DISCUSSION DOCUMENT

Supporting Rationale for Proposed New Work

1. Introduction and Background

Non-Communicable Diseases (NCDs) are a primary cause of early mortality globally, with Diet Related Non-Communicable Diseases (DRNCDs) a leading risk factor contributing to them. Malnutrition in all its forms, including excessive and imbalanced food intake, is a key modifiable risk factor underlying DRNCDs such as obesity, cardiovascular disease (CVD), type 2 diabetes (T2D), and certain cancers. Recent global estimates indicate that risk factors associated with diet, including high body mass index and elevated blood glucose, have increased over the past decade, while other modifiable risk factors, such as smoking, low birth weight, and environmental pollution, have declined [1]. These findings demonstrate the growing importance of diet as a determinant of public health that needs to be addressed globally.

The Codex Alimentarius Commission has an important responsibility to protect consumer health and safety while ensuring fair trade practices through the development of science-based standards and guidelines. Within Codex, the Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU) is responsible for nutritional risk analysis and has established foundational approaches for evaluating DRNCD risk associated with nutrient intakes, both inadequacy and excess [2]. These recommendations are now part of the Guidelines for Nutrition Labeling [3].

However, the scientific understanding of diet and chronic disease risk has evolved beyond single-nutrient paradigms. A considerable body of evidence demonstrates that dietary patterns and food groups and categories are also associated with DRNCD risk. Additionally, many countries are adopting food-based dietary guidelines and classification systems that incorporate broader food characteristics, including formulation, processing, and the overall food matrix. This shift reflects a more integrated understanding of how foods are consumed within dietary patterns and how they influence DRNCDs.

Despite these developments, there is no internationally harmonized framework within Codex to evaluate DRNCD risk at the level of dietary patterns or food categories. This gap creates challenges for global alignment, as national and regional approaches continue to progress, which could lead to consumer confusion and unintended barriers to trade.

Considering this context, this discussion document proposes that CCNFSDU consider new work to evaluate whether existing Codex risk analysis principles could be extended to assess DRNCD risk associated with the consumption of specific food categories given the complexity of foods and their use in diets. The purpose is not to classify foods by DRNCD risk alone, but to evaluate how existing, science-based, Codex tools and principles could provide a framework to assess food-related DRNCD risk in a manner suitable for Codex purposes – to support public health, fair trade, and international harmonization.

2. Problem Statement and Policy Gap

Current Codex guidance for addressing DRNCD risk focuses primarily on the evaluation of individual nutrients. While this approach has supported the development of nutrient reference values (NRVs) and created risk management tools, it does not fully capture the broader factors needed to characterize risk from intact foodstuffs or those being incorporated into national and regional dietary policy.

Governments and public health authorities are currently evaluating and adopting more food-based dietary guidelines and classification systems that extend beyond nutrient composition to include characteristics such as formulation, processing, and various components of the food matrix [4-7]. These systems vary in their scientific foundations and application, resulting in increasing divergence in how food-related health risks are defined and evaluated.

This issue was recently discussed at the 48th session of the Codex Alimentarius Commission [7] in the context of ultra-processed foods (UPF). Members noted the lack of a clear, science-based, globally harmonized definition, relevant to the work of Codex, and emphasized the importance of robust scientific evidence, and the need for common reference points to support effective standards and guidelines development. They also noted the relevance of this issue to multiple Codex committees, and members were encouraged to bring forward proposals for future work.

In the absence of a harmonized Codex framework, continued divergence in national approaches may lead to inconsistent regulatory interpretations, which could increase the complexity of international food trade and create unintended barriers. However, the current lack of a structured, science-based approach to evaluating diet and DRNCD risk beyond individual nutrients limits Codex's ability to provide relevant harmonized, evidence-based guidance.

This represents a clear policy gap. While policy development has moved toward food-based approaches, Codex risk analysis frameworks have not been extended to systematically evaluate DRNCD risk at the level of food categories. Addressing this gap would enable Codex to provide internationally relevant, science-based guidance that supports both public health and fair trade.

3. Scientific Evidence for Diet-DRNCD Relationships

A substantial and consistent body of scientific evidence has demonstrated the relationship between dietary patterns and food groups to DRNCDs, including obesity, T2D, CVD, and certain cancers [8-22]. While earlier approaches focused on individual nutrients, more recent evidence indicates that evaluating foods as consumed within dietary patterns provides additional understanding of the complexity of the diet-health relationship.

Across a range of populations, adherence to healthy dietary patterns, including the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), Nordic diet, and plant-based diets, has been consistently associated with reduced risk of DRNCDs and all-cause mortality [9-15]. Conversely, dietary patterns characterized by high consumption of processed meats, sugar-sweetened beverages, and refined grains have been associated with increased risk [16-18]. Specific food groups have also been associated with risk of DRNCDs: whole grains, fruits, vegetables, nuts, and legumes have been associated with lower risk [19-22], while processed meats and sugar-sweetened beverages have been associated with higher risk [16, 17].

Obesity

A body mass index (BMI) ≥30 kg/m² defines obesity for most countries and is a major independent risk factor for CVD, T2D, certain cancers, and premature mortality [8, 13-15, 18]. Dietary patterns and specific food groups play a role in energy balance and body weight regulation, with considerable evidence linking specific dietary patterns to obesity risk in conjunction with other environmental and societal risk factors, such as reduced physical activity, food insecurity, and urbanization [18].

Healthy dietary patterns, including the Mediterranean, DASH, vegetarian, vegan, and flexitarian, have been associated with lower weight gain over time, reduced incidence of overweight or obesity, and reduced waist circumference [10, 23-26]. Specific food groups have also been shown to impact obesity risk. Higher intakes of whole grains, fruits, vegetables, legumes, and nuts have been associated with lower risk of overweight and obesity, whereas higher intakes of processed meats and sugar-sweetened beverages have been associated with increased risk of weight gain and adiposity [18, 22, 27-30]. Evidence for dairy is mixed but generally indicates neutral or modestly protective associations, particularly for yogurt [31].

