

BEREGNINGER OG METODE BAG NNR2023 – SUNDHED, MILJØASPEKTER - OG BIOTILGÆNGELIGHED

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Forskningsgruppen:
Ernæring, Bæredygtighed og Sundhedsfremme**

Ernæringsfokuskonference 2024

- NNR2023:
- Principper for fastsættelse af Råd om fødevareindtag: fødevaregrupper i NNR203
- Principper for fastsættelse af referenceværdier for næringsstoffer
- Ændringer fra NNR2012 til NNR2023 – eksempler
- Eksempler - næringsstoffer som kan være kritiske i plante-rig kost
- Eksempel: Calcium

Nordic Nutrition Recommendations

50 years of Nordic cooperation for healthy eating

Nordic Council of Ministers



- 1980: 1st edition of NNR (nutrients)
- 2012: 5th edition, **integrating nutrition and physical activity**

**NNR2023 Report Launched June 2023:
Integrating environmental aspects**

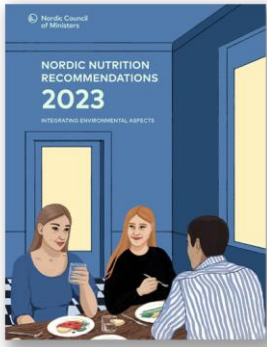
Outline:

What is NNR?

How has environmental aspect been integrated?

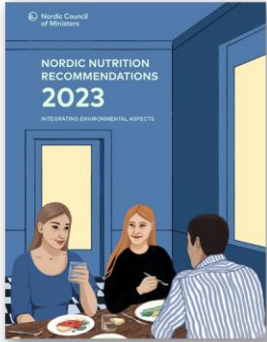


NNR2023 rapporten indeholder



- Anbefalinger for 35 næringsstoffer
- Anbefalinger for 14 fødevaregrupper og 4 andre områder
- Summary for hvert næringsstof/fødevaregruppe
- Videnskabelig evidens for sund og klimavenlig kost

NNR2023 rapporten indeholder



NNR2023 rapport (offentliggjort 20/6-23)

- 7 appendix
- Nye vægtreferencer for nordiske/baltiske befolkningsgrupper (Appendix 4)
- Oversigt over de ca. 100 kvalificerede systematiske reviews (qSR) der har bidraget (Tabel 1, Appendix 2)
- Nye transparente metoder

APPENDIX

Appendix 1.

Appendix 2. List of qualified systematic reviews

Appendix 3. NNR2023 modified AMSTAR 2

Appendix 4. Body size and energy requirement estimations

Appendix 5. Calculation of DRVs

Appendix 6. DRVs for children

Appendix 7. Vitamin D intake and serum 25OHD concentrations: Approaches to dose-response analyses

Framework for national dietary guidelines:

based on:

- Health evidence
- Nutrients contribution
- Environmental aspects

Science advice for intake of food groups.

For national health and food authorities for the work on providing updated sustainable food based dietary guidelines

five papers on principles and methodology

REVIEW ARTICLE

The Nordic Nutrition Recommendations 2022 – principles and methodologies

Jacob Juel Christensen^{1,2}, Erik Kristoffer Arnesen², Rikke Andersen³, Hanna Eneroth⁴, Majjaliisa Erkkola⁵, Anne Høyer⁶, Eva Warensjö Lemming⁴, Helle Margrete Meltzer⁷, Þórhallur Ingi Halldórsson⁸, Inga Þórsdóttir⁸, Ursula Schwab⁹, Ellen Trolle³ and Rune Blomhoff^{1,6,10*}

REVIEW ARTICLE

The Nordic Nutrition Recommendations 2022 – prioritisation of topics for *de novo* systematic reviews

Anne Høyer¹, Jacob Juel Christensen^{2,3}, Erik Kristoffer Arnesen^{1,3}, Rikke Andersen⁴, Hanna Eneroth⁵, Majjaliisa Erkkola⁶, Eva Warensjö Lemming⁵, Helle Margrete Meltzer⁷, Þórhallur Ingi Halldórsson⁸, Inga Þórsdóttir⁸, Ursula Schwab^{9,10}, Ellen Trolle⁴ and Rune Blomhoff^{3,11*}

REVIEW ARTICLE

The Nordic Nutrition Recommendations 2022 – structure and rationale of qualified systematic reviews

Erik Kristoffer Arnesen¹, Jacob Juel Christensen^{1,2}, Rikke Andersen³, Hanna Eneroth⁴, Majjaliisa Erkkola⁵, Anne Høyer⁶, Eva Warensjö Lemming⁴, Helle Margrete Meltzer⁷, Þórhallur Ingi Halldórsson⁸, Inga Þórsdóttir⁸, Ursula Schwab⁹, Ellen Trolle³ and Rune Blomhoff^{1,6,10*}

