenter	Kapitlet är välbalanserat och samlar viktig kunskap om järnupptag- och källor. Det är angeläget att denna kunskap får genomsyra NNR-arbetet och arbetet med de framtida kostråden. Det är också positivt att författarna är tydliga med betydelsen av kött, kyckling, fisk och skaldjur för intaget av järn i en blandad kost, och författarna nyanserar avgörande frågor om hemjärn vs. icke-hemjärn, antinutrienter, köttfaktorn, järnupptag och biotillgänglighet på ett förtjänstfullt sätt.	Kapitlet behöver dock kompletteras med nya, relevanta studier som publicerades under 2022; se C. Mayer Labba (2022); Nutritional Limitations of a Green Protein Shift with Focus on Iron; C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market.	Please read the answer to Reviewer 1
Theres Strand	Svenska Köttföretagen	Det är positivt att författarna tydligt lyfter fram att betydande delar av befolkningen i de nordiska och baltiska länderna löper risk för järnbrist till följd av ett högre behov, och att specifika grupper är särskilt utsatta (små barn, kvinnor fram tillr menopaus, gravida samt vegetarianer), liksom att järnbrist kan leda till allvarliga tillstånd inklusive försämrad mental utveckling hos barn – och att det därför ska vara av hög prioritet att förhindra järnbrist (IDA) hos små barn. Det är vidare positivt att författarna är tydliga med betydelsen av kött, kyckling, fisk och skaldjur för intaget av järn i en	Författarna gör en balanserad redovisning av studier som undersökt kopplingen mellan intaget av järn och cancer. I sammanhanget kan också nämnas den Lancet-publicerade studien The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext) som lyfter fram en kosthållning med lågt innehåll av kalcium, mjölk och fibrer, liksom låg fysisk aktivitet och övervikt, som rapportens främsta riskfaktorer kopplade till tjock- och	Please read the answer to Reviewer 1

		blandad kost, och författarna nyanserar avgörande frågor om hemjärn vs. icke-hemjärn, antinutrienter, köttfaktorn, järnupptag och biotillgänglighet på ett förtjänstfullt sätt. Kapitlet behöver dock kompletteras med nya, relevanta studier som publicerades under 2022; se C. Mayer Labba (2022); Nutritional Limitations of a Green Protein Shift with Focus on Iron; C. Mayer Labba (2022); Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Aviable on the Swedish Market samt S. Bryngelsson m fl (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. Det är bra att författarna uppmärksammar Livsmedelsverkets kostundersökning bland unga (Riksmaten Ungdom 2018) som bland annat visar att omkring en tredjedel av unga tjejer har järnbrist, men också att man konstaterar att detta tyder på att de har ett järnintag som är lägre än det rekommenderade (RI), liksom att man noterar att det saknas nyare studier över järnstatusen hos äldre personer. Kapitlet är välbalanserat och samlar viktig kunskap om järnupptag- och källor. Det är angeläget att denna kunskap får genomsyra NNR-arbetet och arbetet med de framtida kostråden.	ändtarmscancer (efter alkohol och rökning). En kosthållning med ett högt intag av rött kött respektive ett högt intag av processat kött utgjorde rapportens lägsta riskfaktorer. Även det faktum att The World Cancer Research Fund (WCRF) inte förespråkar att kött utesluts från kosthållningen då det är en värdefull källa till näringsämnen såsom järn, zink och vitamin B12 bör nämnas, https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/.	
Amanda Jakobsson	Svenskt Kött	It is positive that the authors clearly highlight that parts of the population in the Nordic and Baltic countries are at risk of iron deficiency. It is furthermore positive that the authors writes that there are specfic groups	Look at "4.General comments to the chapter"	Please read the answer to Reviewer 1

		that are more in risk for iron deficiency (small children, women up to menopause, pregnant women and vegetarians), as well as that iron deficiency can lead to serious conditions including impaired mental development in children - and that it should be a high priority to protect people against iron deficiency (IDA) in young children. It is positive that the authors are clear about the importance of meat, chicken, fish and shellfish for the intake of iron in a mixed diet, and the authors nuance crucial questions about heme iron versus non-heme iron, antinutrients, the meat factor, iron absorption and bioavailability in a meritorious way. However, the chapter needs to be supplemented with new, relevant studies published in 2022; see C. Mayer Labba (2022); Nutritional limitations of a green protein shift with a focus on iron; C. Mayer Labba (2022); Nutritional composition and estimated bioavailability for iron and zinc of meat substitutes available on the Swedish market and S. Bryngelsson et al (2022); Nutritional assessment of plant-based meat analogues on the Swedish market. It is good that the authors draw attention to the Swedish Food Agency's dietary survey among young people (Riksmaten Ungdom 2018), which shows, among other things, that around a third of young girls have an iron deficiency, but also that it was found that this indicates that they have an iron intake that is lower than what is recommended, as well as noting that there		

		is a lack of new studies on the iron status of older people. The authors provide a balanced account of studies that investigated the link between the intake of iron and cancer. In this context, it can also be mentioned that the Lancet-published study The global, regional and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https:/ /www. thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext) which highlights a diet low in calcium, milk and fibre, as well as low physical activity and obesity, as the report's main risk factors linked to colon and rectal cancer (after alcohol and smoking). A diet with a high intake of red meat and a high intake of processed meat were the report's main risk factors. Also, the fact that The World Cancer Research Fund (WCRF) does not advocate that meat should be excluded from the diet as it is a valuable source of nutrients such as iron, zinc and vitamin B12 should be mentioned, https://www.wcrf.org/diet-activity -and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. The chapter is well balanced and gathers important knowledge about iron uptake and sources. It is important that this knowledge permeates the NNR work and the work with the future dietary guidelines.		

Tanja Kalchenko	Physicians' and nutrition association Food for health	Sources of iron On page 3, in section Dietary sources and bioavailability, you write: "Meat, poultry and fish as well as cereals are the main iron sources in a mixed diet." This is not entirely true, at least not in Norway. Dietary surveys show that the main source of iron, in both adults and children, is bread and cereal products, together they account for at least 40% of the total intake, and potatos, vegetables, fruits and berries – for 20 % . Meat and meat products contribute only 20-22 % of iron in the Norwegian diet. These 3 surveys are relevant (for Norway) Norkost 3, Ungkost and Småbarnskost: Adults, Norkost 3, 2011: In table 25b on page 44, we can see that the sources of iron in Norway (adults) are following: -Bread 30% cereals 7% cakes 3% -potatoes 4% -vegetables 8% -fruit and berries 5% -juice 2% -Meat and meat products 20% -fish and fish products 2% -egg 5% -wine 4%.	Could you check similar surveys for other Nordic and Baltic countries, possibly? When the intake of food groups is roughly the same in these countries, one can hardly expect that the intake of iron is significantly different. On page 3, I suggest therefore that you remove this sentence "Meat, poultry and fish as well as cereals are the main iron sources in a mixed diet." and replaced this with the following: "The main source of iron in the Nordic and Baltic countries is bread and other cereal products, which contribute 40-50% of the total iron intake. Meat contributes 20%. Vegetables, fruit, berries and juice - with 20%. Fish, eggs and dairy products together contribute approximately 10%."	The reviewer makes a good point, but the sentence refers to bioavailable iron. This has now been clarified in the text.

		Source: Norkost 3. A nationwide dietary survey among men and women in Norway aged 18-70, 2010-11. The University of Oslo, the Norwegian Food Safety Authority and the Directorate of Health. The same applies to children of school age (Ungkost 2016 - survey) The nationwide dietary survey among pupils in 4th and 8th year in Norway, Ungkost 2016, conducted by the Norwegian Institute of Public Health shows (see table 51 on page 59) that bread, cereals and cakes contributed to a total of 49% of the intake of iron, while meat and meat products contributed 22%, and fruits and veggies – with 14 %. In total, plant foods contribute with about 63%, while animal products - with approx. 30%. Table 51. Sources of nutrients. All participants in 4th year (n=636). Percentage of total intake per person per day (%). Sources of iron were in this table 51 on page 59 the following, -bread 33% -cereals 11% -cookies 5% -potatoes 3% -vegetables 6% -fruit berries 1% -juice 4% -meat meat products 22%		

		-fish 1% -egg 3% Source: The nationwide dietary survey among pupils in 4th and 8th year in Norway, Ungkost 2016, The Norwegian Institute of Public Health https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2016/ungkost-rapport-24.06.16.pdf 2-year-old children Also nationwide dietary survey among 2-year-olds in Norway, conducted by Norwegian Institute for public health, 2020, Småbarnskost 2020, shows on table 28 page 45 following --Bread 31 (whole bread 25%) --Porridge 12% (Industrially produced porridge 7% and homemade porridge 5%) --Meat and meat products 12% - including liver paste 8% --Multivitamin Tablets 9% --Fruit and berries 6% --Vegetables 6% --Cheese 3% --Eggs 3% --Cereal and semolina with milk 3% --Flour, rice, pasta 3% Source; Astrup H, Myhre JB, Andersen LF, Kristiansen AL. "Småbarnskost 3. Landsomfattende undersøkelse av kostholdet blant 2-åringer i Norge". [Småbarnskost 3. Nationwide dietary survey among 2-year-olds in Norway] Rapport		

		2020. Oslo: Folkehelseinstituttet og Universitetet i Oslo, 2020. These 3 surveys are from different years, but the Norwegian Directorate of Health also publishes annual dietary survey, named The development of the Norwegian diet in Norway https://www.helsedirektoratet.no/rapporter/utviklingen-i-norsk-kosthold		
Tanja Kalchenko	Physicians' and nutrition association Food for health	Vegetarian diet and iron You write several places that vegetarians and vegans are at risk of iron deficiency (ID) and ID anemia. I do not see that you have the evidence for this. We have evidence for following: that iron STORES are lower than in omnivores. Theoretically, you could think that lower stores gives higher risk for ID and IDA. But what do we know from the studies? This is following: Per 2023, studies show that vegans and vegetarians in developed countries have a good iron status, and get enough iron with their food. Iron stores are somewhat lower in vegans, compared to omnivores, but 1) The iron stores are between references range, 2) Vegans do not have iron deficiency or iron deficiency anemia more often than omnivores. Here I will refer to and quote several recent	On page 1, in Abstract, you write: "Several large population groups in the Nordic and Baltic countries are at risk of iron deficiency, including infants, young children, menstruating females, pregnant women as well as vegetarians." I suggest to remone "as well as vegetarians". The available studies on iron status among vegetarians and vegans in the Nordic countries show the opposite. Including the study you refer to, Haider 2018. They tend to have lower stores (Haider 2018 and AND 2016), but good intake of iron (Sabiecky 2015, Henjum 2021). 2. On page 9 you write: "A low dietary iron intake is a risk factor for iron deficiency in all age groups. Individuals on a vegetarian or vegan diet are a special risk group, see below." I suggest to delete this: "Individuals on a vegetarian or vegan diet are a special risk group, see below." 3. On page 3 you write: "In vegetarian diets, legumes and processed products, wholegrain	Thanks for the suggestion, we have now changed the sentence. Since vegetables and fruits provide a main enhancer (vitamin C), the wording about enhancers has been removed. It is vitamin C that has the strongest potential to reduce Fe^{3+} to Fe^{2+}. The effect of lactic acid fermentation seems to make more Fe^{3+} available. Thank you for your comments. Concerning the first paper you suggest the Henjum article. It was included in our search but we found it problematic due to likely selection bias, since it was not based on a representative sample of participants. Instead participants were recruited through social media with convenience sampling and snowball sampling methods through closed Facebook groups and in online vegan and vegetarian forums. Thus, it is problematic to transfer the findings to the general population. Concerning the second paper Sobiecki, we agree that total iron

		sources for vegans and vegetarians in Europe 1. Henjum, Norway, 2019-2021, study in Norwegian vegans and vegetarians Quoted: «To our knowledge, this present study is among the first to include multiple measures to evaluate iron status among Norwegian vegans, vegetarians and pescatarians. Although the participants were eating restricted plant-based diets, the majority had sufficient iron status evident by blood markers within the reference range in multiple measures (S-Fe, S-Iron, S-TIBC, S-TSAT). No difference was found in iron status between the dietary groups.» Only a few vegans took supplements in this study. The percentage of those who had iron stores lower than reference values was 9% – roughly the same as the rest of the population. The study concludes that menstruating women should pay attention to their iron status, because some lose too much iron during menstrual bleeding: «5. Conclusions The majority of the vegans, vegetarians and pescatarians in the Oslo area in Norway had sufficient iron status. Female vegans and vegetarians of reproductive age might be at risk of low iron status as women of fertile age have increased needs for iron because of losses due to menstrual bleeding. Young women with restrictive diets should have their iron status monitored.»	cereals and dark green vegetables are important iron sources." Do any studies show this? I do not think so. I do not believe that vegans eat less cereals, fruits, berries and veggies than omnivores. The main source of iron in the Norway, for example, is bread and other cereal products, which contribute 40-50% of the total iron intake. Meat contributes 20%. Vegetables, fruit, berries and juice - with 20%. Fish, eggs and dairy products together contribute approximately 10%. (The sources are: --table 25b on page 44, Norkost 3. A nationwide dietary survey among men and women in Norway aged 18-70, 2010-11. The University of Oslo, the Norwegian Food Safety Authority and the Directorate of Health. -- table 51 on page 59 in The nationwide dietary survey among pupils in 4th and 8th year in Norway, Ungkost 2016, The Norwegian Institute of Public Health https://www.fhi.no/globalassets/dokumenterfiler/rapporter/2016/ungkost-rapport-24.06.16.pdf --table 28 page 45 in Småbarnskost - Astrup H, Myhre JB, Andersen LF, Kristiansen AL. "Småbarnskost 3. Landsomfattende undersøkelse av kostholdet blant 2-åringer i Norge". [Småbarnskost 3. Nationwide dietary survey among 2-year-olds in Norway] Rapport 2020. Oslo: Folkehelseinstituttet og Universitetet i Oslo, 2020. 3. on page 19 you write: "Vegetarian adolescents and adults Vegetarians have significantly lower iron stores than non-vegetarians (126)."	intake has been shown to be higher in studies including especially vegans. However, the bioavailability when vegan meals are composed is typically less than 10%, or even as low as 5%. Thus, absorbed iron is lower in vegan diets than what is possible in diets containing enhancers of iron absorption. Concerning paper 3 Haider LM et al, we have not mentioned ID or IDA in this connection. Concerning paper 4, we agree that there is an adaption of iron absorption that is closely linked to the iron status of the individual. However, when iron requirements are high and if total iron intake and bioavailability is low this regulation may not suffice. Today when diets are climate adapted, especially in public meals, there is a risk that individuals with high iron needs will not absorb enough. Of course, also an omnivore meal can have low bioavailability of iron.