Evidence from randomized controlled trials (RCT) provides support for causal effects for selected dietary components within dietary patterns and certain food groups. Reduced intakes of dietary fat and added sugars, along with increases in dietary fiber, have been shown to reduce body weight and improve adiposity-related outcomes [32-34]. Increased consumption of pulses leads to modest weight loss even in the absence of energy restriction [35]. However, interventions increasing fruits, vegetables, whole grains, nuts, or dairy in isolation generally show neutral effects on body weight unless implemented within an energy-restricted dietary pattern, suggesting that their primary role may be in supporting diet quality and satiety rather than directly inducing weight loss [36, 37].

Type 2 Diabetes

Type 2 diabetes, characterized by insulin resistance and progressive beta-cell dysfunction, affects more than 500 million adults worldwide and is a major risk factor for cardiovascular disease, kidney disease and premature mortality [38]. Dietary patterns play a central role in T2D prevention and management by impacting insulin sensitivity, glycemic control, bodyweight, and systemic inflammation [14, 16].

Prospective cohort studies support robust protective effects of the Mediterranean, DASH, and plant-based diets for T2D risk [9, 10, 12, 39, 40]. Additionally, observational studies have shown higher intakes of processed meat, added sugars, and saturated or trans fats are associated with increased incidence of T2D, whereas diets rich in fruits, vegetables, whole grains, dietary fiber, nuts, legumes, and certain dairy products show protective associations [14, 16, 21, 22]. While exact dietary patterns and macronutrient proportions can vary, overall, the evidence supports a dietary pattern emphasizing fiber-rich plant foods and unsaturated fats while limiting processed meats and added sugars, as a strategy for reducing T2D incidence.

Randomized controlled trials examining the cause effect relationship of dietary components for T2D risk factors report the strongest benefits for whole grains, nuts, legumes, and unsaturated fats replacing saturated fat, whereas evidence for processed meat, added sugars, fruits and vegetables, and dairy is either indirect, mixed, or largely neutral [41-47]. This is primarily attributed to dietary components in these foods, such as dietary fiber, improving blood glucose control, and/or insulin sensitivity. Demonstrating the importance of the food matrix, RCTs on added sugars suggest that adverse glycemic effects are not uniform across all food sources and energy conditions, although sugar-sweetened beverages and excess-energy mixed sugar sources have the largest number of scientific reports [48].

Cardiovascular disease

Cardiovascular disease encompasses coronary heart disease (CHD), stroke, heart failure, and peripheral vascular disease, and remains the leading cause of death globally [49]. Dietary patterns and components can impact multiple cardiovascular risk factors including blood pressure, lipid profiles, inflammation, endothelial function, and thrombosis [50].

Observational evidence has demonstrated an association of diets such as the Mediterranean, DASH, Nordic, and plant-based diets with lower risk of CVD, CHD, and stroke incidence, including some dose response effects [10-12, 39]. Furthermore, evidence from prospective cohort studies and meta-analyses have reported that dietary patterns characterized by higher intake of processed meat, added sugars, and trans or saturated fats were associated with increased CVD risk, including CHD and stroke, whereas diets rich in fruits, vegetables, whole grains, dietary fiber, nuts, legumes, and certain dairy products were associated with reduced risk [13, 17, 20-22].

Randomized controlled trials examining the cause effect relationship of dietary components for CVD risk factors report the strongest benefits for replacing saturated fat with unsaturated fat, increasing nuts, legumes, whole grains, and dietary fiber, and limiting added sugars, whereas evidence for fruits and vegetables, dairy, and red or processed meat is either smaller, inconsistent, or neutral over the short durations typical of RCTs [51-61]. The primary mechanisms by which these are purported to reduce CVD risk is by replacement of saturated fat with unsaturated fat, and inclusion of fiber-rich foods that help reduce LDL-cholesterol, improve glycemic control, and minimize inflammation [56, 57, 62-70].

Cancer

The Global Burden of Disease study estimates that dietary risk factors account for approximately 5% of cancer worldwide [71]. Furthermore, the World Cancer Research Fund (WCRF) and International Agency for Research on Cancer (IARC) have identified evidence linking dietary patterns to certain cancer risks [72]. Cancers of the digestive tract, particularly colorectal and gastric cancer, have shown the strongest dietary associations [73-76]. WCRF estimates that improvements to diet could prevent approximately 30 – 40% of cancers in high income countries and 20 – 30% in low- and middle-income countries [72].

Evidence from prospective cohort studies and meta-analyses have shown plant-based diets, such as the Mediterranean and DASH diet, to have an inverse association with cancer incidence and mortality across several sites, including colorectal, gastric, liver, lung, and breast [76-86]. Alternatively, dietary patterns rich in fat, sugar, energy-dense foods, red and processed meats, while being low in fiber and fresh fruits and vegetables, has been associated with increased risk of colorectal cancer, pancreatic cancer, and breast cancer [76, 80-82]. Specific food categories, such as processed meat and salt-preserved foods, have demonstrated positive associations with cancer incidence and mortality, particularly cancers of the digestive tract, while fruits, vegetables, whole grains, and dietary fiber have shown consistent protective associations [22, 74, 80, 87-97]. Interestingly, dairy products have shown inconsistent associations with cancer risk which are primarily site-specific and dairy product specific [98, 99]. A meta-analysis of prospective cohort studies on colorectal cancer reported a 17% risk reduction per 400 g/day total dairy products, but when types of dairy products were examined, a risk reduction only remained for milk intake, but not cheese [98]. The opposite was observed for breast cancer where consumption of total dairy food, but not milk, was associated with a reduced risk of breast cancer [99]. These findings suggest a role of the food matrix in DRNCD risk, beyond the food group alone.