REVIEW ARTICLE

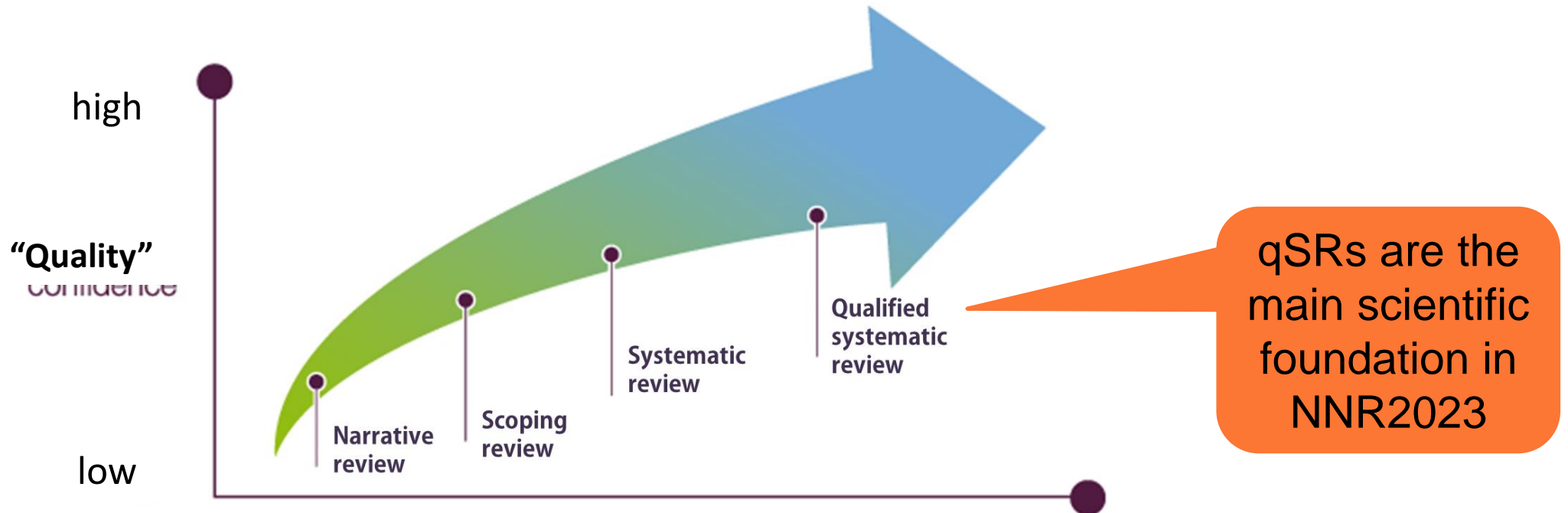
The Nordic Nutrition Recommendations 2022 – handbook for qualified systematic reviews

Erik Kristoffer Arnesen¹, Jacob Juel Christensen^{1,2}, Rikke Andersen³, Hanna Eneroth⁴, Majjaliisa Erkkola⁵, Anne Høyer⁶, Eva Warensjö Lemming⁴, Helle Margrete Meltzer⁷, Þórhallur Ingi Halldórsson⁸, Inga Þórsdóttir⁸, Ursula Schwab⁹, Ellen Trolle³ and Rune Blomhoff^{1,6,10*}

**The Nordic Nutrition
Recommendations 2023 – Use of
Dietary Reference Values (Trolle et al,
to be submitted)**

Evaluate causal effects on health outcomes

Novel definition of qualified systematic reviews qSRs



- Identified ~100 qSRs as
- Produced 9+6 *de novo* qSRs

Principles and methodology (5 papers), organization

Dietary reference values (DRVs)

Food-based dietary guidelines (FBDGs)

Other related topics (5 ScRs):

- Physical activity
- Body weight
- Nutrient/diet intake
- Burden of diseases

• Socio-economic sustainability

Nutrients

reviews on health effects (36 ScRs)

Identified qSRs

De novo qSRs (6 qSRs)

Food groups, diet/meal pattern

reviews on health effects (17 ScRs)

Identified qSRs

De novo qSRs (9 qSRs)

Evaluate *totality* (and for some nutrients also *strength*) of the evidence (ToE/SoE) for selected indicator

«Strong»

«Weak»

Insufficient evidence

Set ref. value with *high* confidence

AR, RI, UL, CDRR, RI range for macros

Set ref. value with *low* confidence

AI, provisional AR

No DRV established

Evaluate ToE/SoE for health effects, nutrient intake, & health challenges

Strong evidence

Strong evidence **and** dose-response, **or** food group key source of nutrients

Set qualitative FBDG

Set quantitative FBDG

Give science advice

Integrate

Set overall FBDG

Evaluate ToE for environmental impact of food consumption (4 ScRs)

Developed framework for dietary guidelines based on health effects and environmental impacts

Quantitative FBDGs

- if the overall evidence is categorized as “Strong evidence” according to predefined criteria, and a dose-response curve has been developed in a qualified meta-analysis
- if food group is considered a key group for nutritional adequacy in the population

Qualitative FBDGs

are suggested if sufficient evidence for causality, but representative dose-response curve cannot be established