		Source: Henjum S, Groufh-Jacobsen S, Stea TH, Tonheim LE, Almendingen K. Iron Status of Vegans, Vegetarians and Pescatarians in Norway. Biomolecules. 2021 Mar 18;11(3):454. doi: 10.3390/biom11030454. PMID: 33803700; PMCID: PMC8003004. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8003004/ 2. Sobiecki, 2015; European Prospective Investigation into Cancer and Nutrition-Oxford study, writes that the intake of iron in vegans was higher than in omnivores: “Vegans had the highest intakes of polyunsaturated fatty acids, dietary fiber, vitamins C and E, folate, magnesium, iron, and copper.” Source: Sobiecki JG, Appleby PN, Bradbury KE, Key TJ. High compliance with dietary recommdations in a cohort of meat eaters, fish eaters, vegetarians, and vegans: results from the European Prospective Investigation into Cancer and Nutrition-Oxford study. Nutr Res. 2016 May;36(5):464-77. doi: 10.1016/j.nutres.2015.12.016. Epub 2016 Jan 6. PMID: 27101764; PMCID: PMC4844163. 3. The study you refer to, Haider 2018, concludes that vegetarians had lower iron stores, which is not the same as iron deficiency (ID) og ID anemia. Quoted: “....adult vegetarians have significantly	I suggest that you either delete this sentence, or supply it with following: "But the stores are still within the reference range. And the prevalence of iron deficiency anemia is not higher than among omnivores." and than that you delete this sentence: "This is probably due to a combination of difficulty of reaching the RI and a lower iron bioavailability." In this sentence "A well-composed vegetarian diet including wholegrains, legumes, seeds and green vegetables and together with enhancers has the potential to secure iron supply." I suggest that you change this sentence on page 19 : 1)delete "green" - because potatos, beetroot, onions and tomatoes have the same amount of iron as pac-choi and broccoli, and many other green vegetables. 2) supply with four food groups: "A well-composed vegetarian diet including wholegrains, legumes, nuts and seeds, vegetables, fruits and berries, and together with enhancers has the potential to secure iron supply." and that you specify word "the enhancers" that you specify this by adding this sentence: "What are "the enhancers"? Iron bioavailability increasis in meals with presence of vitamin C and friut acids, which both naturally occurs in many vegetables (kale, bell pepper, brussels sprouts, broccoli, turnip, red and head cabbage, cauliflower, tomato, broccoli and many others - see matvaretabellen.no or	

		lower serum ferritin levels than their non-vegetarian controls (.....) 4. The Academy of Nutrition and Dietetics, which is the world's largest association for nutrition professionals, concluded the following based on summary of relevant studies: “The absorption process appears to adapt effectively in the case of Western vegetarians because their hemoglobin values and most other measures of iron status are similar to those values seen in nonvegetarians.7” Source: Melina V, Craig W, Levin S. Position of the Academy of Nutrition and Dietetics: vegetarian diets. J Acad Nutr Diet. 2016;116:1970-1980	https://frida.fooddata.dk), and the most of friuts and berries. Which means that meals containing vegetables, fruits and berries will enhance the bioavalability of iron."	
Tanja Kalchenko	on my own	On page 9 you write following: "A low dietary iron intake is a risk factor for iron deficiency in all age groups." Do you have any studies/evidence that support this - I mean to support that this applies to "ALL age groups"? What about Nordic and Baltic countries - is "a low dietary iron intake is a risk factor for iron deficiency in ALL AGE GROUPS"? Do you have any studies? And - if so - how big risk factor is this? When comparing to other sources? As physician, I mean that the cause of ID is blood loss/disease until proven otherwise, with the implied need to search for and identify the cause.	Unless you find good evidence, I suggest removing "all age groups" this sentence: "A low dietary iron intake is a risk factor for iron deficiency in all age groups." And I suggest that you write this: "A low dietary iron intake is a risk factor for iron deficiency in children, but not in adults, in Nordic and Baltic countries." As physician I am afraid/concerned that my colleagues will think too much "diet" and little "disease" when they see patients with ID and IDA. Thus, many patients with gynecological diseases (adenomyosis and polymenorrhoea without a proven underlying cause) are left untreated. This is not life-threatening but tiring.	We thank for these comments but we have not changed the text. It is well known that a sufficiently low dietary iron intake will cause iron deficiency and anemia, regardless of age group. We agree that the risk of a low iron intake is higher in children than in adults, due to their high iron requirements for growth. However, especially in at-risk adults, e.g. vegetarians, pregnant women and women with high menstrual blood losses, insufficient iron intake will result in iron deficiency and anemia. This background paper focuses on diet, not on gastrointestinal bleeding etc., since it is written for the NNR,

		Quoted UpToDate (2019): "CAUSES OF IRON DEFICIENCY — The major causes of iron deficiency are decreased dietary intake, reduced absorption, and blood loss. In adults in resource-rich countries, dietary intake is almost always adequate, and it is usually reasonable to assume that the cause is blood loss until proven otherwise, with the implied need to search for and identify the cause. (See 'Search for source of blood and iron loss' below.) Blood loss — The major cause of iron deficiency in resource-rich countries is blood loss, either overt or occult [14-19]." Quoted one sources of UpToDates 14 - 19: 16 PubMedTI Gastrointestinal causes of refractory iron deficiency anemia in patients without gastrointestinal symptoms.AUAnnibale B, Capurso G, Chistolini A, D'Ambra G, DiGiulio E, Monarca B, DelleFave G SOAm J Med. 2001;111(6):439. BACKGROUND The standard evaluation of a patient with iron deficiency anemia includes a complete evaluation of the gastrointestinal tract to identify a source of bleeding. However, even after a careful examination, many patients remain without a diagnosis. Because iron deficiency anemia results from iron loss or defective absorption, we sought to determine the prevalence of potential gastrointestinal	In the worst case, some gastrointestinal cancers are overlooked. This is unfortunate, and I ask you to emphasize that in our part of the world, diet is not any common cause of ID in adults.	not as a guideline on how to manage a patient with ID or IDA.

		sources for iron deficiency anemia in patients without gastrointestinal symptoms. METHODS Over a 10-month period, 668 outpatients were referred to the University Hematology Department with iron deficiency anemia, defined by a hemoglobin concentration less than 14 g/dL (less than 12 g/dL in women), mean corpuscular volume less than 80 fL, and ferritin level less than 30 microg/L. After excluding patients with obvious causes of blood loss, inadequate diet, chronic diseases, or malignancies, there were 81 eligible patients, 10 of whom refused investigation. The remaining 71 patients (51 women, median age 59 years) underwent colonoscopy, as well as gastroscopy with gastric (antrum and body) and duodenal biopsies. RESULTS A likely cause of iron deficiency anemia was detected in 60 patients (85%). Diseases associated with bleeding were found in 26 patients (37%), including colon cancer (10 patients), gastric cancer (2), peptic ulcer (7), hiatal hernia with linear erosions (5), colonic vascular ectasia (3), colonic polyps (2), and Crohn's disease (1). Causes not associated with bleeding were found in 36 patients (51%), including 19 with atrophic gastritis, 4 with celiac disease, and 13 with Helicobacter pylori gastritis. Six (8%) patients had coincident gastrointestinal findings, and 11 (15%) had no cause identified. Patients with an identified nonbleeding-associated cause were younger than those with a bleeding-associated cause (median, 56 vs 70 years; P = 0.001) and		

		included 59% of women (n = 30) versus 30% of men (n = 6) (P = 0.04). Hemoglobin level was not related to the site and severity of disease. CONCLUSION Gastrointestinal diseases that do not usually cause bleeding are frequently associated with iron deficiency anemia in patients without gastrointestinal symptom or other potential causes of gastrointestinal bleeding."--------		
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	Plant ferritin should not be ignored here (for example pages 3-5, and 15). Plant ferritin is absorbed differently than non-heme iron, and its absorption is better than from non-heme iron. Plant ferritin is found mainly in soy and other legumes and is so especially important iron source for vegetarians. References: Lv C, Zhao G, Lönnerdal B, Bioavailability of iron from plant and animal ferritins. Journal of Nutritional Biochemistry 2015;25:532-540. Lönnerdal B. Soybean ferritin: implications for iron status of vegetarians. Am J Clin Nutr 2009;89(suppl)1680-5. Lönnerdal B, Bryant A, Liu X, Theil EC. Iron absorption from soybean ferritin in nonanemic women. Am J Clin Nutr 2006;83:103-7.	Vegetarian diets and iron at pages 1, 9 and 19. It is important that all vegetarians are not seen as a one group but distinguish men and women who do not lose blood with those who lose. And lacto-ovo-vegetarians should distinguish with vegans also. In general, the problem in vegetarian diets is not to achieving the RI. According to a recent systematic review average iron intake tended to be higher in vegans (21,0 mg/d) compared to vegetarians (15,3 mg/d) and meat eaters (13,9 mg/d). But iron status, measured as ferritin, tended to be higher in meat-eaters than in vegetarians and vegans. It is however noteworthy that the status was particularly low in vegetarian women, not vegan. (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/) The biggest paper about iron and vegetarianism published to date took the body weight into account as a confounding factor (because obesity tended to increase inflammation and inflammation causes ferritin to rise). When body	We thank for this comment. It is correct that soybean ferritin has been explored as a potential vehicle for iron supplementation but we do not see a need to discuss this in the paper. Total Iron content in soybean and other legumes is indeed higher than from some other vegetables. However, these foods also contain high amounts of phytate which binds to iron. Thus, the % absorbed iron from soybeans and other legumes is low. Enhancers of iron absorption such as vitamin C and "the meat factor" can dissolve these bindings partly. So is also the case with soaking, cooking and fermentation. But still after these processes the effect of phytate on iron absorption remain and absorption is inhibited. This is already mentioned on pages 4, 5 and 20.