Across these DRNCDs, the direction of observational evidence demonstrated broad consistency even with differences in study design, populations, and endpoints. Evidence from RCTs provides additional support for causal relationships but also reveals the need for nuance in considering different food groups, chronic disease outcomes, food composition, and effects of the food matrix.

Taken together, the evidence supports Codex consideration to transition from exclusively individual nutrient-based risk analysis approaches to more integrated frameworks that consider food categories and dietary patterns. This does not replace nutrient-based risk assessment but complements it by capturing additional dimensions of diet that are relevant to DRNCD risk.

NOTE: A distinction is warranted between terminology used in scientific literature and that which is applied in Codex frameworks. Most of the available evidence linking DRNCD risk is generated at the level of <u>*food groups*</u> *which share nutritional or biological similarities. In contrast, Codex frameworks are organized around* <u>*food categories*</u> *that reflect regulatory groupings based on product type, use, and composition. While the constructs are similar, they are not equivalent, and translation of the scientific groupings to regulatory groupings requires consideration of factors such as formulation, food matrix, and consumption patterns. For clarity, the terminology used in this document is defined in section 10.*

4. Translation of Evidence to Dietary Guidance and Policy

Multiple authoritative scientific organizations have issued evidence-based dietary guidelines for diet-related NCD prevention. Many of these guidelines emphasize food-based recommendations in addition to nutrient-specific targets. For example, the World Health Organization (WHO) recommends limiting free sugars to less than 10% of total energy intake [100], reducing sodium intake to less than 2 g/day [101], replacing saturated fats with unsaturated fats [102], eliminating industrially produced trans fats [102], and increasing consumption of fruits, vegetables, whole grains, legumes, and nuts [103, 104]. Similarly, the NHS Eatwell Guide recommends 5 servings of fruits and vegetables daily, choosing unsaturated oils in small amounts and limiting foods high in fat, salt, and sugar [105]. For many years the Dietary Guidelines for Americans has promoted healthy dietary patterns including the Mediterranean diet, DASH diet, and plant-based diets, continually emphasizing nutrient-dense food choices that limit added sugar, saturated fat, sodium and alcohol [106]. Argentina, Japan, and China dietary guidelines also include an emphasis on fruits and vegetables, dairy, whole grains, and lean sources of protein, as well as limiting foods higher in sugars, fats, and sodium [107-109]. The EAT-Lancet Commission proposed a similar healthy diet that aligns with environmental sustainability [110]. These convergent recommendations from the published literature and numerous scientific bodies demonstrate the strength and consistency of the evidence linking dietary patterns to DRNCD.

In parallel, several regions are developing or applying food classification systems to inform policy decisions and operationalize dietary guidance. These systems incorporate additional factors such as nutrient composition, formulation, and processing. While there is a lack of consistency among the different approaches, they reflect a broader shift toward evaluation of foods in the context of broader dietary patterns.

However, without a globally harmonized framework, the differences in approaches and classifications may lead to inconsistent policy implementation and interpretation, which may have ramifications for public health and trade. This reinforces the need for Codex to consider whether existing risk analysis principles can be extended to support the evaluation of DRNCD risk at the level of food categories in a way that can align scientific evidence with global policy.

5. Existing Approaches to Classification and Risk Assessment

Nutrition Risk Analysis Within CCNFSDU

The remit of CCNFSDU includes addressing nutritional issues, establishing NRVs, and managing information for label inclusion for specialized nutrition products. As part of this work, the committee has been proactive in its adaptation of risk analysis methods to address the complexity of nutritional risk management.

In 1995 the Committee requested Australia to prepare a discussion paper on the "diet modelling" approach, a form of risk-analysis intended to forecast the impact of changes in food composition on the potential consumption of nutrients and non-nutrients in the diet (ALINORM 95/26 paragraph 91) [111]. At that time, other Codex Committees were already using risk analysis approaches to evaluate microbial and chemical food safety.

CCNFSDU first considered the application of dietary modelling or nutrition-related risk assessment at its 20th session in 1996 [112]. Following discussion at the 22nd Session in 2000, the committee agreed to proceed with the development of a methodology for applying risk assessment to relevant Codex standards and related texts (ALINORM 01/26, paragraphs 128-131) [113]. The Committee noted that nutrient intake assessments were necessary to provide a scientifically justified public health and safety rationale for setting standards or measures more stringent than Codex standards.

At its 23rd Session in 2001, CCNFSDU concluded that implementation of a risk-based approach required establishment, where possible, of upper limits (ULs) for vitamins and minerals and FAO/WHO agreed to extend existing work on recommended nutrient intakes accordingly (ALINORM 03/26, paragraphs 138-143) [114]. During the discussion of this item (CX/NFSDU 01/10), the committee noted that "a risk assessment approach to setting standards for nutrients may be of increasing importance as all governments and Codex address controversial topics such as the use of non-nutritive ingredients (fat, oil and sugar replacements) and different dietary fibers in foods, increased use of novel foods or ingredients, foods derived by biotechnology, dietary supplements and food fortification" as well as assessment and scientific validation of nutrition and health claims [115].

At CCNFSDU's 24th Session in 2002, FAO reported that a technical report on general principles for establishing ULs for vitamins and minerals was in progress [116]. The work aligned with the broader Codex "Draft Working Principles for Risk Analysis for Application in the Framework of Codex Alimentarius", which had already been adopted into the 12th edition of the Codex Alimentarius Commission Procedural Manual (ALINORM 03/41, Appendix IV; and paragraphs 142-148) [117, 118]. Risk assessment was the responsibility of the FAO/WHO expert bodies and other Recognized Authoritative Scientific Bodies (RASBs) (risk assessors). CCNFSDU, working in concert with CCFL, subsequently implemented two nutrient-specific DRNCD NRV standards for intake levels not-to-exceed for saturated fatty acids and sodium (CAC/GL-1985 3.4.4.3) [119]. **These nutrient-specific NRV standards have been in place for over a decade and demonstrate that Codex has already incorporated DRNCD considerations into existing nutrient-based risk-management approaches.** A summary of CCNFSDU work on guidelines and standards related to DRNCD considerations is provided in Appendix III.

