

# Videnskabelig og transparent metode i NNR2023

# Cutting edge methodology and principles

- Novel methodology for setting DRVs and FBDGs – harmonized methodologies from international leading authorities
- Novel fundament for assessment of causality – qualified systematic reviews
- Novel framework for integrating environmental effects of food consumption
- Extensive “checks and balances” – high scientific quality
- Transparent documentation
- Democratic process – several hundred experts included
- Methodology and principles peer reviewed by Scientific Advisory Group



Principles and methodology (5 papers), organization

Dietary reference values (DRVs)

Food-based dietary guidelines (FBDGs)

Nutrients

reviews on health effects (36 ScRs)

Identified qSRs

De novo qSRs (6 qSRs)

Other related topics (5 ScRs):

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

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)

# We developed five papers on principles and methodology

## REVIEW ARTICLE

The Nordic Nutrition Recommendations 2022 – principles and methodologies

Jacob Juel Christensen<sup>1,2</sup>, Erik Kristoffer Arnesen<sup>2</sup>, Rikke Andersen<sup>3</sup>, Hanna Eneroth<sup>4</sup>, Majjaliisa Erkkola<sup>5</sup>, Anne Høyer<sup>6</sup>, Eva Warensjö Lemming<sup>4</sup>, Helle Margrete Meltzer<sup>7</sup>, Þórhallur Ingi Halldórsson<sup>8</sup>, Inga Þórsdóttir<sup>8</sup>, Ursula Schwab<sup>9</sup>, Ellen Trolle<sup>3</sup> and Rune Blomhoff<sup>1,6,10\*</sup>

## REVIEW ARTICLE

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

Anne Høyer<sup>1</sup>, Jacob Juel Christensen<sup>2,3</sup>, Erik Kristoffer Arnesen<sup>1,3</sup>, Rikke Andersen<sup>4</sup>, Hanna Eneroth<sup>5</sup>, Majjaliisa Erkkola<sup>6</sup>, Eva Warensjö Lemming<sup>5</sup>, Helle Margrete Meltzer<sup>7</sup>, Þórhallur Ingi Halldórsson<sup>8</sup>, Inga Þórsdóttir<sup>8</sup>, Ursula Schwab<sup>9,10</sup>, Ellen Trolle<sup>4</sup> and Rune Blomhoff<sup>3,11\*</sup>

## REVIEW ARTICLE

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

Erik Kristoffer Arnesen<sup>1</sup>, Jacob Juel Christensen<sup>1,2</sup>, Rikke Andersen<sup>3</sup>, Hanna Eneroth<sup>4</sup>, Majjaliisa Erkkola<sup>5</sup>, Anne Høyer<sup>6</sup>, Eva Warensjö Lemming<sup>4</sup>, Helle Margrete Meltzer<sup>7</sup>, Þórhallur Ingi Halldórsson<sup>8</sup>, Inga Þórsdóttir<sup>8</sup>, Ursula Schwab<sup>9</sup>, Ellen Trolle<sup>3</sup> and Rune Blomhoff<sup>1,6,10\*</sup>