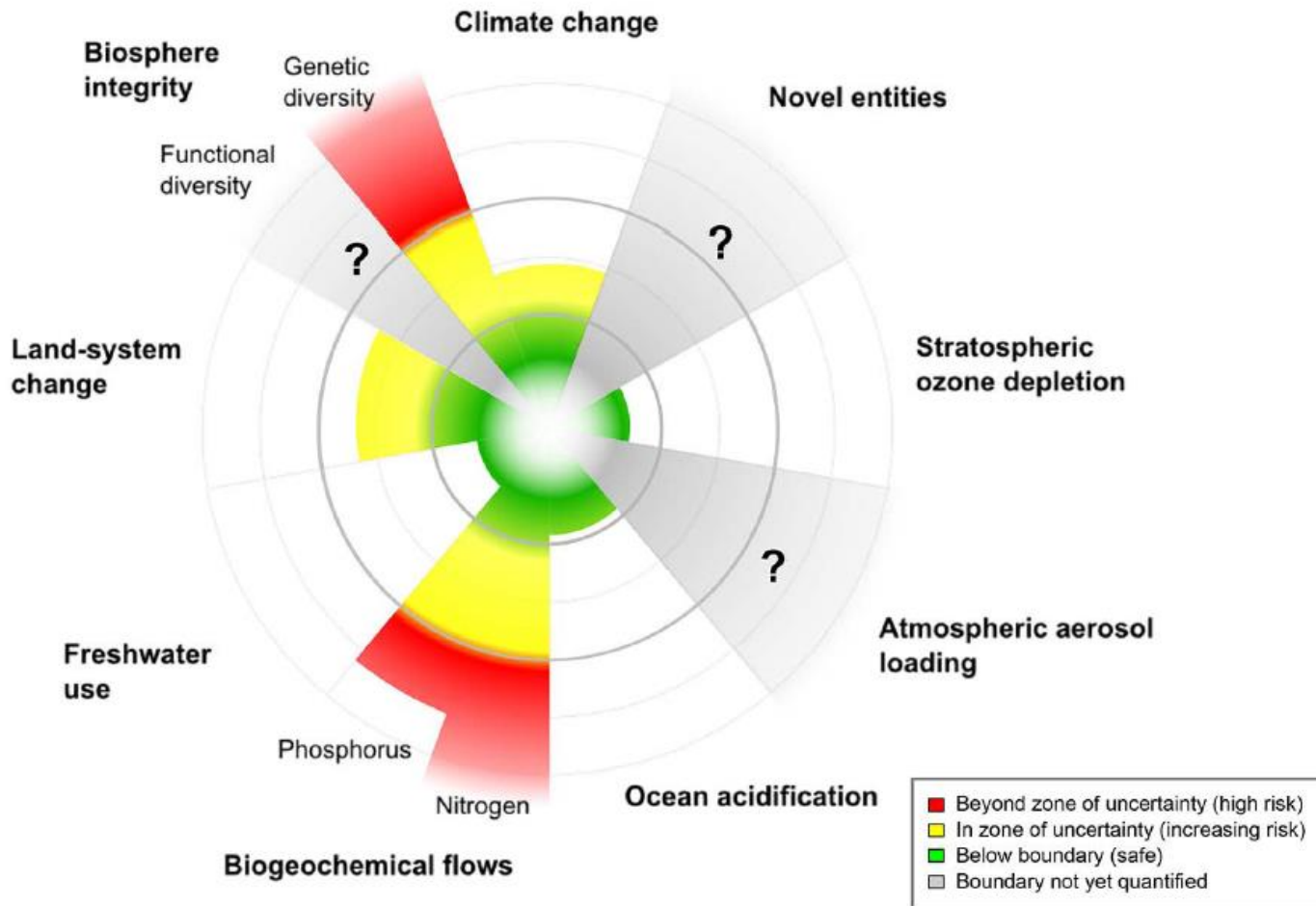
Environmental impact of consumption of the food groups

Priority to changes in dietary patterns that reduce the environmental impact of the food group

Narrowing the health defined ranges of intakes can contribute to reducing the environmental impact without compromising the beneficial health effects.

Planetære grænser

Planetære grænser



Steffen W, Richardson K, Rockström J et al. (2015). Science 347(6223), 736-746

✓ Klimaaftryk

CO₂-ækv.ivalenter (kg/kg fødevare)

✓ Arealanvendelse

LU (m² /kg fødevare)

Udbytte - Vejr, jord, vand, gødning

Areal til foder

Græsningsarealer: dyrkbare, ikke-dyrkbare

Ændringer – Skovrydning

✓ Vand forbrug (vandmangel-vægtede værdier)

WF (fresh water)

Blå WF - grundvand og overfladevand

Grøn WF – nedbør

• Biodiversitet

• Kvælstof- og fosforbelastning

• Pesticidudledning

• Human toxicitet

We followed the FAO/WHO guiding principles for sustainable diets



SUSTAINABLE HEALTHY DIETS...

REGARDING THE HEALTH ASPECT

1 ...start early in life with early initiation of breastfeeding, exclusive breastfeeding until six months of age, and continued breastfeeding until two years and beyond, combined with appropriate complementary feeding.

2 ... are based on a great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed food and drink products.¹⁰

3 ... include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables.¹¹

4 ... can include moderate amounts of eggs, dairy, poultry and fish; and small amounts of red meat.

8 ... contain minimal levels, or none if possible, of pathogens, toxins and other agents that can cause foodborne disease.

7 ... are consistent with WHO guidelines to reduce the risk of diet-related NCDs, and ensure health and wellbeing for the general population.¹²

6 ... are adequate (i.e. reaching but not exceeding needs) in energy and nutrients for growth and development, and to meet the needs for an active and healthy life across the lifecycle.

5 ... include safe and clean drinking water as the fluid of choice.

REGARDING ENVIRONMENTAL IMPACT

9 ... maintain greenhouse gas emissions, water and land use, nitrogen and phosphorus application and chemical pollution within set targets.

10 ... preserve biodiversity, including that of crops, livestock, forest-derived foods and aquatic genetic resources, and avoid overfishing and overhunting.

11 ...minimize the use of antibiotics and hormones in food production.

12 ... minimize the use of plastics and derivatives in food packaging.

REGARDING SOCIOCULTURAL ASPECTS

16 ... avoid adverse gender-related impacts, especially with regard to time allocation (e.g. for buying and preparing food, water and fuel acquisition).

15 ... are accessible and desirable.

14 ... are built on and respect local culture, culinary practices, knowledge and consumption patterns, and values on the way food is sourced, produced and consumed.

13 ...reduce food loss and waste.

NNR2023 – background papers

- 34 health effects of nutrient
- 17 health effects of food groups and dietary pattern
- 1 physical activity
- 1 burden of diseases
- 1 body weight
- 1 food & nutrient intakes

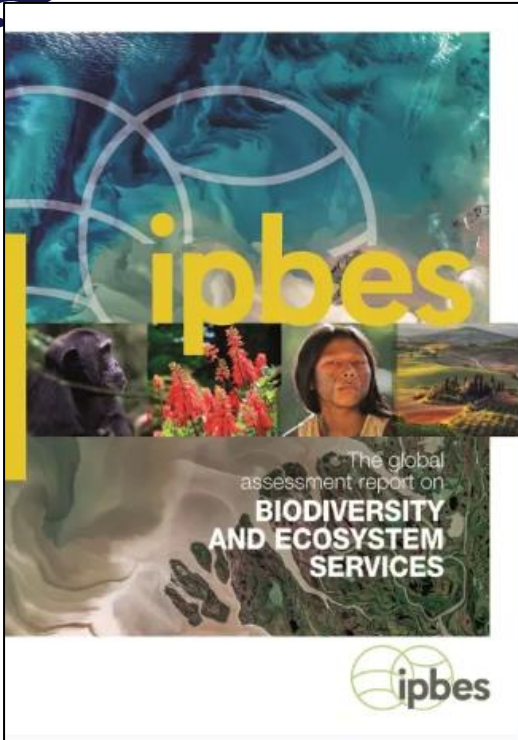
NNR2023 – background papers on sustainability