<u>Other Existing Codex Risk Analysis Frameworks Relevant to DRNCDs</u>

Beyond the work of CCNFSDU, several other Codex committees routinely apply risk-analysis frameworks in collaboration with FAO/WHO expert bodies, including the Codex Committee on Contaminants in Foods (CCCF), the Codex Committee on Food Additives (CCFA), the Codex Committee on Pesticide Residues (CCPR), and the Codex Committee on Food Hygiene (CCFH). While these committees primarily address toxicological, microbiological, additive, or residue related risks, their methodological approaches may have relevance to DRNCD risk analysis. Newer considerations in food qualities that could affect DRNCD risk may require different methods of analysis to create metrics suitable for use in risk analysis. Such methods require evaluation and grading by the Committee on Methods of Analysis and Sampling (CCMAS).

For example, the CCFA, in coordination with JECFA, uses the Food Category System within the General Standard for Food Additives (GFSA) to organize and evaluate additive use by food categories or sub-categories [120]. Likewise, CCCF applies risk assessment methodologies involving the establishment of Maximum Limits (MLs) for contaminants within specific food categories traded globally. While these approaches were developed for evaluation of additives and contaminants, they demonstrated that Codex already applies food category-specific risk assessments and risk management approaches across the global food system. **These existing frameworks may provide useful methodological foundations for considering DRNCD risk for dietary patterns, food groups, or food categories.**

<u>Contemporary Approaches to Diet Quality and Food Classification</u>

As previously discussed, scientific approaches to evaluating diet quality and DRNCD risk have evolved from nutrient-based systems toward broader models of dietary patterns and dietary context. Some of these approaches include nutrient profiling systems, dietary pattern indices, and food classification systems intended to capture multidimensional aspects of diet quality and health risk (Table 1) [121]. A recent article proposed guiding principles for science-based food classification systems that may be of interest to the committee [122].

Table 1. Approaches to Diet Evaluation

Paradigm	Key concept	Example metrics	Limitations
Nutrient reductionism	Individual nutrient adequacy	**Dietary Reference Intakes**: (EAR, RDA, AI, UL, EER, and AMDR), Mean Adequacy Ratio, and Nutrient Rich Foods Index	Ignore food synergies and diet context
Pattern-based assessment	Overall eating pattern predicts health outcomes	**Guideline-based**: Healthy Eating Index and Alternative Healthy Eating Index **Specific patterns**: Healthy Eating Index and Alternative Healthy Eating Index	Ability to distinguish quality within food groups and matrix
Mechanistic proxies	Diet quality captured through specific biological pathways	**Inflammatory**: Dietary Inflammatory Potential and Empirical Dietary Inflammatory Pattern **Glycemic:** Index and Glycemic Load **Oxidative/acid-base:** Dietary Total Antioxidant Capacity and Potential Renal Acid Load	Focus on single mechanisms lack consideration of processing and bioavailability
Processing-based classification	Degree/type of food matrix industrial processing alters health effects independent from nutrients	**Processing based:** NOVA, IARC/EPIC, IFPRI, IFIC, UNC, and Siga score	Standardization, mechanistic understanding, and flawed equation of level of processing with healthfulness
Integrated systems (emerging)	Multi-dimensional quality (nutrients, patterns, processing, and sustainability)	**Multi-variable:** Planetary Health Diet Index, EAT-Lancet index, and World Index for Sustainability and Health	Standardization and validation Lack of common computational method of analysis including weighting factors and variable inclusion
Table adapted from Krenek A, and Gardner CD. [121]			

Many of the tools and approaches continue to evolve and also differ in their intended use, scientific assumptions, and applicability to regulatory risk analysis. Many of these tools were also developed for different purposes, including consumer guidance, dietary assessment, or research purposes rather than regulatory risk analysis. Nevertheless, they illustrate increasing scientific interest in approaches that extend beyond nutrient assessments to broader consideration of foods, dietary patterns, and dietary context.

Implications for Future CCNFSDU Work

Taken together, these examples demonstrate that Codex has long incorporated risk-analysis principles into nutrition and food standard development. Currently, existing Codex frameworks apply food category specific approaches for contaminants, additives, and other food-related risks, while CCNFSDU has established individual nutrient-based approaches to address DRNCD risk management. Because CCNFDU's approach is individual nutrient-based, it does not provide guidance on DRNCD risk profiles based on food groups and dietary patterns. Existing diet quality frameworks and food classification systems contribute useful perspectives, but none fully address the multidimensional nature of DRNCD risk with a regulatory lens. **These considerations support the need for further evaluation of whether existing Codex risk-analysis principles and methodologies could be adapted or expanded to address DRNCD risk associated with food categories and patterns of consumption.**

6. Conceptual Framework and Methodological Considerations for Food Category-Based Risk Assessment

Purpose and Conceptual Basis

The proposed new work would explore whether and how existing Codex risk-analysis principles could be applied to DRNCD associated with food categories. Such an approach should recognize the complexity of the total diet and dietary patterns, including frequency and quantity of consumption, bioavailability, nutrient/energy density, food matrix effects, and population variability in susceptibility and exposure.

Given Codex's mandate in food safety and nutrition, CCNFSDU is well positioned to explore science-based methodologies for evaluating relationships between food categories and DRNCD risk. The proposed work would build upon existing Codex risk-analysis principles while considering emerging scientific understanding related to foods, dietary patterns, and the broader dietary context. The framework presented in the following sections is intended solely as a conceptual illustration of how multidimensional factors could potentially be considered within a structured risk-analysis approach.