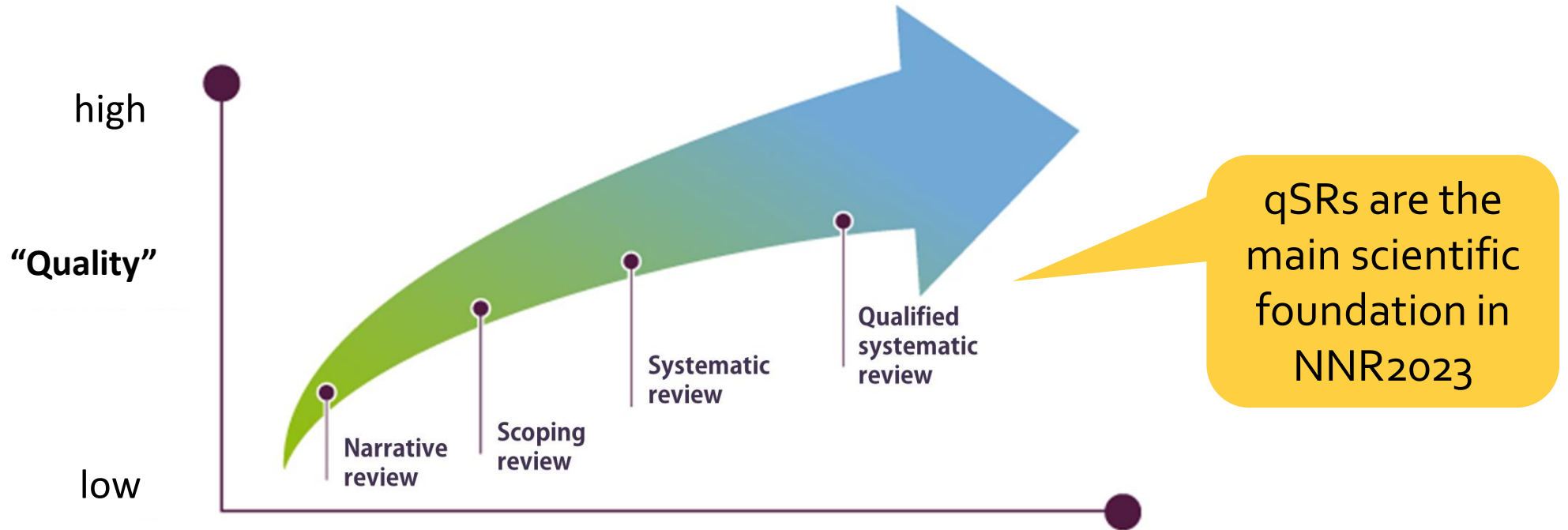
## REVIEW ARTICLE

The Nordic Nutrition Recommendations 2022 – handbook for qualified systematic reviews

Erik Kristoffer Arnesen<sup>1</sup>, Jacob Juel Christensen<sup>1,2</sup>, Rikke Andersen<sup>3</sup>, Hanna Eneroth<sup>4</sup>, Majjaliisa Erkkola<sup>5</sup>, Anne Høyer<sup>6</sup>, Eva Warensjö Lemming<sup>4</sup>, Helle Margrete Meltzer<sup>7</sup>, Þórhallur Ingi Halldórsson<sup>8</sup>, Inga Þórsdóttir<sup>8</sup>, Ursula Schwab<sup>9</sup>, Ellen Trolle<sup>3</sup> and Rune Blomhoff<sup>1,6,10\*</sup>

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

# We evaluated causal effects of diet and nutrient exposures on health outcomes using a novel definition of “qualified” systematic reviews (qSRs)



- Identified ~100 qSRs
- Produced 9 (FBDGs) + 6 (DRVs) *de novo* qSRs



# We included qSRs that fulfilled *a priori* defined eligibility criteria

## Inclusion criteria

- Commissioned by national food or health authorities, or international food and health organization
- Authored by a group of multidisciplinary experts
- Consist of an original SR of the evidence for a nutrient/diet-health relationship
- Includes at least one nutrient/food topic and its relationship to at least one outcome related to a chronic disease or condition that is of public health interest in Nordic or Baltic countries
- Includes a clear description of the SR methodology, which should be similar to the methodology used NNR2023
- Includes an assessment of the quality of primary studies
- Provides an evidence grade for the overall quality of the primary studies
- English language

## Exclusion criteria

- Commissioned or sponsored by industry or an organization with a business or ideological interest
- Later updated in another qualified SR on the same topic
- Focused on an outcome outside the scope of the NNR (e.g. disease management or food safety)

# Examples of qSRs for some essential nutrients

Nutrient	Reference	Published/commissioned by
Vitamin D	Lamberg-Allardt et al. (2013), Newberry et al. (2014), Dewey et al. (2020), Lamberg-Allardt et al. (2023a)	NNR2012, AHRQ, DGAC2020, EFSA
Riboflavin	Buijssen et al. (2014)	EFSA
Niacin	Eeuwijk et al. (2012)	EFSA
Vitamin B6	Eeuwijk et al. (2012), EFSA (2023a)	EFSA
Folate	Donovan et al. (2020b)	DGAC 2020
Vitamin B12	Bärebring et al. (2023)	NNR2023
Biotin	Eeuwijk et al. (2012)	EFSA
Calcium	Uusi-Rasi et al. (2013), Newberry et al. (2014)	NNR2012, AHRQ