			weight was adjusted, there were no difference in the prevalence of iron deficiency between men and women do not menstruate, when comparing vegetarians with omnivores. Only among women who lost blood was iron deficiency more prevalent in vegetarians. In this study, vegans were not distinguished with lacto-ovo-vegetarians or semi vegetarians. Reference: Slywitch E, Savalli C, Duante ACG, Escrivão MAMS. Iron deficiency in vegetarian and omnivorous individuals. Analysis of 1340 individuals. Nutrients 2021,13:2964. Page 12 and 19. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	Concerning IOM's change of name, this information has been added.
Karianne Spetaas Henriksen	Animalia	We appreciate the opportunity to comment on NNR2022s draft chapter on Iron. Regarding the perspective of the chapter We notice that while the scope of the chapter is, among others, iron and chronic diseases, we question how come this section to a large extent is discussing meat and possible health effects. The scope of this chapter is not on meat. The authors use studies examining food groups such as meat, to assess whether iron is linked to poor health. It is questionable to extrapolate the findings from studies not meant to examine health effects of iron, to apply to research questions on iron and health. We miss an appraisal of the uncertainties and limitations in the research included, especially a discussion of the confounding factors. It is widely recognised that the nutrition epidemiology has significant	Regarding diabetes 2 and gestational diabetes 2, p 10: This section is more or less identical to the wording from the NNR2012. If no new qualified litterature has been published since the NNR2012 report, this should be clarified in the chapter of the NNR2022 report. As described in the "The Nordic Nutrition Recommendations 2022 - Instructions to authors of chapters", data gaps for future research should be included if relevant, which we believe is the case of diabetes and iron. Diabetes 2, p 10: In one of the studies (Lee et al 2004) the authors of the chapter are referring to, the conclusion is that « Greater dietary heme-iron intake and/or supplemental iron were associated with an increased risk of Type 2 diabetes, especially amongst those who drink alcohol». The	We discuss the papers critically and come to the conclusion that that they are not really relevant for the recommendations on iron intake. With regard to recommendations on meat intake, we refer to the red meat section of the NNR 2023. Thank you for the comment and we agree. However, specifically for iron, there is no issue of chemical integrity and we are not aware of any "antinutrients" that affect iron utilization after the absorption step. Thus, for iron, absorption and bioavailability can be used interchangeably. Agree, also others have commented on this, see answer to reviewer 1. We thank you for this comment and, even though there has been

		limitations and weaknesses, and the certainty and quality of epidemiological correlatives are highly debated. Thus, the authors ought to present possible limitations concerning the findings reported. Regarding absorption vs bioavailability It appears that the terms "absorption" and "bioavailability" are used randomly in the chapter. Also, the terms are not defined, which they should be. According to the FAO (1), bioavailability encompasses three factors: 1) The digestibility, describing the absorption of a nutrient, 2) Chemical integrity, which describes the proportion of a nutrient that, if absorbed, is in a utilizable form, and 3) Freedom from interference in metabolism resulting from the presence of substances that limit the utilization of the nutrient (antinutrients)1. Thus, even though iron from the diet is absorbed, it does not mean it has high bioavailability. We suggest the authors clearly explains this in the chapter. We suggest that the authors include the paper of Labba et al(2). As meat substitutes are becoming more available and affordable, it is crucial to address challenges regarding nutritive content and bioavailability. Labba et al. found great variations in the nutritional composition of meat substitutes. When analysing the products, they found that the products had very low estimated iron bioavailability due to high phytate content.	difference in relative risk between alcohol drinkers, consuming at least 15 g of alcohol per day, and non-drinkers, was significant. In the highest quintiles of heme-iron intake the relative risks were 1,28 in non-drinkers vs 4,42 in alcohol drinkers. Furthermore, Lee et al found that «Compared to women in the lowest quintile of non-heme iron intake (Q1), women in the highest quintile of non-heme iron intake (Q5) consumed more energy, less animal fat, less vegetable fat, more cereal fibre, and more dietary magnesium. They tended to have healthier behaviour; they had lower BMI and WHR, consumed less alcohol, were less likely to smoke cigarettes, and engaged in more physical activity. Women who consumed more dietary heme iron (Q5 compared to Q1 of heme iron) showed opposite trends». Second paragraph on page 10, line 11-12: «The association between heme iron and T2D could, therefore, be related to the increased risk of T2D that is associated with the intake of red meat». We find this claim to be biased. The scope of this chapter is restricted to iron, and the authors have not done a necessary assessment of the literature to draw this conclusion. Also, as pointed out, the conclusion is drawn without considering the potential/likely effect of confounding factors, for instance alcohol consumption and an overall unhealthy lifestyle. Third paragraph on page 10: «There is probable evidence for the association of heme iron intake with the risk of T2D and GDM even though these associations might not be causal. Because there is no evidence that total iron intake is associated with increased risk of T2D, this does not have any implication for recommended daily intakes of iron». This conclusion is not clear. We ask the	little new information, we have revised and updated this text with several additional recent references. Thank you for this suggestion, which we also received from other reviewers. We have now added a section on "Data gaps for future research".We have revised the text and added snew references based on SRs and MAs. We have also reworded our conclusion and more clearly evaluated the causality and strength of the evidence.

		1.FAO. Dietary Protein Quality Evaluation in Human Nutrition. Report of an FAO Expert Consultation. Vol 92.; 2013. 2. Mayer Labba IC, Steinhausen H, Almius L, Bach Knudsen KE, Sandberg AS. Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Available on the Swedish Market. Nutrients. 2022;14(19). doi:10.3390/nu14193903	authors to clearly evaluate the causality and strength of the evidence on iron intake and diabetes.	
Swedish Food Agency	Swedish Food Agency	This is a comprehensive overview of the many different aspects of iron intake, iron status, bioavailability etc. However, the structure of the chapter is a bit difficult follow. It would be easier for the reader to navigate in the chapter, and find facts, if the structure with headings and subheadings followed the NNR-chapter guidelines (where possible). Abstract: Results and conclusions from the literature searches are missing. The abstract is more of a short introduction to the rest of the chapter, than a summary of the contents of the chapter. What is the purpose of the phytate table? It is not detailed enough to estimate intake, and too detailed for a general overview. Although it is very useful to get an overview of the phytate content of different foods, some of the values are very precise. For example, 374 mg for several soy-based products. Is this figure based on only one analysis of one specific food? A suggestion is to group the foods more and provide ranges for these food groups. Those interested in more detailed phytate values can find a lot	Both iron deficiency and iron overload affect the mithocondria negatively, could you please consider adding this information? Something is wrong with references 25 and 26. Reference 25 is referring to a study investigating the effect of calcium supplements on iron absorption (seems to be correct). But reference 25 is also referring to a two-week study comparing iron absorption from a whole diet containing either enhancing or inhibiting factors of absorption (wrong reference?, is the two-week study done in participants with satisfactory iron stores?) Similarly reference 26 is both referring to a medium-term study on the effects of dietary factors on iron absorption (wrong reference?) and on page 7 a source for the figures on the global prevalence of anaemia (seems to be correct).	We agree and have rewritten the abstract. The phytate content in foods is indeed very important and there is need for much more analyses of phytate content in grains, legumes and meat substitutes the coming years. This especially concerns meat-substitutes. In published results on phytate content different fractions of phytate have been analysed. The INFOODS tables include data from various fractions of phytate and is difficult to interpret. When revising Table 2 we have instead mainly used data from the book Food Phytates by Reddy and Sathe. There are still quite a few foods in this table, however, it is intended to give an overview, and also show the reader the complexity of food phytates. This is now clarified in the text. We agree that these are interesting topics and we included this type of studies in our literature review. However, we have not found any data suggesting that this should

		more in the FAO/INFOODS Food Composition Databases. https://www.fao.org/infoods/infoods/tables-and-databases/faoinfoods-databases/en/ It would be interesting to add information about the relation between copper and iron and perhaps zink in this chapter. Since they share the same absorption mechanisms and copper, like iron, is required for normal erythropoiesis. Moreover, copper deficiency causes an iron-deficiency-like anemia and iron and copper seem to have similar physiochemical and toxicological properties.		influence dietary recommendations and we already exceeded the word limit, so we decided not to include these topics in the paper. See above, interesting but we think it is beyond the scope of the current paper. Thank you for spotting this. We have now corrected the references.
Puk Holm	Danish Agriculture & Food Council	Thank you for the opportunity to comment on the chapter on Iron. As meat is one of the main contributors to dietary iron and plant-based meat alternatives are more available on the market, bioavailability of iron from these products is relevant to address. Recently a Swedish paper was published on this subject (1). Labba et al. estimated that iron bioavailability is very low in these types of products due to high phytat content. The concern for lower healthiness of ultra-processed foods, as these meat alternatives often are, is also addressed from FAO (2). 1. Mayer Labba IC, Steinhausen H, Almius L, Bach Knudsen KE, Sandberg AS. Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Available on the Swedish Market. Nutrients. 2022;14(19). doi:10.3390/nu14193903 2. Food and Agriculture Organisation of the united Nations: Ultra-processed foods, diet	Both in the abstract, line 3 and on page 2, 3rd paragraph, line 2 the concern about iron overload is addressed. The homeostacis is naturally regulated from dietary sources of iron and therefore the concern should be more clearly directed at overload from pharmaceutical iron supplementation, not dietary intake, and at individuals with hereditary haemochromatosis as described in NNR 2012. Under Methods on page 2, the search strategy and date of search(es) of literature is not included as the instructions to the authors of chapters prescribes. This is noted for previous chapters too. The discussion on gaps and future research is missing too. To give precise and relevant comments these information's are important. Page 11, 2nd paragraph: "Some meta-analyses have shown significant associations between red meat intake and breast cancer, endometrial cancer, colorectal cancer, lung cancer as well as hepatocellular carcinoma. (……) The World Cancer Research Fund in 2018 concludes that there is limited evidence that consumption of red	We have now included Mayer-Labba doctoral thesis as reference. We have chosen not to include discussion about ultra-processed foods in this chapter. 1. There is a separate chapter about UPF in NNR2023 2. Several meat-substitutes are classified as UPF, however its effect in relation to iron nutrition is not unambiguous. Please read the answer to reviewer 1. With regard to meat and the risk of cancer, we refer to the NNR chapter on red meat.

		quality, and health using the NOVA classification system. Rome 2019. Ultra-processed foods, diet quality and human health (fao.org)	meat and processed meat increases the risk of colorectal cancer. Most authorities, including the NNR, recommend a limitation of the consumption of red meat and processed meat. However, it is much less clear if iron intake has any causal effect in relation to this." Based on the authors haven´t conducted the necessary review on mechanisms to conclude that it is iron from red meat that is linked to cancer, we suggest the authors reconsider the wording in this paragraph. We recommend referring to World Cancer Research Fund (WCRF) (3) and DTU Food National Food Institute in 2016 (4) as they describe that iron is one of the suggested mechanisms in the development of cancer. The WCRF and DTU concludes that there is limited evidence suggesting consumption of foods containing haem iron increases the risk of colorectal cancer. Page 11, 2nd paragraph, line 12: The following sentence is not related to iron and should be deleted: "One possible mechanism for the association between meat intake and cancer are the mutagenic compounds formed when cooking meats at high temperatures". 3. World Cancer Research Fund - American Institute for Cancer Research. Meat, Fish and Dairy Products and the Risk of Cancer; 2018. https://www.wcrf.org/sites/default/files/Meat-Fish-and-Dairy-products.pdf 4. Mejborn H, et al: Mechanisms behind cancer risks associated with consumption of red and processed meat. National Food Institute, Copenhagen Center for Health Technology. 2016.	

Eilin Lundekvam By	MatPrat	We appreciate the opportunity to comment on NNR2022s draft chapter on Iron. Regarding the perspective of the chapter We notice that while the scope of the chapter is, among others, iron and chronic diseases, we question how come this section to a large extent is discussing meat and possible health effects. The scope of this chapter is not on meat. The authors use studies examining food groups such as meat, to assess whether iron is linked to poor health. It is questionable to extrapolate the findings from studies not meant to examine health effects of iron, to apply to research questions on iron and health. We miss an appraisal of the uncertainties and limitations in the research included on health outcomes, especially a discussion of the confounding factors. It is widely recognised that the nutrition epidemiology has significant limitations and weaknesses, and the certainty and quality of epidemiological correlatives are highly debated. Thus, the authors ought to present possible limitations concerning the findings reported.	Abstract In the abstract, line 3: "Since humans have no mechanisms for iron excretion, iron overload is also a concern." However, on page 19, under the section «Upper level of iron intake», second paragraph, the authors state: «Because iron absorption is homeostatically regulated, the risk of dietary iron overload is mainly limited to individuals with hereditary disorders of iron metabolism, especially hemochromatosis (.....). There is no evidence that heterozygotes for hemochromatosis are at an increased risk of iron overload. Thus, the NNR DRVs and UL for the general population do not apply to patients with this relatively uncommon condition». Also, on page 2, third paragraph, line 2, the authors write: «Iron has a much lower bioavailability than other nutrients, making dietary factors affecting iron absorption especially important for individuals who have depleted iron stores. However, dietary factors are less important for individuals with high iron stores, in whom iron absorption normally is homeostatically downregulated». We find the concern of iron overload, as it is described in the abstract, not in accordance with several statements in the chapter. We ask the authors to reconsider the statement regarding a concern of overload in the abstract, as it gives the impression that the general population is at risk of iron overload. Methods According to the "The Nordic Nutrition Recommendations 2022 - Instructions to authors of chapters" on the NNR webpage, it is stated	It was suggested by the scoping review that we should discuss the possible effects of iron on cancer, that is why we did the literature review and discuss this topic. However, as stated in our chapter, there is no evidence of an association between iron intake per se and cancer. For the discussion on meat and cancer risk, we refer to the red meat chapter in the NNR 2023. We agree that there are limitations in nutrition epidemiology research. However, our calculations of requirements are not based on epidemiological research but rather on factorial analyses. Also, we do discuss the limitations in the paper. Good point. We have removed the sentence from the abstract. The search strategy is attached as Appendix 1. It is not feasible to discuss possible effects of iron on cancer without mention of these papers. We state clearly that "Other meta-analyses have shown only very weak associations between red and processed meat consumption and cancer outcomes. There is a lack of evidence from intervention trials that show any effect of lower red meat intake on cancer outcomes." It is still a fact that most authorities, including the NNR recommends a limitation of the consumption of red meat and

			that authors “Include information about literature search strategy and date of the search”. We ask the authors to include this. Iron and risk of cancer p 11, second paragraph: “Some meta-analyses have shown significant associations between red meat intake and breast cancer, endometrial cancer, colorectal cancer, lung cancer as well as hepatocellular carcinoma. (……) We ask the authors to reconsider this paragraph, as the scope of the chapter is restricted to iron. The authors have not done a necessary review of the literature to assess whether it is the iron in meat that is the possible mechanism regarding red meat and cancer. Furthermore, the World Cancer Research Fund in 2018 concludes that there is only strong evidence an increased risk association between colorectal cancer and consumption of red meat and processed meat. However, it is much less clear if iron intake has any causal effect in relation to this. An option could be to describe that iron is one of the suggested mechanisms by referring to the WCRF. The WCRF concludes that “the evidence suggesting that consumption of foods containing haem iron increases the risk of colorectal cancer is limited”.1 Iron and risk of cancer, p 11, second paragraph, line 12: “One possible mechanism for the association between meat intake and cancer are the mutagenic compounds formed when cooking meats at high temperatures”. We ask the authors to omit this sentence as this possible mechanism is not related to iron.	processed meat. We have added reference to the NNR2023 paper on red meat. As suggested, we have omitted this sentence. We have changed the words “meat or meat components” to “heme iron” in the manuscript.