Multidimensional nature of DRNCD risk assessment

Assessment of DRNCD risk at the food category level presents several methodological challenges due to the myriad factors beyond individual nutrient influence on DRNCD risk. However, advances in dietary assessment, data analysis, and scientific understanding of dietary patterns and food matrix effects support more integrated approaches to dietary risk analysis.

One example of a potential framework organizes relevant considerations into three complementary domains:

Group 1: Food matrix and composition

- Nutritional composition (macro and micronutrients, energy density, dietary fiber)
- Food formulation (ingredients and additives)
- Food structure and matrix effects impact on bioavailability, satiety, or palatability
- Food preparation and processing methods
- Potential contaminants or other food-related exposures

Group 2: Human factors

- Dietary patterns including frequency and quantity of consumption
- Population variability (demographics and health status)
- Bioavailability and metabolic variability
- Potential genetic- and microbiome-related interactions

Group 3: Food environment, economic and social context

- Availability and accessibility of foods
- Cultural and behavioral dietary practices
- Socioeconomic influences on consumption patterns
- Broader food-system considerations (e.g., sustainability) relevant to population exposure

These domains provide an example of a multidisciplinary and overall diet approach to DRNCD related risk analysis while recognizing the interactions among foods, populations, and dietary context that can influence health outcomes.

Integration with Existing Codex Risk Analysis Principles

The Codex risk assessment framework provides a structured, science-based, and transparent process that includes hazard identification, hazard characterization, exposure assessment, and risk characterization [123]. Within the example framework, food matrix and composition factors may contribute primarily to hazard identification and characterization, while human and contextual factors may contribute more to exposure assessment and characterization of population variability.

Risk characterization would integrate evidence across these domains to evaluate potential relationships between food categories, patterns of consumption, and DRNCD outcomes within the context of the overall diet. This approach is expected to complement rather than replace nutrient-based risk assessment methodologies. Additionally, the impact of food composition and matrix would encompass compositional and process interactions, such as how food additive mixtures and processing interact in the context of DRNCD risk, a risk analysis separate from the toxicological risk evaluations currently conducted by CCFA on stand-alone food additive ingredients.

To identify food categories, the Food Category System and Food Category Descriptors (Appendix IV) established in CXS 192-1995 General Standard for Food Additives by CODEX CCFA could be used as examples for applying a DRNCDs risk assessment methodological framework [120]. The following example is presented solely to illustrate how this framework could be applied within a food category-based risk analysis.

Fine Bakery Wares (CXS 192-1995, Category 07.2)

Fine bakery wares (Category 07.2), as defined in the General Standard for Food Additives (CXS 192-1995) [120], include ready-to-eat products such as cakes, cookies, pies, doughnuts, sweet rolls, muffins, and mixes for their preparation. These products are widely consumed across different populations and are commonly characterized by formulations varying in combinations of refined/whole grains, added sugars, fats, and differing levels of dietary fiber and micronutrients. An example framework for conducting an assessment on this category is provided in Appendix II.

Within a conceptual risk-analysis framework:

- Hazard identification could be informed by food composition and matrix, including energy density, added sugar, sodium and saturated fat content, formulation, and structural impacts on palatability and/or satiety.
- Hazard characterization could evaluate the relationship between the hazards identified and DRNCD-related outcomes.
- Exposure assessment could consider the frequency and quantity of consumption, portion sizes, cultural dietary patterns, and population-specific intake variability.
- Risk characterization could integrate these factors within the context of the overall diet while accounting for variability in formulation, processing, and population susceptibility.

This example illustrates how food matrix, human factors, and contextual factors could potentially be evaluated within a structured risk-analysis framework.

Key methodological considerations

An important consideration of this framework is the heterogeneity that exists within food categories and subcategories. Foods classified within the same Codex category may differ considerably in nutritional composition, formulation, preparation methods, structural characteristics, and contributions to health. As a result, category-level assessments should recognize the importance of sufficient granularity to avoid assuming uniform effects of all foods within a category. For example, in the "fine bakery wares" category, a chocolate chip muffin and a low-fat bran muffin would both fall in the same category, but have substantially different nutritional profiles, implications for DRNCD risk, and variability in intake levels in the overall diet. Other variations, such as cooking temperature and time, ingredient interactions, viscosity, density, and fiber content, are just a few other characteristics that would need consideration within individual food categories.

The proposed framework is not intended to establish a new food classification system or classify foods as inherently "good" or "bad." Rather, it is to provide a structured and science-based approach for evaluating factors that may contribute, positively or negatively, to DRNCD risk within the context of the overall diet. Foods can simultaneously contain both beneficial and less desirable attributes, so any developed framework should support balanced evaluation to support continuous improvement and innovation, rather than binary classification. The framework should also remain flexible and adaptable to evolving scientific understanding and regional dietary contexts.

7. Relevance to Codex and International Trade

Codex Alimentarius's tagline of "safe, good food for everyone - everywhere" highlights its unique role in global food trade to set international food standards that protect consumer health and ensure fair practices in the food trade through science-based guidelines. As global food systems evolve, many countries and regions are developing dietary guidance intended to address DRNCDs, including policies related to nutrient profiling, front-of-pack labeling, and food classification systems.

These approaches can often differ substantially in aspects of terminology, methodology, scope, and scientific rigor. Increasing divergence has the potential to impact international trade harmonization, particularly if food categories or dietary risk concepts are defined or applied differently across regions [124].

CCNFSDU is uniquely positioned within Codex to explore if existing risk-analysis principles could support more consistent and scientifically based approaches for evaluating DRNCD-related risks associated with dietary patterns and food categories. Development of internationally recognized methodological principles could help support transparency, improve scientific consistency, and enable greater alignment across member countries while respecting national public health priorities and regulations.

Given the global burden of DRNCDs and the growth of food-based dietary policies, consideration of the food category related risk assessment approaches is highly relevant to the ongoing work of Codex and CCNFSDU.