- 4 food systems, diet & environmental sustainability
- 1 social and economical sustainability

Environmental impact

- GHG emissions
- water use
- land use
- nitrogen & phosphorus use
- chemical pollution
- biodiversity impact





The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services (2019)

- Declarations from the Nordic Council of Ministers:
- Action plan 2021-2024
- Biodiversity (03.05.22)
- Sustainable food systems (24.06.21)
- Global climate agenda (30.04.20)
- Nordic carbon neutrality (25.01.19)



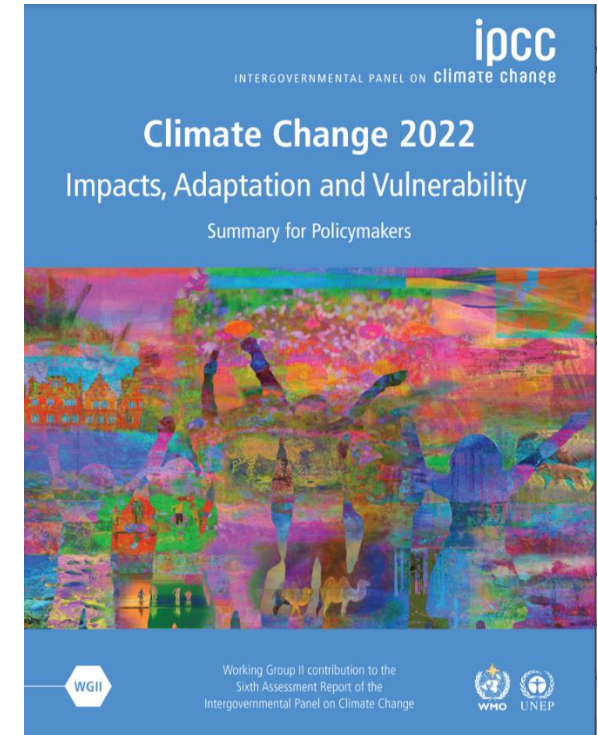
Evidence synthesis on environmentally sustainable food consumption



Science advice for policy by European academies (SAPEA), A sustainable food system for the European Union (2020)



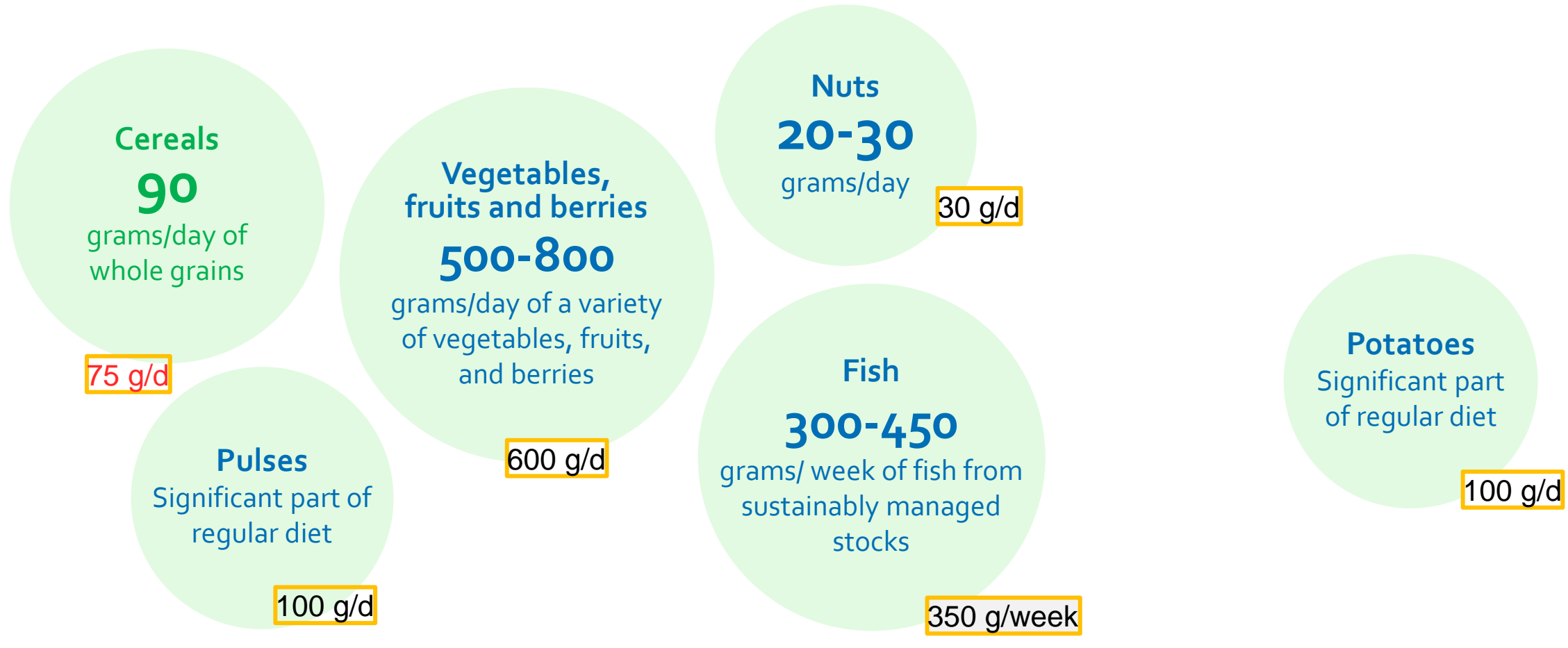
5 NNR background papers on sustainability