			Iron and risk of cancer, p 11, second paragraph, line 14: "A systematic review of the mechanistic studies of the link between heme iron intake and risk of colorectal cancer showed that these studies were based on levels of meat or meat components that were much higher than those in normal human diets and concluded that there is insufficient evidence to confirm a mechanistic link". Although this is an important fact about the studies regarding meat and cancer, we suggest the authors to reconsider this paragraph, as the scope of the chapter is on iron and not on meat. References 1. World Cancer Research Fund/ American Insitute for Cancer Research. Meat , Fish and Dairy Products and the Risk of Cancer.; 2018. https://www.wcrf.org/sites/default/files/Meat-Fish-and-Dairy-products.pdf	
Anna-Lena Klapp	ProVeg International	-	1) On page 3 the authors write: "In contrast to other sources of iron, heme iron, which is found in meat, poultry, fish and seafood, has a relatively high and stable bioavailability (about 25%)." We think that this sentence should be complemented with the following information: While 17% of nonheme iron gets absorbed, which is found in bread, cereals, legumes, and vegetables. A higher bioavailability of nonheme iron can be achieved by concurrent ingestion of ascorbic acid (vitamin C) and decreasing the concurrent ingestion of inhibitors (e.g., phytates,	Non-heme iron absorption is already discussed in depth in the manuscript. Thanks for the comment, the sentence has been modified. The wording has been changed to: "In predominately plant based, vegetarian and vegan diets, beans, lentils, peas, nuts and seeds, and products med from these, wholegrain cereals and dark green vegetables are important iron sources".As mentioned above, this paper is focused on iron and we

			polyphenols, and calcium). Reference: Moustarah F, Daley SF. Dietary Iron. [Updated 2022 Oct 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK540969/ 2) On page 3, the authors state: "Meat, poultry and fish as well as cereals are the main iron sources in a mixed diet." Please provide a source for this statement. We also think that the information given by the authors should be qualified as follows: However, a national dietary survey conducted among adults in Norway showed that the main sources of iron are bread and cereal products. Together bread and cereal products account for at least 40% of the total intake, while meat and meat products contribute 20 % of iron in the Norwegian diet. Reference: Norkost 3. A nationwide dietary survey among men and women in Norway aged 18-70, 2010-11. The University of Oslo, the Norwegian Food Safety Authority and the Directorate of Health. 3) On page 3, the authors write: "In vegetarian diets, legumes and processed products, wholegrain cereals and dark green vegetables are important iron sources". Please specify which processed products exactly you are referring to.	refer to the NNR 2023 red meat section for in-depth discussion on the health effects of meat. Since we did not find any convincing evidence that dietary iron intake is a risk factor for non-communicable diseases such as type 2 diabetes, we cannot support such a recommendation.

			4) On page 11, the authors claim: "The World Cancer Research Fund in 2018 concludes that there is limited evidence that consumption of red meat and processed meat increases the risk of colorectal cancer (85) and most authorities, including the NNR, recommend a limitation of the consumption of red meat and processed meat" We think that the following information should be added here: The International Agency for Research on Cancer (IARC) which is the cancer agency of the World Health Organization concludes that there is sufficient evidence from epidemiological studies that eating processed meat causes colorectal cancer. Reference: WHO (2015). Cancer: carcinogenicity of the consumption of red meat and processed meat. Available at: https://www.who.int/news-room/questions-and-answers/item/cancer-carcinogenicity-of-the-consumption-of-red-meat-and-processed-meat: Accessed 09.03.2023. 5) On page 19, the authors write: "Vegetarians have significantly lower iron stores than non-vegetarians (126). This is probably due to a combination of difficulty of reaching the RI and a lower iron bioavailability." Please add the following information from Haider et al. (2018): "However, since high iron stores are also a risk factor for certain non-communicable diseases, such as type 2 diabetes, it is recommended that not only vegetarians but	

			also non-vegetarians should regularly control their iron status and improve their diet regarding the content and bioavailability of iron by consuming more plants and less meat.” Reference: Haider LM, Schwingshackl L, Hoffmann G, Ekmekcioglu C. The effect of vegetarian diets on iron status in adults: A systematic review and meta-analysis. Crit Rev Food Sci Nutr. 2018 May 24;58(8):1359-1374. doi: 10.1080/10408398.2016.1259210. Epub 2017 Jul 5. PMID: 27880062.	
Erica Lindberg	Svenska Fåravelsförbundet	Svenska Fåravelsförbundet anser att författarna i det här kapitlet gör en ambitiös och balanserad genomgång av relevanta studier över bland annat kopplingen mellan intag av järn och diabetes samt cancer. Dock vill vi påtala att eftersom författarna gjorde sin genomgång av relevant litteratur för kapitlet redan i maj 2021, så har detta resulterat i att flera intressanta svenska studier om järn och biotillgänglighet (Cecilia Mayer Labba samt Susanne Bryngelsson m fl) som kom under 2022 inte är med i kapitlet – vilket får ses som kapitlets största brist. Att man påtalar när starka samband saknas är bra. Andra delar vi ser positivt på är att man har identifierat och noga påtalar den generella bristen på långtidsstudier av hög kvalitet, liksom behov av specifika studier, bland annat järnupptaget hos äldre. Välkommet är också tydligheten i att det är animalier (kött, kyckling, fisk och skaldjur) som bidrar med hemjärn samt att man understryker skillnader i järnupptag och biotillgänglighet. Man är vidare tydlig med vilka risker som järnbrist innebär (och att detta är betydligt vanligare hos	Det är positivt att författarna tydligt lyfter fram att betydande delar av befolkningen i de nordiska och baltiska länderna löper risk för järnbrist till följd av ett högre behov, och att specifika grupper är särskilt utsatta (små barn, kvinnor fram till menopaus, gravida samt vegetarianer), liksom att järnbrist kan leda till allvarliga tillstånd inklusive försämrad mental utveckling hos barn – och att det därför ska vara av hög prioritet att förhindra järnbrist (IDA) hos små barn. Det är vidare positivt att författarna är tydliga med betydelsen av kött, kyckling, fisk och skaldjur för intaget av järn i en blandad kost, och författarna nyanserar avgörande frågor om hemjärn vs. icke-hemjärn, antinutrienter, köttfaktorn, järnupptag och biotillgänglighet på ett förtjänstfullt sätt. Kapitlet behöver dock kompletteras med nya, relevanta studier, där vi hänvisar till detaljer och källor angivna i yttrandet inlämnat av Svenskt Kött. Det är bra att författarna uppmärksammar Livsmedelsverkets kostundersökning bland unga (Riksmaten Ungdom 2018) som bland annat visar	Thank you for the comment. Please read answer to reviewer 1.

		vegetarianer).	att omkring en tredjedel av unga tjejer har järnbrist, men också att man konstaterar att detta tyder på att de har ett järnintag som är lägre än det rekommenderade (RI), liksom att man noterar att det saknas nyare studier över järnstatusen hos äldre personer. Författarna gör en balanserad redovisning av studier som undersökt kopplingen mellan intaget av järn och cancer. I sammanhanget kan också nämnas den Lancet-publicerade studien The global, regional, and national burden of colorectal cancer and its attribute risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017 https://www.thelancet.com/journals/langas/article/PIIS2468-1253(19)30345-0/fulltext) som lyfter fram en kosthållning med lågt innehåll av kalcium, mjölk och fibrer, liksom låg fysisk aktivitet och övervikt, som rapportens främsta riskfaktorer kopplade till tjock- och ändtarmscancer (efter alkohol och rökning). En kosthållning med ett högt intag av rött kött respektive ett högt intag av processat kött utgjorde rapportens lägsta riskfaktorer. Även det faktum att The World Cancer Research Fund (WCRF) faktiskt inte förespråkar att kött utesluts från kosthållningen, då det är en värdefull källa till näringsämnen såsom järn, zink och vitamin B12, bör nämnas, https://www.wcrf.org/diet-activity-and-cancer/cancer-prevention-recommendations/limit-red-and-processed-meat/. Kapitlet är välbalanserat och samlar viktig kunskap om järnupptag- och källor, även om komplettering med viktiga källor som angivits	

			ovan, behöver göras. Det är angeläget att denna kunskap får genomsyra NNR-arbetet och arbetet med de framtida kostråden.	
L.M. Granskog	concerned citizen	Iron deficiency and iron deficiency anemia is widespread, also in Nordic countries, this is discussed on page 18 in the chapter. This is of special concern with regard to girls/women of childbearing age. It is clear from this chapter that animal source foods are sources of more readily absorbable iron. Claiming that vegetarian diets have the potential to supply enough iron doesn't mean that they will or that women eating vegetarian diets will get enough iron, especially at times when needs are greater, such as during pregnancy. A recommended diet should contain adequate sources of nutrition from real foods (https://doi.org/10.1016/S2542-5196(23)00006-2). It is unethical to recommend dietary patterns composed of natural foods that are likely result in nutrient deficiencies in large segments of the population. Dietary guidelines should recommend whole foods that adequately supply nutrient needs (https://doi.org/10.1016/S2542-5196(23)00006-2). Diets that require fortification with supplements are by definition inadequate. In some cases supplements will be needed, but dietary advice for the general population should not be based on pills and fortification, but rather on real foods. Supplementation may not always be available, or may have unwanted side effects that discourage use (https://doi.org/10.1016/0277-9536(94)90135-X).	This reference and the points made therein should be discussed in this chapter: https://doi.org/10.1016/S2542-5196(23)00006-2 Many people in India both rich and poor are vegetarians, there are also many children with stunting in India. It is a good question what will happen in Nordic countries if the dietary guidelines advise even less consumption of foods that are good sources of iron. It is unethical if vegetarian diets are claimed to be sufficient sources of nutrients if in practice they often result in nutrient deficiencies.	We do not fully understand these comments but we have made some clarifications in the text on vegetarian diets.

Tanja Kalchenko	Physicians' and nutrition association Food for health	The evidence about that read and processed meats cause colorectum-cancer is strong. Both WHO and WCRF have made this conclusion. Therefor many expert panels recommend to avoid processed meats and limit red meats. See my specific comment and sources Could you also explain what is red meats and processed meats? Cancer Research UK, WCRF https://www.wcrf-uk.org/preventing-cancer/what-can-increase-your-risk-of-cancer/red-and-processed-meat-and-cancer-risk/ Quoted: «What is processed meat? Processed meat has been smoked, cured or had salt or chemical preservatives added rather than having just been cooked or reformed (like most sausages and burgers). This includes bacon, salami, chorizo, corned beef, pepperoni, pastrami, hot dogs and all types of ham." WHO. Cancer: Carcinogenicity of the consumption of red meat and processed meat https://www.who.int/news-room/questions-and-answers/item/cancer-carcinogenicity-of-the-consumption-of-red-meat-and-processed-meat Healthy Eating Plate. Harvard School of Public Health, her http://www.health.harvard.edu/healthy-	On page 11 you write following: "The World Cancer Research Fund in 2018 concludes that there is limited evidence that consumption of red meat and processed meat increases the risk of colorectal cancer (85) and most authorities, including the NNR, recommend a limitation of the consumption of red meat and processed meat." I suggest that you replace LIMITED in".. that there is limited evidence that consumption.." with STRONG. If you look at the table page 38 in your source 85 (WCRF AICR https://www.wcrf.org/wp-content/uploads/2021/02/Summary-of-Third-Expert-Report-2018.pdf), here we can see that there is convincing ecidence about proscessed meat and probable about read meat, reg. colorectum. It is red colour on processed meat and orange colour on red meat, Red colour mean convincing increased risk, and orange - propably increased risk. Both mean strong evidence. This is correct that "most authorities, including the NNR, recommend a limitation of the consumption of red meat and processed meat." And after this sentence I suggest writing following: "And some authorities - WHO, recommend to avoid processed meats. Sources:	See above. We refer the discussion to the NNR 2023 section on red meat.