# We developed nine *de novo* qSRs in NNR2023

<p>REVIEW ARTICLE</p> <p>Protein intake in children and growth and obesity: A systematic review and meta-analysis</p> <p>Erik Kristoffer Arnesen<sup>1*</sup>, Birna Thorisdottir<sup>2</sup>, Christel Lamberg-Allardt<sup>3</sup>, Linnea Bärebring<sup>4</sup>, Bright I. Nwaru<sup>5</sup>, Jutta Dierkes<sup>6</sup>, Alfons Ramel<sup>7</sup>, Fredrik Söderlund<sup>8</sup>, and Agneta Åkesson<sup>9</sup></p>	<p>REVIEW ARTICLE</p> <p>Dietary fiber and growth, iron status and bowel function in children 0–5 years old: a systematic review</p> <p>Jutta Dierkes<sup>1,2</sup>, Bright I. Nwaru<sup>3</sup>, Alfons Ramel<sup>4</sup>, Erik Kristoffer Arnesen<sup>5</sup>, Birna Thorisdottir<sup>6</sup>, Christel Lamberg-Allardt<sup>7</sup>, Ulrike Spielau<sup>2</sup>, Fredrik Söderlund<sup>9</sup>, Linnea Bärebring<sup>8</sup> and Agneta Åkesson<sup>9</sup></p>	<p>REVIEW ARTICLE</p> <p>Risk of Alzheimer's disease and dementia: a systematic review</p> <p>Alfons Ramel<sup>4</sup>, Erik Kristoffer Arnesen<sup>5</sup>, Birna Thorisdottir<sup>2</sup>, Christel Lamberg-Allardt<sup>3</sup>, Fredrik Söderlund<sup>8</sup>, Linnea Bärebring<sup>9</sup> and Agneta Åkesson<sup>9</sup></p>
<p>REVIEW ARTICLE</p> <p>Legume consumption in adults and risk of cardiovascular disease and type 2 diabetes: a systematic review and meta-analysis</p> <p>Birna Thorisdottir<sup>1*</sup>, Erik Kristoffer Arnesen<sup>2</sup>, Christel Lamberg-Allardt<sup>3</sup>, Alfons Ramel<sup>4</sup>, Bright I. Nwaru<sup>5</sup>, Jutta Dierkes<sup>6,7</sup>, and Agneta Åkesson<sup>9</sup></p>	<p>REVIEW ARTICLE</p> <p>Intake of vitamin B12 in relation to vitamin B12 status in groups susceptible to deficiency: a systematic review</p> <p>Linnea Bärebring<sup>1</sup>, Christel Lamberg-Allardt<sup>2</sup>, Birna Thorisdottir<sup>3</sup>, Alfons Ramel<sup>4</sup>, Fredrik Söderlund<sup>5</sup>, Erik Kristoffer Arnesen<sup>6</sup>, Bright I. Nwaru<sup>7</sup>, Jutta Dierkes<sup>8,9</sup> and Agneta Åkesson<sup>9</sup></p>	<p>REVIEW ARTICLE</p> <p>Supplementation with long chain n-3 fatty acids during pregnancy, and risk to risk of asthma and atopic dermatitis: a systematic review and meta-analysis of clinical trials</p> <p>Christel Lamberg-Allardt<sup>3</sup>, Birna Thorisdottir<sup>4</sup>, Erik Kristoffer Arnesen<sup>7</sup>, Jutta Dierkes<sup>8,9</sup> and Agneta Åkesson<sup>9</sup></p>
<p>REVIEW ARTICLE</p> <p>Animal versus plant-based protein intake and risk of cardiovascular disease and type 2 diabetes: a systematic review of controlled trials and prospective cohort studies</p> <p>Christel Lamberg-Allardt<sup>1</sup>, Linnea Bärebring<sup>2</sup>, Bright I. Nwaru<sup>4</sup>, Birna Thorisdottir<sup>5</sup>, Alfons Ramel<sup>6</sup>, Fredrik Söderlund<sup>8</sup>, and Agneta Åkesson<sup>7</sup></p>	<p>REVIEW ARTICLE</p> <p>White meat consumption and risk of cardiovascular disease and type 2 diabetes: A systematic review and meta-analysis (Ramel et al, in press)</p>	<p>REVIEW ARTICLE</p> <p>Iron intake and risk of cardiovascular disease, type 2 diabetes and metabolic syndrome: a systematic review and meta-analysis</p> <p>Bright I. Nwaru<sup>3</sup>, Ulrike Spielau<sup>2</sup>, Jutta Dierkes<sup>6,7,8</sup>, Alfons Ramel<sup>9</sup>, Christel Lamberg-Allardt<sup>10</sup> and Agneta Åkesson<sup>4</sup></p>