8. Key Questions for Committee Discussion

- To what extent could existing risk-analysis principles and approaches within Codex be adapted to address DRNCD risk associated with food categories, food groups, or dietary patterns?
- Is the development of a food category-based method within the remit and expertise of CCNFSDU? What other stakeholders may need to be involved? How could such work align with existing Codex activities and systems?
- What scientific criteria and types of evidence would be appropriate for evaluating relationships between food categories, patterns of consumption, and DRNCD risk?
- How should the overall diet context, population variability, frequency, and quantity of consumption be considered within a food category-based risk assessment framework?
- How might food matrix characteristics, formulation, and processing methods be appropriately incorporated into DRNCD risk analysis?
- What methodological approaches could support flexibility to consider heterogeneity within food categories and regional dietary differences?
- How could Codex work in this area move forward to both support international harmonization while respecting national public health priorities and regulations?

9. Conclusion and Recommendation

Diet-related non-communicable diseases continue to represent a major global public health challenge, with growing scientific evidence suggesting that DRNCD risk is influenced not only by individual nutrients, but also by broader dietary patterns, food groups, food categories, and characteristics of the food matrix within the context of the total diet.

CCNFSDU and other Codex committees have extensive experience applying science-based risk-analysis principles to nutrition, food safety, additives, contaminants, and related food-category approaches. At the same time, increasing development of national and regional frameworks related to DRNCD risk demonstrates the need for internationally harmonized methodological principles that are transparent, evidence-based, and adaptable to differing dietary contexts and public health priorities.

The proposed new work would enable CCNFSDU to explore whether existing Codex risk-analysis principles and methodologies could be adapted or expanded to address DRNCD-related risks associated with patterns of food consumption and food categories. Such work is not intended to create a new regulated food classification system or classify foods as inherently "good" or "bad," but rather would support structured scientific evaluation within the context of the total diet. CCNFSDU is invited to consider whether new work in this area would be appropriate and beneficial to support future Codex guidance related to DRNCD risk assessment and risk management.

10. Terms and Definitions

The following working definitions are provided solely for the purposes of this discussion paper and do not represent formal Codex definitions unless otherwise specified.

Bioavailability

The extent to which nutrients or other food components are released from the food matrix, absorbed, and utilized by the body.

Dietary pattern

The quantities, proportions, variety, combinations, and frequency of foods and beverages that are habitually consumed over time.

Diet-Related Non-Communicable Diseases (DRNCDs)

Chronic non-communicable diseases for which dietary intake and dietary patterns are recognized as contributors to risk, including but not limited to obesity, cardiovascular disease, type 2 diabetes, hypertension, and certain cancers.

Energy density

The amount of energy provided per unit of weight or volume of food or beverage, typically expressed as kilocalories or kilojoules per gram or milliliter.

Food category

A grouping of foods that share common characteristics based on composition, intended use, processing, preparation, or regulatory classification

Food environment

The physical, economic, policy, and sociocultural conditions that influence food availability, accessibility, affordability, marketing, selection, and consumption.

Food formulation

The composition and combination of ingredients, additives, and processing inputs used in the manufacture or preparation of a food product.

Food group

A collection of foods categorized primarily according to shared nutritional characteristics or common dietary guidance usage, such as fruits, vegetables, dairy, grains, or meats.

Food matrix

The physical and chemical structure of a food, including the interactions among nutrients and non-nutrient components, which may influence digestion, bioavailability, satiety, metabolic responses, and health effects.

Food processing

Physical, chemical, biological, or technological methods applied to foods during manufacturing, preparation, preservation, packaging, or storage to improve safety, stability, quality, functionality, or convenience.

Food subcategory

A more specific subdivision within a broader food category that groups foods with additional shared characteristics related to composition, formulation, preparation, or use.

Nutrient Profiling

The classification or ranking of foods according to their nutritional composition using predefined criteria or algorithms intended to support dietary guidance, policy, labeling, or related applications.

Palatability

The sensory acceptability and perceived pleasantness of a food that may influence consumer food preference and consumption behavior.

11. REFERENCES

1. Institute for Health Metrics and Evaluation. *Global Burden of Disease 2023: Findings from the GBD 2023 study*. 2025; Available from: https://www.healthdata.org/research-analysis/library/global-burden-disease-2023-findings-gbd-2023-study.
2. FAO & WHO. *Codex Alimentarius Commission Procedural Manual - Thirtieth Edition*. Paragraphs 271-305. 2025 [cited 2026 March]; Available from: https://doi.org/10.4060/cd7978en.
3. FAO & WHO. *Guidelines on Nutrition Labeling CXG 2-1985, 2024 Revision*. Paragraphs 3.4.4.3 - 3.4.7. 2024; Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXG%2B2-1985%252FCXG_002e.pdf.
4. EuroHealth Net. *Tackling Ultra-processed Food for a Healthier and Just Food System*. 2025; Available from: https://eurohealthnet.eu/wp-content/uploads/publications/2025/2411_eurohealthnet-policy-precis-upf.pdf.
5. United States Food and Drug Administration, *Ultra-Processed Foods.* 2025.
6. Northcott, T., et al., *Regulatory responses to ultra-processed foods are skewed towards behaviour change and not food system transformation.* Nature Food, 2025. **6**(3): p. 273–282.
7. FAO & WHO. *Joint FAO/WHO Food Standards Programme. Codex Alimetarius Commission.* Forty-eighth session. Paragraphs 195 - 201. 2025; Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-701-48%252FFINAL%252520REPORT%252FREP25_CACe.pdf.
8. Collaborators, G.D., *Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017.* The Lancet, 2017. **393**(10184): p. 1958–1972.
9. Dinu, M., et al., *Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials.* European Journal of Clinical Nutrition, 2018. **72**(1): p. 30–43.
10. Chiavaroli, L., et al., *DASH dietary pattern and cardiometabolic outcomes: An umbrella review of systematic reviews and meta-analyses.* Nutrients, 2019. **11**(2): p. 338.
11. Massara, P., et al., *Nordic dietary patterns and cardiometabolic outcomes: a systematic review and meta-analysis of prospective cohort studies and randomised controlled trials.* Diabetologia, 2022. **65**(12): p. 2011–2031.
12. Gan, Z.H., et al., *Association between plant-based dietary patterns and risk of cardiovascular disease: a systematic review and meta-analysis of prospective cohort studies.* Nutrients, 2021. **13**(11): p. 3952.
13. Bechthold, A., 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): p. 1071–1090.
14. Neuenschwander, M., et al., *Role of diet in type 2 diabetes incidence: umbrella review of meta-analyses of prospective observational studies.* BMJ, 2019. **366**: p. 2368.