		eating-plate	1. WHO and IARC. The European Code Against Cancer. The International Agency for Research on Cancer (IARC) is the specialized cancer agency of the World Health Organization. https://cancer-code-europe.iarc.fr/index.php/en/ Quoted: “Avoid processed meat; limit red meat and foods high in salt.” Cancer Research UK, WCRF https://www.wcrf-uk.org/preventing-cancer/what-can-increase-your-risk-of-cancer/red-and-processed-meat-and-cancer-risk/ Quoted: "Our Recommendation is to limit red meat and avoid processed meat – find out how" Norwegian Cancer Association (Kreftforeningen) oreningen.no/forebygging/kosthold-og-kreft/ "Limit the amount of red meat and avoid processed meat products such as bacon, minced meat and sausages as far as possible. If you do eat meat, it is best to choose white meat, clean meat and lean meat products with little salt." WHO. Cancer: Carcinogenicity of the consumption of red meat and processed meat https://www.who.int/news-room/questions-and-answers/item/cancer-carcinogenicity-of-the-consumption-of-red-meat-and-processed-meat Quoted: "We recommend avoiding processed meat because there is strong evidence that it is a cause	

			of bowel and stomach cancer. It also tends to contain added salt, and be higher in fat and provide fewer nutrients than unprocessed red meat, making unprocessed red meat the better choice if you do eat red meat.» Then, could you consider to explain what processed meats are? Cancer Research UK, WCRF https://www.wcrf-uk.org/preventing-cancer/what-can-increase-your-risk-of-cancer/red-and-processed-meat-and-cancer-risk/ Quoted: «What is processed meat? Processed meat has been smoked, cured or had salt or chemical preservatives added rather than having just been cooked or reformed (like most sausages and burgers). This includes bacon, salami, chorizo, corned beef, pepperoni, pastrami, hot dogs and all types of ham." WHO. Cancer: Carcinogenicity of the consumption of red meat and processed meat https://www.who.int/news-room/questions-and-answers/item/cancer-carcinogenicity-of-the-consumption-of-red-meat-and-processed-meat Quoted: "What do you consider as processed meat? Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef, but processed meats may also contain other red meats, poultry, offal, or meat by-products such as blood."	

			"Examples of processed meat include hot dogs (frankfurters), ham, sausages, corned beef, and biltong or beef jerky as well as canned meat and meat-based preparations and sauces." WHO about red meat, quoted: "What do you consider as red meat? Red meat refers to all mammalian muscle meat, including, beef, veal, pork, lamb, mutton, horse, and goat."	
Tanja Kalchenko	Physicians' and nutrition association Food for health	On page 11, Iron and risk of cancer, you write "Other meta-analyses have shown only very weak associations between red and processed meat consumption and cancer outcomes (83)." Later you refer also to 84. Your sources 83 and 84 (some of the authors are members in NutriRecs consortioum) have been commented by many researchers and expert panels. Several researchers, for example, Harvard T.H. Chan School of Public Health https://www.hsph.harvard.edu/nutritionsource/2019/09/30/flawed-guidelines-red-processed-meat/ where surprised about Zeraatkar et al. studies and are concerned about following: 1--the use of methodology and 2--abstract conclusion vs findings. Quoted Harvard T.H. Chan School of Public Health: "The new guidelines are not justified as they contradict the evidence generated from their own meta-analyses. Among the five	I suggest that you remove this sentence page 11: "There is a lack of evidence from intervention trials that show any effect of lower red meat intake on cancer outcomes (84)." It is very difficult/in practice not possible to conduct intervention trials on diet and cancer. Intervention trials are not basically/initially suitable for assessing health outcomes that develop over a long period of time, such as cancer and CVD/atherosclerosis. I refer to The NNR 2022 principles and methodologies: "Lifestyle habits such as diet and physical activity are difficult to control over a long period of time in free-living people, but their impact on health develops over a long period of time. In addition, adequate controls for foods and lifestyle habits are difficult to achieve and poor compliance with the intervention complicates the interpretation of the results. Such studies therefore normally only cover a small part of the development of the disease,	See above. We refer the discussion to the NNR 2023 section on red meat.

		published systematic reviews, three meta-analyses basically confirmed previous findings on red meat and negative health effects." "This is a prime example where one must look beyond the headlines and abstract conclusions. It is important for journalists, health professionals, and researchers to look beyond the sensational headlines and even the abstracts of the papers to verify the evidence behind the claims. It's also crucial to understand that nutrition research is a long and evolving process, and therefore critical to look at the totality of the evidence. These studies should not change current recommendations on healthy and balanced eating patterns for the prevention of chronic diseases. Existing recommendations are based on solid evidence from randomized controlled studies with cardiovascular risk factors as the outcomes, as well as long-term epidemiologic studies with cardiovascular disease, cancer, type 2 diabetes, and mortality as outcomes. " Norwegian researches (Fadnes LT, Arnesen EK, Aune D. Should we reduce consumption of red meat? Tidsskr Nor Laegeforen. 2020;140(10):10.4045/tidsskr.19.0786. Published 2020 Jun 24. doi:10.4045/tidsskr.19.0786 https://pubmed.ncbi.nlm.nih.gov/32602328/) ask about these (Iron-chapter sources 83	and often lack post-trial follow-up on the long-term effects of the intervention. A notable exception are studies focusing on type 2-diabetes." Christensen JJ, Arnesen EK, Andersen R, et al. The Nordic Nutrition Recommendations 2022 - principles and methodologies. Food Nutr Res. 2020;64:10.29219/fnr.v64.4402. Published 2020 Jun 18. doi:10.29219/fnr.v64.4402 Could you please confer with this NNR-methodology-group?	

		and 84): "To what degree do these add new knowledge and the direction for how we regard the health effect of red meat?" Quoted, and the source nr 1 here is Iron-chapter-source number 84: "The new systematic reviews on red and processed meat show that a reduction in consumption of processed meat of 21 g per day is associated with a relative risk reduction of 8 % for premature deaths (1). However, mean consumption in Norway is three times as high (approx. 70 g/day) (2), and a reduction that corresponds to the mean consumption is associated with a relative risk reduction of around 35 % for premature deaths (1, 3). For each 50 g per day reduction in unprocessed red meat intake, a 7 % risk reduction in premature mortality was found." the source nr 1 is Iron-chapter-source number 84. Could you please consider asking your NNR 2022-metodology-collegues about the use of methodology in the sources 83 and 84? And more: if the conclusions in 83 and 84 are in line with the main findings in 83 and 84?		
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Iron draft. Here are the comments from LRF. It is important to be clear on the fact that it is practically not possible to increase the bioavailability of iron from plant foods,	Page 1, Abstract. The authors emphasize that "several large population groups in the Nordic and Baltic countries are at risk of iron deficiency, including infants, young children, menstruating females, pregnant women as well as vegetarians." However, ill, frail, and elderly are important risk groups as well, and the text would benefit from	We have found no studies showing widespread iron deficiency in the elderly population in the Nordic countries, and we have found no evidence that a higher iron intake in these populations would improve wound healing and the immune system. We have already

		demonstrated in Swedish research. Mayer Labba I-C et al, 2022, as well as a doctoral thesis (Mayer-Labba I-C, 2022), show that the bioavailability of iron in certain sorts of beans is one forth of that in meat. This great difference needs to be considered in meal planning for public meals. Mayer Labba I-C et al. Nutritional Composition and Estimated Iron and Zinc Bioavailability of Meat Substitutes Available on the Swedish Market. Nutrients. 2022;14(19):3903.) Nutritional Limitations of a Green Protein Shift with Focus on Iron (chalmers.se).	including these, although they were not part of the initial scoping review. We find it surprising that is was so, since iron is such a crucial nutrient for wound healing and immune system. We urge the committee/authors to reconsider this and include these risk groups in this chapter as well. Page 4, paragraph 3: It is stated that "females have lower intake than males". Also, it may be worth mentioning that females to a greater extent then men find their iron in plant foods. Given the significantly lower bioavailability of non-heme iron than heme iron, it would be of great importance to mention that females need to be aware of the difference and, also, that animal iron sources may benefit females (as well as the other risk groups) to the extent where they are recommended to keep or even increase their intake of the same. Page 5: The authors focus on single meal studies when mentioning calcium and milk as decreasing bioavailability of iron. They then move on to claim that "studies of whole diets show varying results". However, to make it clearer to readers, the text would benefit from including some of the many references that state the opposite – that calcium or milk does not decrease the uptake of iron. Among these references is the Swedish Food Agency (Livsmedelsverket), stating that "a high intake of calcium may prove decreasing of the iron intake, but this has mostly been found to be true for single meal studies and not over longer periods of time". https://www.livsmedelsverket.se/livsmedel-och-innehall/naringsamne/salt-och-mineraler1/jarn	made it clear in the paper that iron from animal sources has higher bioavailability, and that vegetarian meals have lower bioavailability. Answer, in this study Ca was administered in the morning, fasting and then the women did not have a meal until after 4 hours. This supports the paper we have referred to Gleerup et al, were over a two-week period foods with high Ca-content (milk, cheese) were administered eight with all meals including lunch and dinner, or the other option Ca was low in lunch and dinner and was instead administered with breakfast and in-between meals. The study showed that over a longer period than a single meal Ca affected iron absorption and despite the same amount of Ca over a day, moving the intake to breakfast and in-between meals gave higher iron absorption. We have not included the suggested reference because it does not add information. We have written: "Several studies have shown that the effects of dietary factors on iron absorption are very weak, non-existent or even reversed in medium-term studies where the intervention lasts for a couple of months", which also is true for this paper. Bo Lönnerdal writes: " Thus, the inhibitory effect may be of short duration and there also may be

			There are also an abundance of references stating that calcium does not inhibit iron uptake. I.e: Calcium Does Not Inhibit the Absorption of 5 Milligrams of Nonheme or Heme Iron at Doses Less Than 800 Milligrams in Nonpregnant Women. J Nutr. 2011;141(9):1652–1656. Available online from: https://academic.oup.com/jn/article/141/9/1652/4630672 It is speculated whether the non-existing effect of calcium on the uptake may be described as an adaptive response. Bendich A. Calcium supplementation and iron status of females. Nutrition. 2001;17(1):46-51. Available online från: https://www.sciencedirect.com/science/article/abs/pii/S0899900700004822 These references support that claim: Minihane AM och Fairweather-Tait SJ: Effect of calcium supplementation on daily nonheme-iron absorption and long-term iron status. Am JClin Nutr. 1998;68(1):96-102. Tillgänglig online från: https://academic.oup.com/ajcn/article/68/1/96/4666064 Karen H. C. Lim et al. Iron and Zinc Nutrition in the Economically-Developed World: A Review. Nutrients 2013, 5, 3184-3211. Tillgänglig online från: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3775249/ Lönnerdal, 2010. Calcium and iron absorption--mechanisms and public health relevance. Int J Vitam Nutr Res. 80, 293-9. Tillgänglig online från: https://www.ncbi.nlm.nih.gov/pubmed/21462112	compensatory mechanisms. The interaction between Ca and Fe may be a lumenal event, affecting Fe uptake through DMT1 (divalent metal transporter 1) at the apical membrane. However, it is also possible that inhibition occurs during Fe transfer into circulation, suggesting roles for the serosal exporter ferroportin (FPN) and hephaestin. We explored these possibilities in human intestinal Caco-2 cells cultured in monolayers. Iron transport (59Fe) and expression of DMT1, FPN, and hephaestin were assessed after 1.5 and 4 hours with 0 or 100 µM CaCl2. Although Ca did not affect Fe uptake or DMT1 expression at 1.5 hours, FPN abundance at the basolateral membrane decreased, resulting in increased cellular Fe retention and decreased Fe efflux. After 4 hours, DMT1 and FPN expression increased and there was increased FPN at the membrane, suggesting a rebound effect. Thus, the effect of Ca on Fe absorption may be of short duration and adaptation may occur with time. This may explain why studies on long-term Ca supplementation of different groups fail to show any adverse effects on Fe status." We have added this reference.

Tanja Kachenko	on my own	I have comments to table 2 Potato Lentils, chick peas and soy Tomato pure	I compare Iron content in your Table 2, with matvaretabellen.no and https://frida.fooddata.dk/ Potato in your table gives only 0,4 mg Iron. I see that Iron content in potatoes is 0,8 - 1,0 mg: Potatoes, uncooked 1.03 mg https://frida.fooddata.dk/food/4?lang=en Potato, early, raw: 0,8mg https://matvaretabellen.no/poteter-g6.1/potet-tidligpotet-raa-06.001 Could you please consider to change Iron content in potato? Than you write "Lentils, dry, cooked 2.7-3.2" - but dry and cooked it is not the same. I think you ment that when dried lentils are cooked, then thei will content 2.7-3.2 mg Iron. This is correct, but could you consider to change the formulation? The same reg chickpeas and soy beans. Then, could you consider to add tomato pure in the table nr 2? It gives 4,5 mg Iron. https://matvaretabellen.no/tomatpur-06.080	The table 2 is intended to give an overview and not fully cover iron and phytate content in foods. We have changed wording to “dry and cooked”.