# We developed *de novo* qSRs in an eight-step process

1) Define research question

Step 1

**NNR2022 Committee**  
Identify and define a research question (i.e. PI/ECOTSS)

Scientific Advisory Group

2) Protocol development

Step 2

**NNR SR Centre**  
Develop protocol and register in PROSPERO

**NNR2022 Committee**  
Scientific Advisory Group

3) Literature search

Step 3

**NNR SR Centre Librarians**  
Develop literature strategy and perform search;  
collect results in Endnote; import to Rayyan

**Independent librarians or experts**  
Consult on strategy

4) Screening and selection

Step 4

**Two independent NNR SR Centre Experts**  
Screen and select eligible studies

**Independent NNR SR Centre Senior Expert**  
Resolve discrepancies

5) Data extraction

Step 5

**Two independent NNR SR Centre Experts**  
Develop data extraction table; extract data

**Independent NNR SR Centre Senior Expert**  
Resolve discrepancies

6) Assessing risk of bias

Step 6

**Two independent NNR SR Centre Experts**  
Assess risk of bias of individual studies (RCTs: Cochrane's  
"Risk of bias 2.0 tool"; observational studies: modified ROBINS)

**Independent NNR SR Centre Senior Expert**  
Resolve discrepancies

7) Synthesis and grading of SoE

Step 7

**NNR SR Centre**  
Synthesis and grading of total strength of evidence  
(Meta analysis may be included; WCRF criteria used for grading)