15. Schwingshackl, L., et al., *Food groups and risk of all-cause mortality: a systematic review and meta-analysis of prospective studies.* The American Journal of Clinical Nutrition, 2017. **105**(6): p. 1462–1473.
16. Schwingshackl, L., 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): p. 363–375.
17. Malik, V.S., et al., *Long-term consumption of sugar-sweetened and artificially sweetened beverages and risk of mortality in US adults.* Circulation, 2019. **139**(18): p. 2113–2125.
18. Schlesinger, S., 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): p. 205–218.
19. Aune, D., et al., *Whole grain consumption and risk of cardiovascular disease, cancer, and all cause and cause specific mortality: systematic review and dose-response meta-analysis of prospective studies.* BMJ, 2016. **353**: p. 2716.
20. Chareonrungrueangchai, K., et al., *Dietary Factors and Risks of Cardiovascular Diseases: An Umbrella Review.* Nutrients, 2020. **12**(4): p. 1088.
21. Afshin, A., et al., *Consumption of nuts and legumes and risk of incident ischemic heart disease, stroke, and diabetes: a systematic review and meta-analysis.* The American Journal of Clinical Nutrition, 2014. **100**(1): p. 278–288.
22. Reynolds, A., et al., *Carbohydrate quality and human health: a series of systematic reviews and meta-analyses.* The Lancet, 2019. **393**(10170): p. 434–445.
23. Lotfi, K., et al., *Adherence to the Mediterranean Diet, Five-Year Weight Change, and Risk of Overweight and Obesity: A Systematic Review and Dose–Response Meta-Analysis of Prospective Cohort Studies.* Advances in Nutrition, 2022. **13**(1): p. 152–166.
24. Barnard, N.D., S.M. Levin, and Y. Yokoyama, *A systematic review and meta-analysis of changes in body weight in clinical trials of vegetarian diets.* J Acad Nutr Diet, 2015. **115**(6): p. 954–69.
25. Mambrini, S.P., et al., *Plant-based and sustainable diet: A systematic review of its impact on obesity.* Obes Rev, 2025. **26**(6): p. e13901.
26. Tran, E., et al., *Effects of Plant-Based Diets on Weight Status: A Systematic Review.* Diabetes Metab Syndr Obes, 2020. **13**: p. 3433–3448.
27. Wang, X., et al., *Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis.* BMJ, 2014. **349**: p. g4490.
28. Boeing, H., et al., *Critical review: vegetables and fruit in the prevention of chronic diseases.* European Journal of Nutrition, 2012. **51**(6): p. 637–663.
29. Maki, K.C., et al., *The relationship between whole grain intake and body weight: results of meta-analyses of observational studies and randomized controlled trials.* Nutrients, 2019. **11**(6): p. 1245.
30. Malik, V.S., et al., *Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis.* Am J Clin Nutr, 2013. **98**(4): p. 1084–102.
31. Chen, M., et al., *Effects of dairy intake on body weight and fat: a meta-analysis of randomized controlled trials.* American Journal of Clinical Nutrition, 2012. **96**(4): p. 735–747.

32. Hooper, L., et al., *Effects of reducing total fat intake on body weight: systematic review and meta-analysis of randomized controlled trials.* Cochrane Database of Systematic Reviews, 2020(5): p. CD011834.
33. Jovanovski, E., et al., *Effects of viscous fiber supplementation on body weight: a systematic review and meta-analysis of randomized controlled trials.* American Journal of Clinical Nutrition, 2020. **111**(2): p. 471–485.
34. Rogers, P.J., et al., *Does low-energy sweetener consumption affect energy intake and body weight? A systematic review.* International Journal of Obesity, 2016. **40**(3): p. 381–394.
35. Kim, S.-Y., et al., *Effects of dietary pulse consumption on body weight: a systematic review and meta-analysis of randomized controlled trials.* American Journal of Clinical Nutrition, 2016. **103**(5): p. 1213–1223.
36. Johnston, B.C., et al., *Comparison of weight loss among named diet programs in overweight and obese adults: a meta-analysis.* JAMA, 2014. **312**(9): p. 923–933.
37. Schwingshackl, L., et al., *Food groups and risk of overweight, obesity, and weight gain: a systematic review and dose-response meta-analysis of prospective studies.* American Journal of Clinical Nutrition, 2018. **108**(3): p. 576–591.
38. International Diabetes Federation. *IDF Facts and Figures*. 2025; Available from: https://idf.org/about-diabetes/diabetes-facts-figures/.
39. Galbete, C., et al., *Evaluating Mediterranean diet and risk of chronic disease in cohort studies: an umbrella review of meta-analyses.* European Journal of Epidemiology, 2018. **33**(10): p. 909–931.
40. Esposito, K., et al., *Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis.* Metabolic Syndrome and Related Disorders, 2010. **8**(6): p. 471–476.
41. Sanders, L.M., et al., *Whole grain intake, compared to refined grain, improves postprandial glycemia and insulinemia: a systematic review and meta-analysis of randomized controlled trials.* Critical Reviews in Food Science and Nutrition, 2023. **63**(21): p. 1–19.
42. Mao, T., et al., *Effects of dietary fiber on glycemic control and insulin sensitivity in patients with type 2 diabetes: A systematic review and meta-analysis.* Journal of Functional Foods, 2021. **82**: p. 104500.
43. Tindall, A.M., et al., *The effect of nuts on markers of glycemic control: a systematic review and meta-analysis of randomized controlled trials.* The American Journal of Clinical Nutrition, 2019. **109**(2): p. 297–314.
44. Bielefeld, D., S. Grafenauer, and A. Rangan, *The Effects of Legume Consumption on Markers of Glycaemic Control in Individuals with and without Diabetes Mellitus: A Systematic Literature Review of Randomised Controlled Trials.* Nutrients, 2020. **12**(7).
45. Sanders, L.M., M.L. Wilcox, and K.C. Maki, *Red meat consumption and risk factors for type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials.* European Journal of Clinical Nutrition, 2023. **77**: p. 156–165.
46. Sochol, K.M., et al., *The Effects of Dairy Intake on Insulin Resistance: A Systematic Review and Meta-Analysis of Randomized Clinical Trials.* Nutrients, 2019. **11**(9): p. 2237.
47. Mitri, J., et al., *Effect of dairy consumption and its fat content on glycemic control and cardiovascular disease risk factors in patients with type 2 diabetes: a randomized controlled study.* Am J Clin Nutr, 2020. **112**(2): p. 293–302.