28. Zinc

Name	Organization	General comments	Detailed comments	Comments from authors
Jan O. Aaseth	Inland Norway University Applied Sciences	Here, I only comment the chapter on Zinc. The NIH, explains in more in detail the function of Zn, the importance of adequate intake, and the problems related to increased intake of plant food (the problems for vegetarians and some other groups). They ends up with a somwhat higher recommended intakes, based on a list of relevant literature. I attach their main points, and would recommend some more on background and risk groups.	NIH – US – Fact Sheet on Zn - Health Professional Zinc Fact Sheet for Health Professionals Table of Contents • Introduction • Recommended Intakes • Sources of Zinc • Zinc Intakes and Status • Zinc Deficiency • Groups at Risk of Zinc Inadequacy • Zinc and Health • Health Risks from Excessive Zinc • Interactions with Medications • Zinc and Healthful Diets • References • Disclaimer This is a fact sheet intended for health professionals. For a reader-friendly overview of Zinc, see our consumer fact sheet on Zinc. Introduction Zinc, an essential mineral, is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is also found in some cold lozenges, over-the-counter drugs sold as cold remedies, and some denture adhesive creams. Zinc is involved in many aspects of cellular metabolism. It is required for the catalytic activity of hundreds of enzymes, and it plays a role in enhancing immune function, protein and DNA synthesis, wound healing, and cell signaling and division [1-4]. Zinc also supports healthy	Considered. No adjustments done.

			growth and development during pregnancy, infancy, childhood, and adolescence and is involved in the sense of taste [2,3,5]. The total amount of zinc in the body is approximately 1.5 g in women and 2.5 g in men [2]. Most of this zinc is stored in skeletal muscle and bone [1-3]. The processes that maintain zinc homeostasis are absorption of zinc from the diet, excretion into the gastrointestinal tract, and reabsorption in the gastrointestinal lumen [2,3]. In general, as zinc intakes rise, the amount of zinc absorbed also increases, but its fractional absorption drops [2,3]. Serum or plasma zinc levels are typically used in clinical practice to assess zinc status. In healthy people, the amount of zinc in serum or plasma is 80 to 120 mcg/dL (12 to 18 mcmol/L) [2]. Serum zinc levels below 70 mcg/dL in women and 74 mcg/dL in men indicate inadequate zinc status. However, both serum and plasma measures have important limitations. Zinc concentrations in serum are associated with the patient's sex and age as well as the time of the blood draw (morning vs. evening) and do not always correlate with dietary or supplemental zinc intakes [6]. Zinc levels also fluctuate in response to other factors, including infections, changes in steroid hormones, and muscle catabolism during weight loss or illness [1,3]. Clinicians consider risk factors (such as inadequate caloric intake, chronic alcohol use, and malabsorptive digestive diseases) and signs of zinc deficiency (such as impaired growth in infants and children) when they assess a patient's zinc status [1]. Recommended Intakes Intake recommendations for zinc and other nutrients are provided in the Dietary Reference	

			Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the National Academies of Sciences, Engineering, and Medicine [1]. DRIs is the general term for a set of reference values used for planning and assessing nutrient intakes of healthy people. These values, which vary by age and sex, include: • Recommended Dietary Allowance (RDA): Average daily level of intake sufficient to meet the nutrient requirements of nearly all (97%–98%) healthy individuals; often used to plan nutritionally adequate diets for individuals. • Adequate Intake (AI): Intake at this level is assumed to ensure nutritional adequacy; established when evidence is insufficient to develop an RDA. • Estimated Average Requirement (EAR): Average daily level of intake estimated to meet the requirements of 50% of healthy individuals; usually used to assess the nutrient intakes of groups of people and to plan nutritionally adequate diets for them; can also be used to assess the nutrient intakes of individuals. • Tolerable Upper Intake Level (UL): Maximum daily intake unlikely to cause adverse health effects. Table 1: Recommended Dietary Allowances (RDAs) for Zinc [1] Age Male Female Pregnancy Lactation Bi...	

Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for the opportunity to comment on the zinc draft. Meat, eggs, and fish are stated as sources of zinc. However, the authors have left out that milk and dairy products, including cheese, make up for 16% of the intake among adults in Sweden (Riksmaten för vuxna 2010-11), and 22% of the intake among adults in Denmark. (Danskernes kostvaner 2011-13). For comparison, meat and meat products contribute to 22% of the intake among the adult Swedish population, and 33% among the adult Danish population. The same argument is valid for Swedish children and adolescents, where important sources are milk and dairy (21%) meat (19%), meat products (5%), and cereals (17%) (Riksmaten Ungdom 2016-17). Bread contributes to 11% of the zinc intake among adults in Sweden. In Denmark, bread and cereals intake contribute to 22% of the intake, while eggs and fish contribute to 3%, respectively. Thus, milk and dairy, including cheese, ought to be stated as important sources of zinc in the diet.		Milk and dairy is included as an important source of zinc.

Ulrika Åkesson	Food Frame Sweden AB	Globalt utgör zinkbrist en reell hälsorisk. I Norden har vi goda förutsättningar till en balanserad kost där animaliska livsmedel ingår och är en naturlig del av vår matkultur. Vi har i Norden en lång tradition av att producera kött och mjölk av hög kvalitet. Det bör tydligt framgå i nya näringsrekommendationer att kött är bland de livsmedel som utgör de främsta källorna till zink. Eftersom även mjölk och mjölkprodukter bidrar med mycket zink och står för en betydande del av intaget hos både vuxna, barn och tonåringar (se Riksmaten) bör även dessa livsmedel omnämnas som viktiga zinkkällor. Författarna identifierar fytinsyran i plantbaserade dieter som en möjlig risk för fler fall av zinkbrist framgent och ser framtidens zinkstatus som en viktig forskningsfråga, samt konstaterar att det saknas kunskap om konsekvenserna av mild och måttlig zinkbrist, liksom att pålitliga biomarkörer bör identifieras. Eftersom animalier är den huvudsakliga källan till zink, vilket författarna också påtalar, bör de näringsmässiga fördelarna med en varierad och hälsosam kost med kött och mjölkprodukter framhållas än mer.		Milk and dairy is included as an important source of zinc.

Karianne Spetaas Henriksen	Animalia AS	The main literature search for the chapter was performed October 13, 2019. We question why a more recent literature search is not performed? After all, it has been 3 years since the search was done. The chapter addresses issues concerning diets dominated by plant foods. We suggest that these points are gathered in a seperate paragraph.	Page 2, line 10-11 «We have also identified other reviews that are relevant for the section describing the health outcomes through a "snowballing approach".» We suggest that the termonology «snowballing approach» is explained in the text.	All searches will be updated before the publication of the final NNR2023 report.
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc),	Finnish Vegan Association		Page 4. According to a recent systematic review, the mean zinc intake across studies was similar in all dietary patterns: vegans, vegetarians, and meat-eaters. Across studies, the average zinc status tended to be slightly lower for vegetarians and vegans than for meat-eaters, but only vegans have higher prevalence of zinc deficiency compared to vegetarians and meat-eaters. (Neufingerl N, Eilander A. Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 2022;14:29. Available: https://pubmed.ncbi.nlm.nih.gov/35010904/)	Reference not included.
Plant Food Sweden	Plant Food Sweden	We welcome the opportunity to comment on this chapter. We appreciate the quality work done. We wish to share some detailed comments and references on the sections on "Physiology" and "Requirement and recommended intakes".	Page 2: Physiology Current text: "Diets dominated by plant foods are rich in phytate, and vegetarians may accordingly be at risk of low zinc absorption." Page 4: Requirement and recommended intakes; Adults Current text: "It is possible that a more plant-based diet with a higher content of chelating substances such as	Considered. Not changed according to suggestion.

			phytic acid and tannins may increase zinc requirements. Furthermore, since animal-source foods are the main sources of zinc, a shift to a predominant plant-based diet might result in lower mean intakes and a higher proportion of the population that falls below the AR." Comment: The sentences "Diets dominated by plant foods are rich in phytate, and vegetarians may accordingly be at risk of low zinc absorption." and "… , a shift to a predominant plant based diet might result in lower mean intakes and a higher proportion of the population that falls below the AR.", does not provide the totality of the evidence. It is suggested that a section is added where the risk/benefit of plant-based diets is discussed. The following paragraph is a highly relevant quote from the "WHO DRAFT guideline. Carbohydrate intake for adults and children" (ongoing public consultation) that should be considered: "Plant-based foods including whole grains, vegetables, fruits and pulses, contain a variety of compounds, some of which have been shown to inhibit absorption of certain nutrients, most notably minerals such as iron, zinc and calcium. These 'antinutrients' as they are sometime called include lectins, oxalates, phytates, goitrogens, phytoestrogens, tannins, saponins, and glucosinolates, although many have also been shown to have heath benefit unrelated to their impact on nutrient absorption (Petroski, 2020). Although these compounds have been shown to inhibit absorption of other nutrients, the extent	

			to which this actually occurs varies from person to person and is generally only observed at very high intakes and in those with existing nutritional deficiencies; in the context of adequate, diverse diets the inhibitory effect of these compounds is generally not significant (Petroski, 2020). In addition, some simple methods of preparation including soaking and heating, and more advanced methods including germination and fermentation appear to further lower inhibitory potential (Petroski, 2020). Therefore, while those with nutritional deficiencies or who are at high risk for nutritional deficiencies – particularly undernourished children and those who rely heavily on foods containing these compounds as staple foods without much additional diversity in the diet – may need to adopt behaviours that minimise the ability of these compounds to inhibit absorption of other nutrients, others can generally consume whole grains, vegetables, fruits and pulses with little to no risk." Source: https://www.who.int/news-room/articles-detail/online-public-consultation-draft-guideline-on-carbohydrate-intake Petroski W, Minich DM. Is There Such a Thing as "Anti-Nutrients"? A Narrative Review of Perceived Problematic Plant Compounds. Nutrients. 2020;12(10):2929.	
Theres Strand	Svenska Köttföretagen AB	• Zink är en helt nödvändig mineral som har betydelse för flera viktiga biologiska processer, såsom vår celldelning, tillväxt och immunsystemets funktion. Det är bra att författarna tydligt nämner kött bland de livsmedel som utgör de främsta källorna till zink. Eftersom även mjölk och mjölkprodukter bidrar		Milk and dairy is included as an important source of zinc.

		med mycket zink och står för en betydande del av intaget hos både vuxna, barn och tonåringar (se Riksmaten) bör även dessa livsmedel omnämnas som viktiga zinkkällor. • Författarna identifierar fytinsyran i plantbaserade dieter som en möjlig risk för fler fall av zinkbrist framgent och ser framtidens zinkstatus som en viktig forskningsfråga, samt konstaterar att det saknas kunskap om konsekvenserna av mild och måttlig zinkbrist, liksom att pålitliga biomarkörer bör identifieras. Eftersom animalier är den huvudsakliga källan till zink, vilket författarna också påtalar, bör de näringsmässiga fördelarna med en varierad och hälsosam kost med kött och mjölkprodukter framhållas än mer. Globalt, där möjligheten till en varierad kost saknas, utgör zinkbrist en reell hälsorisk.		
Johanna Eén	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment on the chapter on Zinc. The intake of zinc is essential for several important biological processes, such as cell division, growth and a fully functional immune system. It is therefore positive that the authors clearly mention meat as one of the main zinc sources. Since milk and dairy products contribute to a significant part of the zinc intake among children and adolescents, and adults (Riksmaten), these foods also ought to		Milk and dairy is included as an important source of zinc.

		be highlighted as important zinc sources. The authors identify phytic acid in plant-based diets as a possible risk for increased zinc requirements. They consider future zinc status as an important research question and point out the lack of knowledge about the consequences of mild and moderate zinc deficiency, and the importance of identifying reliable biomarkers. Since animal-source foods are the main sources of zinc, the nutritional benefits of a balanced and healthy diet with meat and dairy products could be even more emphasized in the draft. Globally, where the possibilities to choose a balanced diet are limited, zinc deficiency is a serious health risk.		