The Intergovernmental Panel on Climate Change (IPCC) - SIXTH ASSESSMENT REPORT
 Part 1: The Physical Science Basis (8/2021)
 Part 2: Impacts, Adaptation and Vulnerability (2/2022)
 Part 3: Mitigation of Climate Change (4/2022)
 AR6 Synthesis Report (3/2023)

Health evidence and sustainability evidence: NNR2023 compared to Danish FBDG 2021 (10 MJ/d)

Increased consumption – mainly plant foods

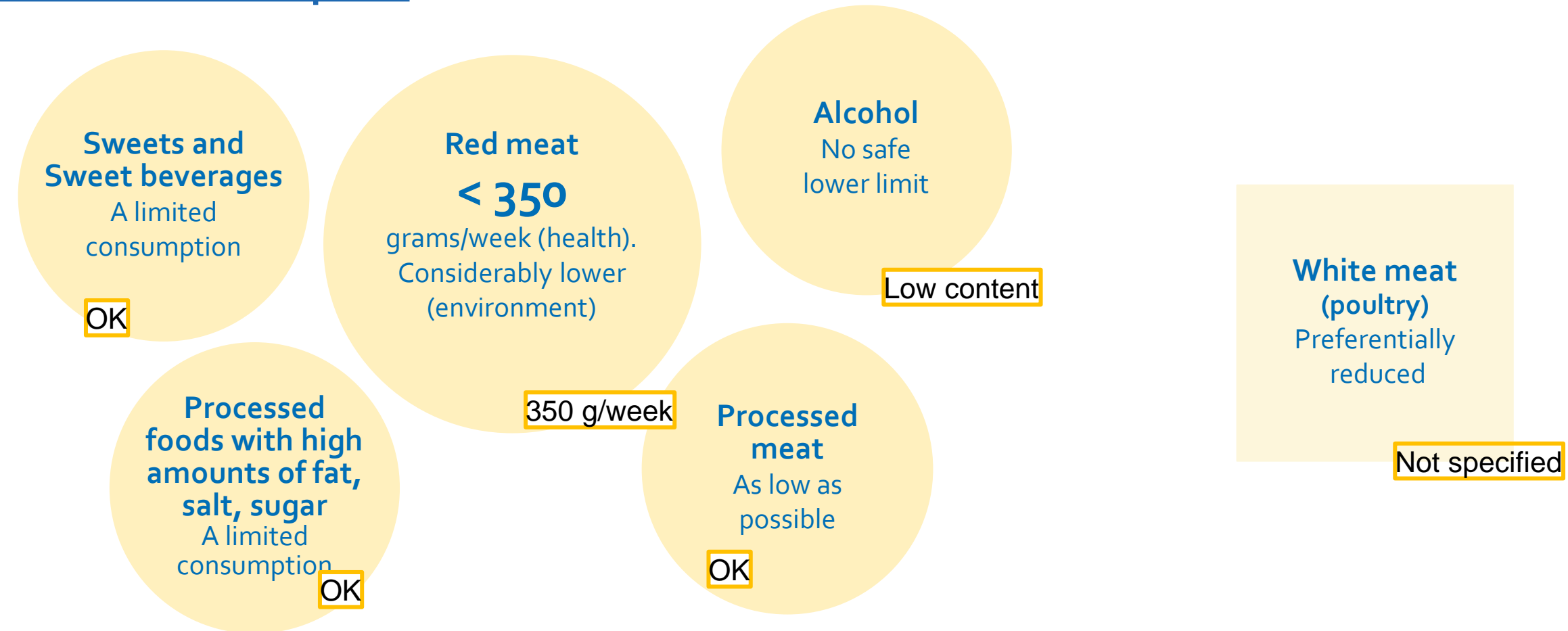


Health and environment

Environment

Health evidence and sustainability evidence: NNR2023 compared to **Danish FBDG 2021** (10 MJ/d)

Reduced consumption



Health and environment

Environment

Health evidence and sustainability evidence: NNR2023 compared to Danish FBDG 2021

Moderate consumption

Milk and dairy

350-500

Incl. cheese,
milk conversion factor 5-10

ml/day of low fat dairy
(health). Preferentially lower
dependent on nutrients
in overall diet
(environment).

250 g milk, 20 g cheese per d

Eggs

A moderate intake of egg
may be part of a healthy and
environment-friendly
diet. (Consumption of up to
1 egg per day can be part of
a healthy diet)

OK

Health and environment

Other changes: Coffee
 Fruit juice
 Vegetable oils

Nye aldersgruppeinddelinger (harmonisering)

Nye energireferenceværdier

Table 8 Reference values for energy intakes in groups of adults with sedentary and active lifestyles.

Age, years	Reference weight, kg ¹	REE, MJ/d ²	Average PAL 1.4, MJ/d	Average PAL 1.6, MJ/d	Active PAL 1.8, MJ/d
FEMALES					
18-24	64.2	5.9	8.3	9.4	10.6
25-50	64.1	5.7	8	9.0	10.2
51-70	62.5	5.2	7.2	8.3	9.3
>70	60.6	5.1	7.1	8.2	9.2
MALES					
18-24	75.2	7.4	10.4	11.8	13.2
25-50	74.8	7.1	9.9	11.3	12.7
51-70	73.0	6.4	9	10.3	11.6
>70	70.6	6.3	8.8	10.1	11.3
Pregnancy ¹					
≤50	76.4	6.4	8.9	10.2	11.5
Lactation ²					
≤50	62.4	7.8	10.9	12.5	14.1

¹ See Appendix 4 and Cloetens & Ellegård (2023) for sources and methodology as well as reference values per year of age.

² For corresponding values expressed as kilocalories (kcal)/day, see Appendix 4.