**Independent NNR SR Centre Senior Expert**  
Resolve discrepancies

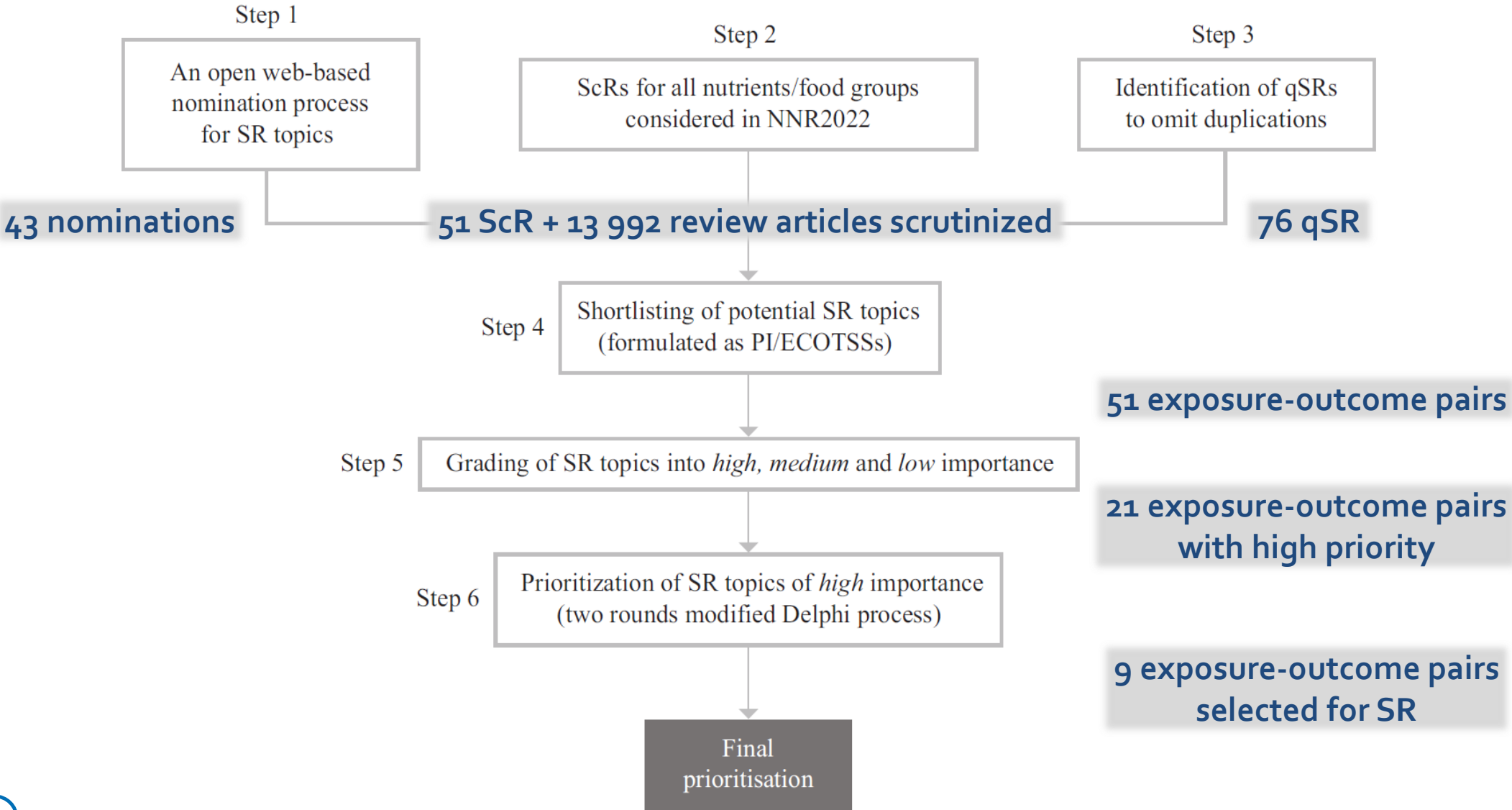
8) Reporting

Step 8

**NNR SR Centre**  
Finalize report

**At least two independent experts**  
Peer review

# Process for prioritising systematic review topics



# To develop FBDGs, we evaluated health effects, nutrients, health challenges, & environmental impact

## 1. Health effects of food groups were given priority

- Main basis for assessment: NNR2023 background papers of respective food groups, meal- and dietary pattern
- Evidence for association with chronic disease outcomes: qSR

*If **strong evidence** for a causal effect between the food group and health, we defined the range associated with low risk of diseases*

## 2. The food group contributes w/significant amounts of essential nutrients in the general population

## 3. Public health challenges related to health effects of the food group

## 4. 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 intake” can contribute to reducing the environmental impact without compromising the beneficial health effects



# We assessed health effects of 15 food groups, and meal- and dietary patterns for the first time in NNR

- NNR2023 did include extensive assessment, as background papers, of the health effects of food groups, meal- and dietary patterns for the first time
- Health effects of food and food groups (defined by qSRs) are the primary focus of setting FBDGs

## We set quantitative FBDGs:

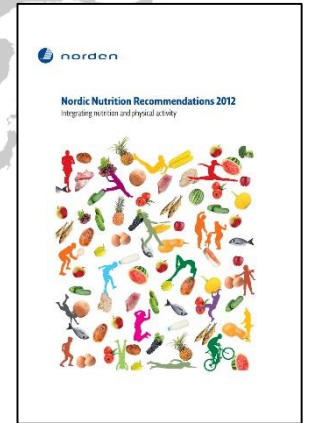
- if the overall evidence was categorized as “strong evidence” according to predefined criteria, and a dose-response curve had been developed in a qualified meta-analysis, or
- if the food group is considered a key group for nutritional adequacy in the population.