29. Iodine

Name	Organization	General comments	Detailed comments	Comments from authors
Marianne Hope Abel	Norwegian Institute of Public Health	The iodine chapter provides a well written summary and background for the iodine recommendations in the new NNR. However, I miss an overview of all recommended levels. May a Table 1 with the recommendations be missing? There is only a Table 2 in the chapter.	P1 – par2 (and p8 par2): I think iodization in Finland is voluntary Ref: Nystrom HF, Brantsaeter AL, Erlund I, Gunnarsdottir I, Hulthen L, Laurberg P, et al. Iodine status in the Nordic countries - past and present. Food Nutr Res. 2016;60:31969. P1 – par3: Does iodine excess cause a visible goitre, like in iodine deficiency? I know that goitre rates are increased in iodine excess, but I do not know if the goitre from iodine excess is visible or if it can only be measured by ultrasound. P3 par2: Thiocyanate from cigarette smoking should be mentioned as it is a strong goitrogenic factor. Goitrogens are explained as "dietary factors", but smoking is probably the most important factor in a Nordic setting. P4 par2: It should be mentioned that thiocyanate from smoking may inhibit the iodine transport in the mammary gland and reduce the iodine content of breastmilk. Ref: Laurberg P, Nohr SB, Pedersen KM, Fuglsang E. Iodine nutrition in breast-fed infants is impaired by maternal smoking. J Clin Endocrinol Metab. 2004;89(1):181-7. P5 par4: The iodine content in fish, dairy products etc. may vary a lot, thus calculating the intake based on dietary data and food composition tables may	This table will be included in the final NNR report. P1 corrected. P1 par 2 and P8 par 2 corrected. P1 par 3: sentence changed for correction.P3 par 2: information and new reference added. P5 par 4: changed made. P& par 2: corrected. P7 part 2: not included as the year can be seen in refernce list. P7 par3: Part of the text omitted in the public consultation. P 7 par 4: changed. P8 par 2: included. P10 par 1: changed according to suggestion.

			not provide accurate estimates of intake. P6 par1: In Denmark, one compared an area with mild ID to an area with moderate ID. Not mild ID to severe ID. P6 par 2: "In regions of severe ID, i.e., median UIC <20 μg/L…" (not <50 g/L) P6 par2: "In regions of mild-to-moderate ID, i.e., median UIC in pregnant women <150 μg/L…" (not: maternal UIC <150 μg/L) P7 par2: Maybe include year in parenthesis for the recommendations from WHO, EFSA and IOM? P7 par2: …include a safety margin for any goitrogenic substances in foods and from cigarettes. P7 par3 (Infants and children): This paragraph ends rather abruptly at children 6 months of age. Are remaining parts of this paragraph missing? Also, the statement "..adjustments of the dietary reference values should be considered" seems misplaced as this document states the reference values. I miss text regarding older infants, toddlers, and children. P7 par4: The first sentence may be misinterpreted as a general recommendation for supplements for pregnant and lactating women. Maybe change to: "During pregnancy and lactation, iodine turnover is increased." It	

			should be mentioned in the paragraph that the increased needs in pregnancy may be covered by iodine stored in the thyroid if iodine status is adequate prior to pregnancy. P8 par2: women of childbearing age (and maybe also pregnant and lactating women) should be mentioned in the list of subgroups of the population that are mild-to-moderately iodine deficient (together with immigrants etc.) P8 par 2 (mid part): There should be a new paragraph for "Results from MoBa…" P8 par2 (last part): Most breastfeeding mothers in the Nordic countries should take an iodine-containing supplement to reach the recommended intake of 200 µg/day. Current strategies for salt iodization do not secure an adequate iodine intake for breastfeeding mothers. P10 par1: Optimal range for median UIC in 1–2-year-old children is not 100-200 µg/L, but is suggested to be >200 µg/L. The cutoff for risk of iodine excess for median UIC is currently uncertain, but probably exceeds 350 µg/L Andersson M, Braegger CP. The Role of Iodine for Thyroid Function in Lactating Women and Infants. Endocr Rev. 2021. P10 par1: There should be a new paragraph at "More nationally representative data.." because this refers to knowledge gaps regarding status in the	

			Nordic countries, whereas the first part of the paragraph refers to general knowledge gaps in iodine nutrition.	
Ellen Ulleberg	Norwegian Dairy Council	The chapter on iodine is thorough and describes the situation with insufficient iodine intake in certain parts of the population well. We would have liked to see an overview of dietary sources of iodine in the introduction or at least in the part describing the dietary intakes in the Nordic and Baltic countries. What are the current main contributors to the iodine intake in the different countries? In the section "Iodine fortification and supplementation" it is stated that it "is challenging to eliminate iodine deficiency by changes in dietary habits". This statement requires a reference. Rather than to give up because there are few sources of iodine in the diet, and we see a trend towards lower consumption of these foods, the Nordic and Baltic health authorities should work to turn this trend. As stated later "initiation of iodine supplementation or fortification during pregnancy is too late to confer benefits". Since adequate iodine status is desired in the years prior to pregnancy, changes in dietary habits that could provide sufficient iodine to fertile women thus should be a desired goal. In our opinion the Nordic Nutrition Recommendations should focus on giving advice about diets		We have added information about the main dietary sources both in the abstract and the chapter on iodine intakes in the Nordic and Baltic countries. A detailed overview is however out of the scope of this chapter.

		where food contribute to an adequate intake of all nutrients. In this regard milk, yoghurt, egg and white fish should be recommended to fertile women. In the last paragraph of this chapter, it is stated that "Healthy and sustainable diets are characterized by more plant-based and less animal-based foods than the current average diets in the Nordic and Baltic countries." This statement is premature as the NNR background article identifying a sustainable diet in a local context has not been released. We would like to argue that a diet is not sustainable unless it provides the nutrients we require and thus a diet with less milk and dairy products, eggs and fish is not sustainable in Nordic countries with iodine deficiencies. Rather than accepting the declined consumption of fish and milk, one should work to make health professionals and the general public aware of the importance of iodine rich food in the diet. We also would like a reference to this statement: «A decline in the consumption of these foods has already started and is expected to take place quite rapidly in the next decade».		
Karianne Spetaas Henriksen	Animalia og MatPrat/Opplysningskontoret for egg og kjøtt	According to the findings in this chapter, new studies confirm that several important health challenges in the Nordic countries are associated with insufficient iodine intake. However, the WHO guideline for implementation of salt iodisation has only been applied in	Paragraph: Iodine fortification and supplementation, line 4-5: . "It is challenging to eliminate iodine deficiency by changes in dietary habits." This claim must have a reference	The sentence "is challenging to eliminate iodine deficiency by changes in dietary habits"has been deleted both from the abstract and in this section.

		some Nordic countries, as country specific food patterns differ and some countries have a history of being iodine sufficient due to high consumption of milk and fish. The chapter states that there are few sources of natural iodine in the diet. In Norway, these sources include mainly white fish, dairy products and eggs (1). The intake of fish in Norway is below recommended intake, and the consumption of milk has decreased over years. The current intake of eggs is too low to meet the needs of iodine. Thus, the challenge is an insufficent intake of dietary sources available in Norway. An universal implementation of iodized salt is discussed. However, while iodisation of salt would be beneficial for some, it could potentially cause major health risk to others, such as children 1-2 years of age. A report from the Norwegian Scientific Committee for Food and Environment identified the challenge with iodized salt, due to upper intake levels and toxicity (2). In addition, the governments across the Nordic region are working to decrease the intake of salt in the diet. This points out the importance of using the different countries food resources to meet the challenges of low iodine status, by increasing the intake of whole foods as sources of iodine. The chapter highlights that a major		

		challenge is that large parts of the population suffer from iodine deficiency. This is especially true for vegetarians and vegans. According to the chapter, the use of seaweed products is increasing in the Nordic countries. This is problematic due to the high content of iodine in these products. Also, the recommendation for iodine increases during pregnancy and lactation (1). Thus, the need to recommend whole foods as sources of iodine, must be prioritized. According to the chapter, a healthy and sustainable diet is characterized by more plant-based products and less animal products than the current situation in the Nordic countries today. However, this can lead to negative health outcomes and even lower intake of foods naturally rich in iodine. The chapter claims that «it is difficult to eliminate iodine deficiency by changing dietary habits ». This is contradicting to the chapter's introduction, saying « .. and some countries have a history of being iodine sufficient due to high consumption of milk and fish». There is a great potential to make animal products an even more important source of iodine. We question why providing knowledge to the general public regarding food-based sources of iodine is not clearly emphasized. Instead the recommendations first and foremost include iodine supplements or universal salt iodisation. This does not correspond		

		to health recommendations from the Norwegian Directorate of Health (3,4). We ask for the NNR2022 to recommend dietary changes in the general public to meet the recommended intakes of iodine before recommending supplements. Also, it is premature to draw conclusions on sustainable food choices in the Nordic region as these papers are either not published or on public hearing. We ask that sustainable issues are omitted from the chapter. References 1. www.helsenorge.no. Viktig å få nok jod. 2. Vitenskapskomiteen for mat og miljø. Benefit and Risk Assessment of Iodization of Household Salt and Salt Used in Bread and Bakery Products. Scientific Opinion of the Panel on Nutrition, Dietetic Products, Novel Food and Allergy of the Norwegian Scientific Committee for Food and Environment. Oslo; 2020. 3. www.helsenorge.no. Kosttilskudd - trenger vi det? 4. Departementene. Nasjonal Handlingsplan for Bedre Kosthold (2017–2021) Sunt Kosthold, Måltidsglede Og God Helse for Alle! Oslo; 2017.		
Livsmedelsverket	Livsmedelsverket		Abstract as well as page 8: the ISO-code for Sweden is SE, not S. Page 8: This sentence does not make sense. "Universal salt iodization of all salt for human animal consumption, including salt used for food processing and	Abstarct and ISO code for Sweden corrected.

			manufacturing is the strategy recommended by WHO (12, 13, 64)." Page 7: Consumption of algae is described as problematic because of their high content of iodine. This is true, but we would suggest another formulation. A combination with the more neutral writing in NNR 2012 could be advantageous: "Algae are often suggested as a vegetarian source of iodine, especially in vegan diets. However, because the content of iodine in algae vary considerably (some varieties might even contain toxic amounts), the iodine content of algae should be known before the food is consumed." Algae could also be mentioned in the very last paragraph of the chapter, on how to tackle and monitor changes in iodine status during at transition towards a more plant-based diet. This is an area where we definitely need more knowledge.	
Guro Waage	Nortura SA	Public consultation on iodine. Due August 29, 2022, Nortura SA. First, the authors state that it is challenging to eliminate iodine deficiency by changes in dietary habits (p.8). We ask for this claim to be substantiated by a reference. As written in the chapter the access to		Sentence referring to the challenge of changing dietary habits was rephrased in the revised version. Sustainability is handled by the committee, not by chapter authors. Upper intake levels and challenges related to salt

		iodin-containing food products varies between the Nordic and Baltic countries. The WHO guideline for implementation of salt iodisation has therefore only been applied in some of the countries, as other countries have a history of being iodin sufficient. In Norway we have accessible sources of iodine in our diet, like white fish, dairy products, and egg (1), but the intake is too low to secure sufficient amount of iodin. Therefore, implementation of universal iodized salt is discussed. Universal implementation of iodized salt would be beneficial for some, but it also comes with a risk of posing harm to others. The report from the Norwegian Scientific Committee for Food and Environment identified this as a challenge when assessing the possibility to implement universal salt iodisation (2). In addition, the governments across the Nordic region are working to decrease the intake of salt in the diet. This points out the importance of using different countries food resources to meet the challenge and increase the intake of whole food as a source of iodine. We question why recommendations for dietary changes, in direction of regular consumption of food rich in iodine, are not discussed more thoroughly in this chapter. Second. In the conclusion of the chapter, it is stated that a healthy and sustainable diet are characterized by more plant-		iodization are discussed in the section "Data gaps for future research".

		based and less animal-based foods than the current average diets in the Nordic and Baltic countries (p.10). Further, that a change towards less animal based food will increase the iodine deficiency in the population. Because of that the authors recommend strengthen the rational for implementing universal salt iodisation. It seems controversial to conclude that a healthy diet is a diet that clearly increases the risk of deficiency. To recommend implementation of universal salt iodisation, instead of providing knowledge to the public regarding food-based sources of iodin, do not correspond to the health recommendations from The Norwegian Directorate of health3,4. It should be highly possible to increase the intake of plant-based food, and still include sufficient amount of iodin-containing animal-based food in the Norwegian diet. Third, it is our opinion that the conclusive remark on sustainability is premature as the background papers on environmental sustainability in local context are not completed. Kilder: 1) www.helsenorge.no. Viktig å få nok jod. https://www.helsenorge.no/kosthold-og-ernaring/sma-grep-for-et-sunt-kosthold/derfor-trenger-vi-jod/ 2) Norwegian Scientific Committee for		

		food and environment (VKM). Benefit and risk assessment of iodization of household salt and salt used in bread and bakery products. Scientific opinion of the panel om Nutrition, Dietetics products, Novel food and Allergy.: VKM report 2020 3) www.helsenorge.no. Kosttilskudd - trenger vi det? https://www.helsenorge.no/kosthold-og-ernaring/sma-grep-for-et-sunt-kosthold/trygg-bruk-av-kosttilskudd/. 4) Departementene. Nasjonal Handlingsplan for Bedre Kosthold (2017–2021) Sunt Kosthold, Måltidsglede Og God Helse for Alle! Oslo; 2017.		
Johanna Kaipiainen (M.Sc, RD) , Charlotta Hyttinen (M.Sc), Evy Peltola (M.Sc, RD)	Finnish Vegan Association		Page 7: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine. Chapter "Iodine fortification and supplementation", page 8: It would be good to mention here, that WHO has suggested amounts of iodine fortification in salt, based on estimated salt consumption a day. If estimated salt consumption is upper recommended amount 5 g/day, WHO recommends 39 mg iodine in kg salt (39 µg/g). (World Health Organization. Guideline: fortification of food-grade salt with iodine for the prevention and control of iodine deficiency disorders. Geneva: World Health Organization; 2014) Page 10: It should be emphasized here, that all adult vegans and vegan children from 7 years need to supplement their	P7: changed. Iodine fortification and supplementation: Minor changes made for clarification, but we do not agree that we should include the level of fortification recommended by WHO as there are several factors that influence the level of fortification.