³ Weight gain of 14 kg during pregnancy, assuming a pre-pregnancy BMI of 18.5-24.9

⁴ Exclusive breastfeeding 0-6 months postpartum

Voksne:

- Vægt beregnet fra højde af nordiske og baltiske populationsgrupper skaleret til en BMI 23 kg/m²

Spædbørn og børn op til 6 år:

- Vægt og højde fra publicerede vækstkurver fra Danmark, Estland, Finland, Norge og Sverige

Børn og unge 6-17 år:

- Vægt beregnet fra højde fra publicerede vækstkurver fra Danmark, Estland, Finland, Norge og Sverige og sunde BMI defineret af WHO
- **Hvorfor?** Repræsentative vægtkurver for Nordiske og Baltiske lande

Overordnet ingen ændringer i makronæringsstofanbefalinger

Box 2: Recommended intake ranges of macronutrients for adults

Fats		25-40 E%
Cis-monounsaturated	10-20 E%	
Cis-polyunsaturated	5-10 E%	
Saturated fatty acids	<10 E%	
Carbohydrates		45-60 E%
Dietary fibre	≥25-35 g/d	At least 3 g/MJ
Added and free sugars	<10 E%	
Proteins		10-20 E%

Fri sukker: tilsat sukker + sukker naturligt forekommende i honning, sirup, frugt juice og frugt juice koncentreter

Sukker:

- NNR2023: Tilsat og fri sukker < 10 E%
- NNR2012: Tilsat sukker < 10 E% (alle)
- NNR2023:
 - ≥ 2 år: tilsat og fri sukker < 10 E% og helst lavere
 - < 2 år: undgå fødevarer og drikkevarer med tilsat og fri sukker

Kostfiber:

- NNR2023: mindst 3 g/MJ
 - Børn ≥ 2 år: 2-3 g/MJ eller mere
- NNR2012: approximately 3 g/MJ
 - Børn ≥ 2 år: 2-3 g/MJ

Recommendations micronutrients

- All DRVs recalculated, first time in NNR

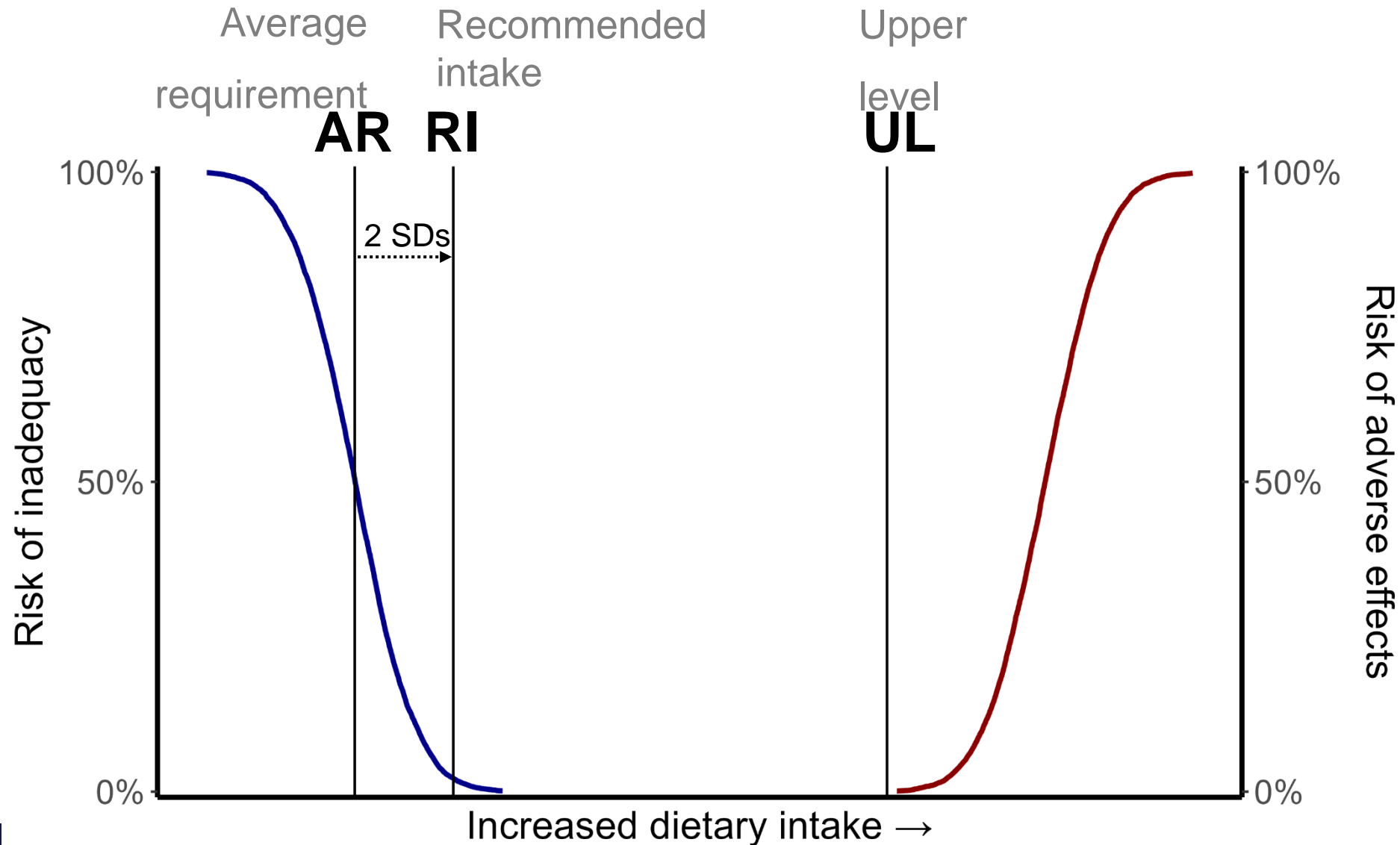
7 nutrients received recommendation for first time in NNR

- Vitamin K
- Biotin
- Pantothenic acid
- Choline
- Manganese
- Molybdenum
- Fluoride