## We set qualitative FBDGs:

- if there was sufficient evidence for causality (“strong evidence”), but representative dose-response curves could not be established.



# To update the dietary reference values (DRVs), we used harmonized cutting-edge methodology



- Sharing of resources
- Improved quality

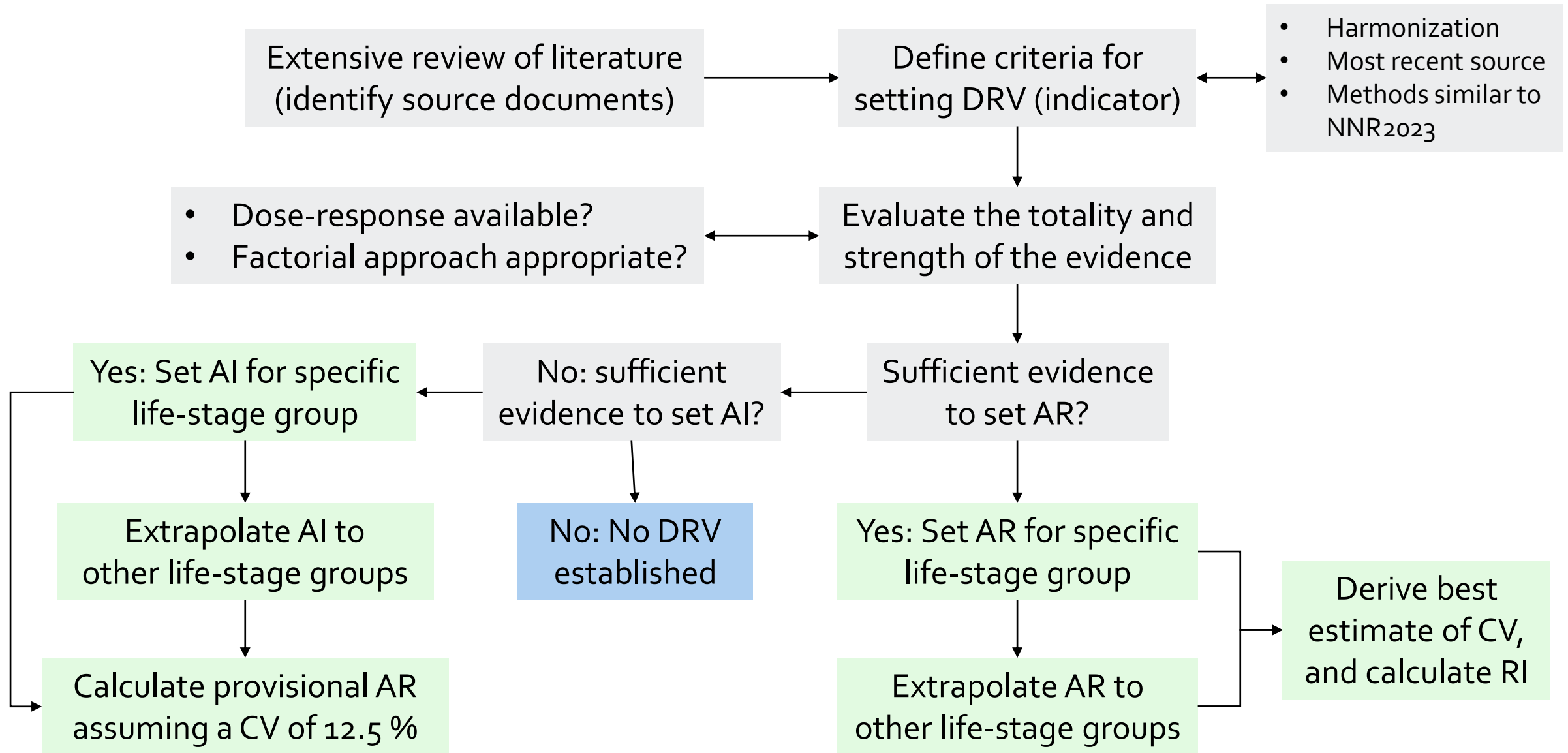


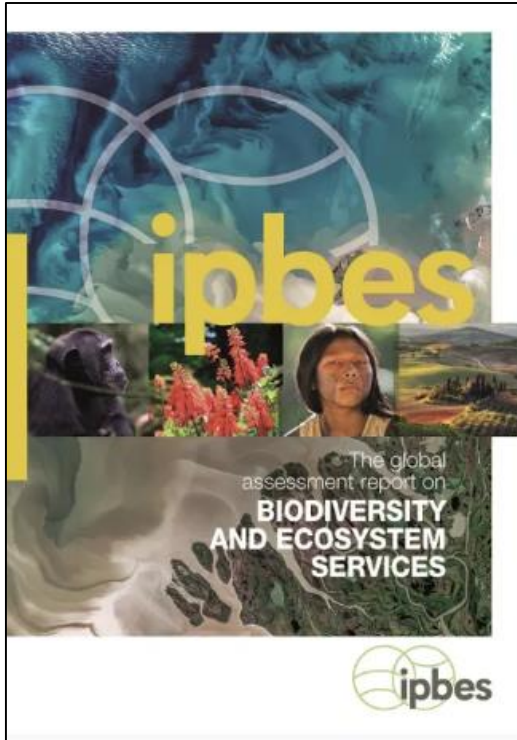
# Major improvements in deriving the new and updated DRVs

- We documented the source publications and criteria for setting DRVs
- We documented the calculation and extrapolation of all updated DRVs
- We derived new reference weights for children and adults
- We adopted a new set of life-stage groups
- We report three new DRVs: the AI, the Provisional AR, and the CDRR
- We defined a clear set of principles for setting DRVs



# We defined a clear set of principles for setting DRVs





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)



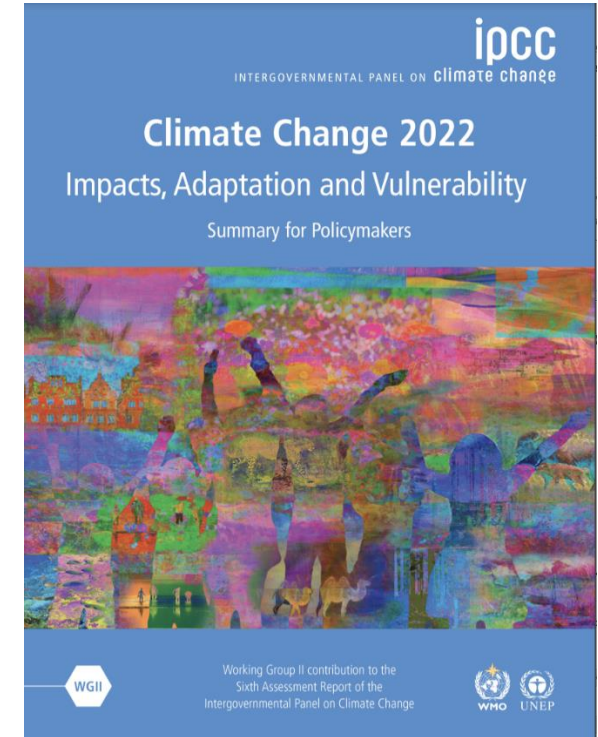
## Evidence synthesis on environmentally sustainable food consumption



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



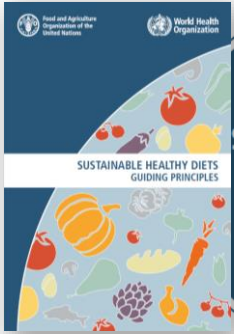
5 NNR background papers on sustainability



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)



# 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.<sup>10</sup>

**3** ... include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables.<sup>11</sup>

**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.<sup>12</sup>

**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



Sociocultural and economic aspects integrated at the national level

# Principles and methodology (5 papers), organization

## Dietary reference values (DRVs)

### Nutrients

reviews on health effects (36 ScRs)

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*De novo* qSRs (6 qSRs)

### Other related topics (5 ScRs):

- Physical activity
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Integrate

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

# Thank you.

Jacob J Christensen  
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