			diet with iodine. Younger vegan children should use iodine supplement only in the case, if they do not use iodized oat-based milk alternative. Many oat-based milk alternatives are nowadays fortified with iodine. Amount of iodine in oat-based milk alternatives varies from 16 to 22.5 µg/100 g. Children under 7 can be easily exceed the tolerable upper limit for iodine (200-250 µg/g set by EFSA) if they use more than 5 dl iodized oat-based milk alternative and same time the iodine supplement is in use.	
Ann-Kristin Sundin	LRF Mjölk	Dear NNR committee, Again, thank you for the opportunity to take part in the NNR work though public consultations. In the chapter on iodine, we would like to see an overview of the intake of iodine in the Nordics and Baltic countries, as well as the main sources of iodine in each country, respectively. This is important in ensuring that the national FBDG are aligned with the nutrition recommendations. Some foods are stated as major sources (milk, egg, and white saltwater fish), but "dairy" is surely a whole food group in need of recognition in this aspect.	Under the section "Iodine fortification and supplementation" it is stated that "the main challenge regarding iodine nutrition in the Nordic and Baltic countries is that large subgroups of the population are mild-to-moderately iodine deficient". We interpret this as a rational for keeping, and in some cases increasing, the FBDG for foods that are major contributors to iodine. It is, however, further stated that "is challenging to eliminate iodine deficiency by changes in dietary habits". We are missing the reference to this statement, though, and would like to argue that finding natural food sources of nutrients continuously need to be first priority in general. Under the section "Pregnancy and lactation" it is stated that "ensuring adequate daily iodine in years and months before pregnancy is more important than a large increased in iodine intake after pregnancy has started".	Pregnancy and lactation: Information about dietary souces of iodine have been added both in the abstract and chapter on iodine intake. FBDG are outside the scope of the present chapter. Sentence referring to the challenge of changing dietary habits was rephrased in the revised version. Sustainability is handled by the committee, not by chapter authors.

			Referring to our concerns above, we would like to emphazise the importance of keeping, and in some cases increasing, the FBDG for iodine-rich foods. Here, milk and dairy, egg, and white fish are important foods to be recommended to women in child-bearing ages. Lastly, under the section "Data gaps for future research" it is stated that "Healthy and sustainable diets are characterized by more plant-based and less animal-based foods than the current average diets in the Nordic and Baltic countries." First, we want to point to the fact that not all plant-based foods are sustainable and not all animal-based foods are un-sustainable as indicated. (A suggestion of re-phrasing, therefore, would be "Healthy and sustainable diets are characterized by more healthy plant foods and less low-quality meat products, as well as discretionary foods and drinks than in the current average diets in the Nordic and Baltic countries.") Second, we would like to stress that "sustainable" as is defined today encompasses the health dimension, and for this sake, if a distinction needs to be made, "sustainable" needs to be specified as "environmentally" if this is what is being referred to. Claiming that plant-based foods are more healthy and environmentally sustainable, and vice versa for animal-based foods is	

			too simplified a statement. This generalization is detrimental to the education of the population, ranging from consumers to decision-makers, when it comes to nutrition and health. For instance, cakes, crisps, and refined carbohydrate products are mostly plant-based, but has often a very low value of nutrients for the general population. Furthermore, as is already stated in this chapter, the major dietary sources of iodine are, indeed, of animal origin (milk and dairy, egg, white fish). There are other nutrients as well to take into consideration, not the least iron, which has a very low bioavailability in the non-haemic form present in plant-based foods. Fortification with a single nutrient such as iodine in salt has indeed proved to be a successful way of increasing the intake of that nutrient on a population basis. However, foods are more than just the sum of single nutrients, and thus we urge the NNR committee and the authors of this and other chapters to recognize the importance of the food matrix and its implication on general health.	
Plant-food Sweden	Plant-food Sweden	We welcome the guidance on nutritional consequences of transitioning to more plant-based food systems. No changes suggested.	We welcome the expert's opinions on iodine sources, supplementation, intake in vulnerable groups, risk/benefit analysis of fortification, and possible effects on iodine intake in the transitioning from an animal-based to a healthy plant-based diet. We have no changes to suggest.	Thank you for your comment.

Anna Maria Karlsen	NHO Mat og Drikke/FoodDrinkNorway	There are several foods naturally rich in iodine, such as milk and dairy products, fish and seafood, and eggs. These foods have a natural part in the Nordic diet, but their consumption has declined over the years. The paper, however, mainly discusses the intake of iodine supplements or the implementation of universal salt iodization as measures to reduce the prevalence of iodine deficiency disorders. We question why recommendations for dietary changes, in direction of regular consumption of food rich in iodine, are not discussed more thoroughly. We have also noticed that the paper states that "Healthy and sustainable diets are characterized by more plant-based and less animal-based foods than the current average diets in the Nordic and Baltic countries" (page 10). The NNR2022 food-based dietary guidelines will integrate environmental sustainability aspects, and several background papers are under preparation. So far, only the first paper is released for public consultation. We ask that the NNR2022 chapter on iodine should omit concluding sustainability until all background papers are completed.		Authorities in the Nordic countries have advised regular intake of cow's milk and saltwater fish for years, but the intake of foods rich in iodine is still declining in all countries. It is outside the scope of this paper to discuss more thoroughly why recommendations for dietary changes, in direction of regular consumption of food rich in iodine. Sustainability is handled by the committee, not by chapter authors.

30. Selenium

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc),	Finnish Vegan Association	No general comments.	Page 12. It says here: "This also applies to vegetarians and vegans because plant foods might contain low levels of selenium", but references are lacking. To our knowledge, selenium intake in vegans has been studied in Finland, Sweden, and Denmark in Northern countries. Intake has been less than the recommended intake in young Swedish vegans and in Danish vegans, but adequate in Finnish vegans. This may due the fact that selenium is added in fertilizers in Finland. It is also noteworthy, that most vegan multivitamins contain selenium. References: Elorinne A-L, Alfthan G, Erlund I, Kivimäki H, Paju A, Salminen I et al. Food and nutrient intake and nutritional status of Finnish vegans and non-vegetarians. PLoS One 2016;11(2):e0148235.doi:10.1371/journal.pone.0148235 Available: https://pubmed.ncbi.nlm.nih.gov/26840251/ Kristensen NB, Madsen ML, Hansen TH, Allin KH, Hop pe C, Fagt S et al. Intake of macro- and micronutrients in Danish vegans. Nutrition Journal 2015;14:115. Available: https://nutritionj.biomedcentral.com/articles/10.1186/s12937-015-0103-3 Larsson CL, Johansson GK. Dietary intake and nutritional status of young vegans and omnivores in Sweden. American Journal of Clinical Nutrition 2002;76:100-6. Available: https://pubmed.ncbi.nlm.nih.gov/12081822/	Thank you for this information. pp. 11 and 12: More information on selenium intake of vegans and relevant references have been included.

Amanda Jakobsson	Svenskt Kött	Dear NNR Committee, Thank you for the opportunity to comment upon the Selenium draft. Please find below the comments from Svenskt Kött. The draft is well balanced and provides good knowledge of the importance of selenium in a varied and healthy diet, as well as the differences between dietary sources from various countries, and the selenium status of different populations, among other things. It highlights meat as an important source of selenium, referring to the percentage (40%) of selenium consumed in Finland, among other facts of interest. NNR 2012 recommends a higher intake of selenium, and it appears that the authors would advocate a further increase of recommended intake. Foods of animal origin are considerable sources of the selenium consumed in the Nordic countries and selenium deficiency, even if uncommon, can cause severe health conditions. In this light, meat, offals, fish, eggs, milk and cheese, among other dairy products, ought to be highlighted in NNR 2022 as important selenium sources. It is positive that the authors mention the importance of bioavailability, and differences in bioavailability between different dietary sources (various fish species).	Please find all comments in "general comments to the chapter".	Thank you for the comment on dietary sources of selenium. Updated and detailed information on dietary sources of selenium in the Nordica and Baltic countries were not available. In the review paper of Lemming and Pitsi, 2022 for NNR2022 such information is not given, but should be possible to extract from their database. Selenium intake of vegans and non-vegetarians from Sweden, Denmark and Finland have been compared. A lower intake was found in vegans indicating that meat, eggs, and dairy products are important dietary sources of selenium. A note on that has been added to the manuscript.

31. Copper

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association	No general comments.	page 18: cupper > copper pages 20 and 21: It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	We have added that IOM is now National Academy of Sciences, Engineering, and Medicine (NASEM)
Swedish food agency	Swedish food agency	No general comments	In the introduction you write the following: "In the human body, copper functions as a structural component in a number of proteins as well as a catalytic cofactor of a number of enzymes involved in energy and iron metabolism,........ It would be interesting to read more about the role of copper in iron metabolism since iron is also included in the NNR. I.e could the iron metabolism be negatively affected by to low intake of copper?	We mention in the text that zinc and iron may compete with copper for absorption. However, this is likely not relevant for dietary intakes. The effect of zinc is seen at doses much higher then the recommended intake. A systematic review for the previous NNR (Domellöf et al., 2013) found no conclusive evidence for an effect of iron supplements on copper absoprtion. However, we think the effect on iron status is outside the scope of this chapter.

32. Chromium

No comments received

33. Manganese

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc),	Finnish Vegan Association	No general comments.	Page 7 and 8. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	The name change is now clarified at the first mentioning of Institute of Medicine (IOM) in the text. For the remaning text, the name IOM is kept, as it was the name in 2001, when the assessment of manganese was performed, and as it is complying with the name in the reference.
Ann-Kristin Sundin	LRF	Dear NNR Committee, Thank you for this opportunity to comment on the Manganese draft. Here are the comments from LRF. In the Manganese draft, the authors use the term plant-based foods. We reckon this is a marketing term, rather than a scientific one. A better choice of words would be plant foods, as in the Cereals draft.		As suggested, we have now changed this word in the abstract to plant foods

34. Molybdenum

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Johanna Kaipiainen (M.Sc, RD), Charlotta Hyttinen (M.Sc)	Finnish Vegan Association		Page 1,4, 7 and 8. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	Thank you for the comment. The name change is now clarified in the Abstract. In the text, the name Institute of Medicine is kept, as it was the name in 2001, when the assessment of molybedenum was performed, and as it is complying with the name in the reference.

35. Fluoride

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comment from authors
Johanna Kaipiainen (M.Sc, RD),	Finnish Vegan Association	No general comments.	Page 5. It would be good to mention here that the Institute of Medicine has changed its name to the National Academy of Medicine.	We have taken the comments into account.

36. Phytochemicals and antioxidants

Name	Organization	General comments to the chapter	Specific comments to the chapter	Comments from authors
Torunn Nordbø	Opplysningskontoret for brød og korn	OBK appreciate the opportunity to comment on NNR2022s draft chapter on Antioxidants and phytochemicals. See specific comment.	On page 7, section dietary intake, grain products are briefly mentioned as a contributor of antioxidants. Cereals/whole grain are a good source of antioxidants. This is also mentioned in the NNR2022s draft chapter on cereals: "Phenolic compounds in whole grains have antioxidative properties". We suggest the authors also state in the abstract and introduction section (p2-3), where they highlight other food sources, that whole grain is a considerable source of antioxidants. References: Khan, J.; Khan, M.Z.; Ma, Y.; Meng, Y.; Mushtaq, A.; Shen, Q.; Xue, Y. Overview of the Composition of Whole Grains' Phenolic Acids and Dietary Fibre and Their Effect on Chronic Non-Communicable Diseases. Int. J. Environ. Res. Public Health 2022, 19, 3042. https://doi.org/10.3390/ijerph19053042 Călinoiu LF, Vodnar DC. Whole Grains and Phenolic Acids: A Review on Bioactivity, Functionality, Health Benefits and Bioavailability. Nutrients. 2018 Nov 1;10(11):1615. doi: 10.3390/nu10111615 Bienik, D. 2017. Bioaktive fytokjemikalier i fullkorn og mulige fysiologiske virkningsmekanismer. https://doi.org/10.18261/ntfe.15.2.2 Fardet, A. (2010). New hypotheses for the health-protective mechanisms of whole-grain cereals: What is beyond fibre? Nutrition Research Reviews, 23(1), 65-134. doi:10.1017/S0954422410000041 Lui, R. H. Whole grain phytochemicals and health. 2007. Journal of Cereal Science, vol 46, Issue 3, p207-219, https://doi.org/10.1016/j.jcs.2007.06.010	We would like to thank Norbø from brød/korn for the comment. We agree that whole grain is also a source of phytochemicals with antioxidant properties, and we have therefore added more information in the abstract and in the introduction.