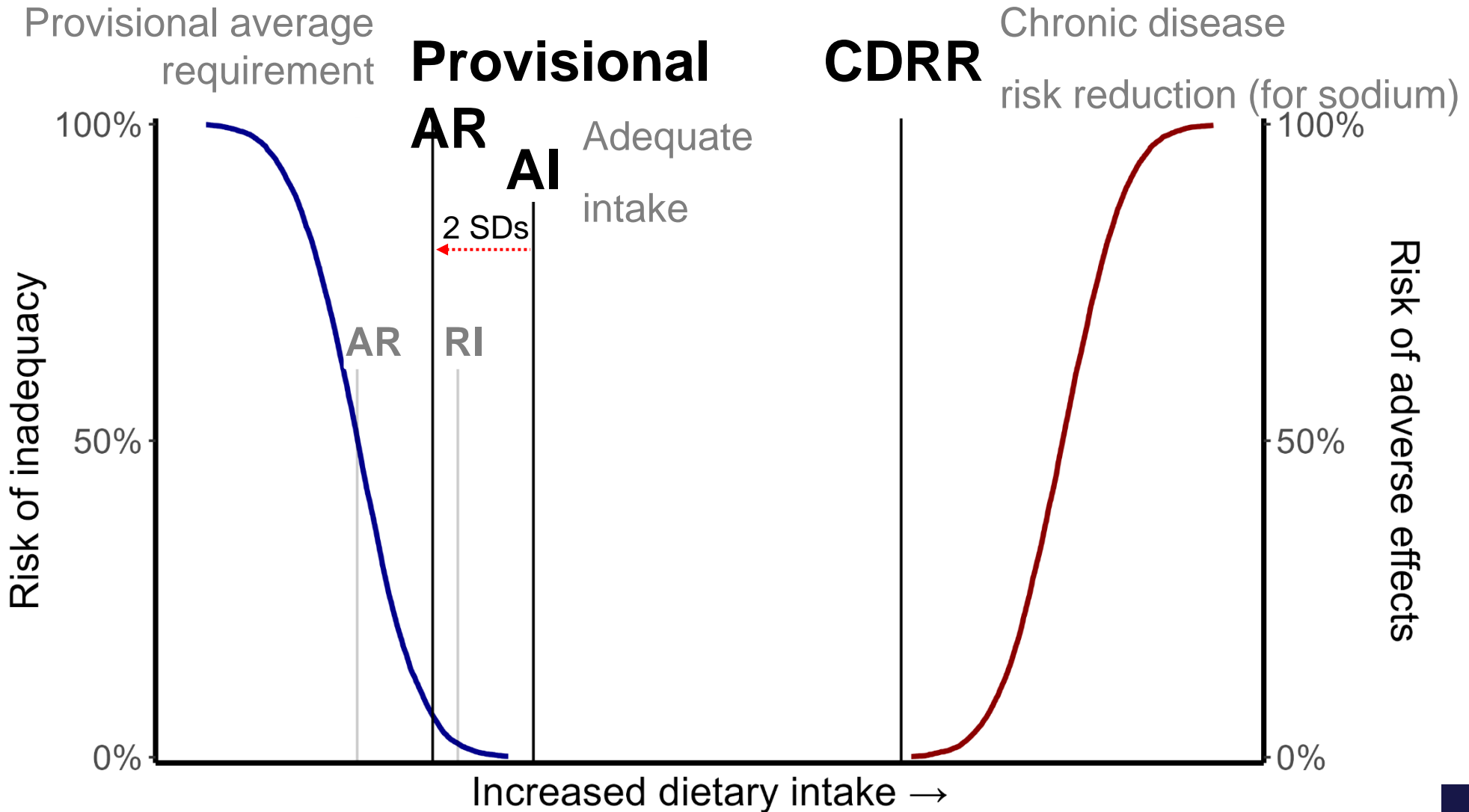
9 nutrients changed recommendation by more than 20% (adults)

- Vitamin E
- Vitamin B₆
- Folate
- Vitamin B₁₂
- Vitamin C
- Calcium
- Thiamine
- Zinc
- Selenium

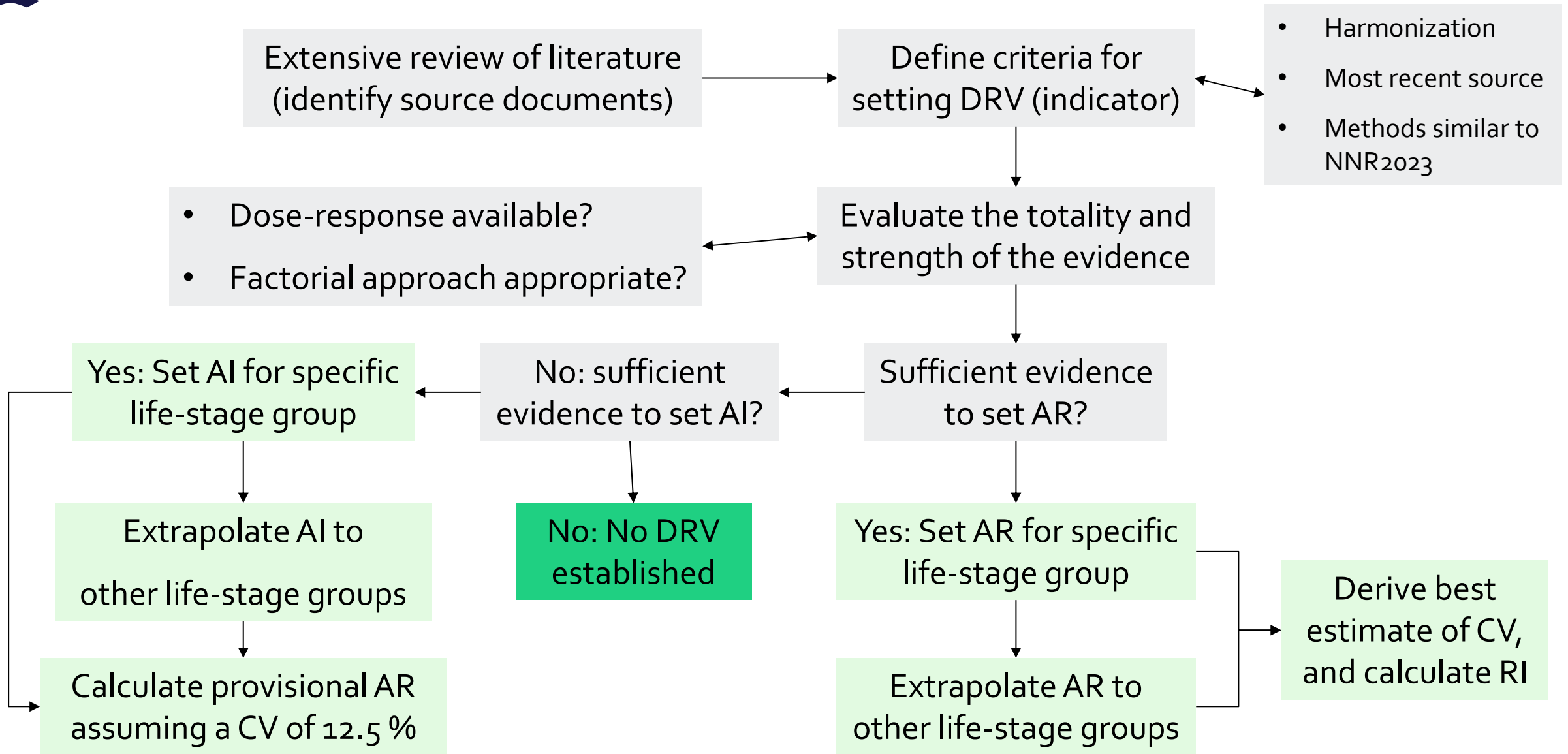
DRVs known from NNR2012: the AR, the RI, and the UL



Three *new* DRVs in NNR2023: the AI, the Provisional AR, and the CDRR



A clear set of principles for setting DRVs



Metoder til fastsættelse af DRVs

NNR2023: Appendix 5

- Dosis-respons metode
 - fx D-vitamin, thiamin, riboflavin, niacin, B6-vitamin, folate, C-vitamin, iodine (AI)
- Faktoriel metode (formel)
 - fx A-vitamin, E-vitamin (AI), **jern**, zink, **calcium**, selen (AI)
- Observeret indtag
 - fx K-vitamin, pantothensyre, biotin, B12-vitamin, kolin, kalium, magnesium, kobber, mangan, molybdæn

Changes in DRVs from NNR2012 to NNR2023, examples

- Selenium increased 33-63% - AI
- Calcium increased 19-33% - RI
- Riboflavin increased 33% for adult women – RI

- Vitamin B12

7-14 y	50-100%	increase
15y+	100%	increase
- Vit E

2-10y	50%+	increase
11-17y	20-50%	increase
18-50yF	20-50%	increase
- Zinc

11-17y F:	33-41%	increase
18y+:	33-41%	increase
- Vit C

18y F:	27%	increase
18y M:	47%	increase
7-17y:	0-60%	increase

Calcium.

- The AR of calcium for adults in NNR2012 was derived from one Norwegian balance study in male convicts.
- In NNR2023, the DRVs are updated and adopted from EFSA. The updated AR for adults takes into account several balance studies, in which the mean calcium intake necessary to equal excretion was found to be 715 mg/day. Additionally, an allowance for 40 mg/day of dermal losses of calcium, which was not measured in the studies, was added to derive the revised AR of 750 in males and females aged ≥ 25 years.
- EFSA: adult absorption: 25%

Children and adolescents: Factorial method:

Dietary requirement =

$$\frac{[(\text{urinary losses/kg bw} + \text{faecal losses/kg bw} + \text{dermal losses/kg bw}) \times \text{reference weight} + \text{calcium accretion in bone}]}{\text{fractional absorption}}^*$$

Age y	Physiological requirement (mg/day)(c)	Percentage of absorption(d)
1-3	174	40
4-6	204	30
7-10	235	35
11-14	378	40
15-17	391	45(M) 35(F)

absorption values reported in the literature differ depending on the study population, habitual calcium intake and stage of puberty.

800-1800 mg

EFSA opinion on calcium 2025

- **The absorption of calcium**
- about 30% from dairy and fortified foods (e.g. orange juice, tofu, and soy drink)
- and nearly twice as high from certain green vegetables (e.g. bok choy, broccoli, and kale)
- Mineral waters can also be a good source of absorbable calcium
- Some foods contain compounds, such as oxalic acid and phytic acid, that bind calcium or otherwise interfere with calcium absorption
- among the foods high in phytic acid are fiber-containing whole-grain products and wheat bran, beans, seeds, nuts, and soy isolates. The extent to which these compounds affect calcium absorption varies.

Calcium – a scoping review for Nordic Nutrition Recommendations 2023

Jóhanna E. Torfadóttir and Kirsti Uusi-Rasi (FNR 2023)

Beskræftes delvist af et nyere studie: *Muleya et al., Food research International 2024*

Dog varierer det for berigede produkter – kunne ikke bekræftes for tofu, plante-drikke

Broccoli, ærter og kål var højere end mælk og

Kikærter og linser samt fuldkornsbrød lå medium-højt

Opsummering

- NNR2023 metoder er beskrevet.
- Man kan finde frem til evidensen bag
- DRVs og råd om fødevareindtag – kan danne baggrund for udformning af kostråd af nationale myndigheder
- Calcium DRV for børn og unge er baseret på faktoriel metode
- Absorption er med i ligningen
- Stadig brug for mere viden om optag fra den samlede kost.