48. Choo, V.L., et al., *Food sources of fructose-containing sugars and glycaemic control: systematic review and meta-analysis of controlled intervention studies.* BMJ, 2018. **363**: p. k4644.

49. Naghavi, M., et al., *Global burden of 292 causes of death in 204 countries and territories and 660 subnational locations, 1990–2023: a systematic analysis for the Global Burden of Disease Study 2023.* The Lancet, 2025. **406**(10513): p. 1811–1872.

50. Dong, C., et al., *Cardiovascular disease burden attributable to dietary risk factors from 1990 to 2019: A systematic analysis of the Global Burden of Disease study.* Nutrition, Metabolism and Cardiovascular Diseases, 2022. **32**(4): p. 897–907.

51. Liu, Q., et al., *Fructose-containing food sources and blood pressure: A systematic review and meta-analysis of controlled feeding trials.* PLOS ONE, 2023. **18**(8): p. e0264802.

52. Te Morenga, L.A., et al., *Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids.* The American Journal of Clinical Nutrition, 2014. **100**(1): p. 65–79.

53. World Health Organization. *Increased consumption of fruit and vegetables for the primary prevention of cardiovascular diseases: Systematic review summary*. 2013; Available from: https://www.who.int/tools/elena/review-summaries/fruit-vegetables-ncds--increased-consumption-of-fruit-and-vegetables-for-the-primary-prevention-of-cardiovascular-diseases?

54. Blanch, N., P.M. Clifton, and J.B. Keogh, *A systematic review of vascular and endothelial function: effects of fruit, vegetable and potassium intake.* Nutr Metab Cardiovasc Dis, 2015. **25**(3): p. 253–66.

55. Elsahoryi, N.A., et al., *The effect of increased fruit and vegetable consumption on blood pressure and lipids: a pooled analysis of six randomised controlled fruit and vegetable intervention trials.* Age Ageing, 2024. **53**(Suppl 2): p. ii80–ii89.

56. Marshall, S., et al., *The Effect of Replacing Refined Grains with Whole Grains on Cardiovascular Risk Factors: A Systematic Review and Meta-Analysis of Randomized Controlled Trials with GRADE Clinical Recommendation.* Journal of the Academy of Nutrition and Dietetics, 2020. **120**(11): p. 1859–1883.e31.

57. Reyneke, G.L., et al., *The Effect of Non-Oil Seed Legume Intake on Blood Pressure: A Systematic Review and Meta-Analysis of Randomized Controlled Trials.* Advances in Nutrition, 2023. **14**(4): p. 637–651.

58. Derakhshandeh-Rishehri, S.M., et al., *No adverse effects of dairy products on lipid profile: A systematic review and meta-analysis of randomized controlled clinical trials.* Diabetes Metab Syndr, 2021. **15**(6): p. 102279.

59. Kiesswetter, E., et al., *Effects of Dairy Intake on Markers of Cardiometabolic Health in Adults: A Systematic Review with Network Meta-Analysis.* Adv Nutr, 2023. **14**(3): p. 438–450.

60. Sanders, L.M., et al., *Beef Consumption and Cardiovascular Disease Risk Factors: A Systematic Review and Meta-analysis of Randomized Controlled Trials.* Current Developments in Nutrition, 2024. **8**(12).

61. Guasch-Ferré, M., et al., *Meta-Analysis of Randomized Controlled Trials of Red Meat Consumption in Comparison With Various Comparison Diets on Cardiovascular Risk Factors.* Circulation, 2019. **139**(15): p. 1828–1845.

62. Lichtenstein, A.H., et al., *2021 dietary guidance to improve cardiovascular health: a scientific statement from the American Heart Association.* Circulation, 2021. **144**(23): p. e472–e487.

63. Visseren, F.L.J., et al., *2021 ESC Guidelines on cardiovascular disease prevention in clinical practice: Developed by the Task Force for cardiovascular disease prevention in clinical practice with representatives of the European Society of Cardiology and 12 medical societies With the special contribution of the European Association of Preventive Cardiology (EAPC).* European Heart Journal, 2021. **42**(34): p. 3227–3337.
64. Arnett, D.K., et al., *2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines.* J Am Coll Cardiol, 2019. **74**(10): p. e177–e232.
65. Kris-Etherton, P.M., et al., *Hyperlipidemia*, in *Encyclopedia of Human Nutrition, vol. 3*, B. Caballero, Editor. 2023, Elsevier, Academic Press. p. 361–379.
66. Nishi, S.K., et al., *Effect of nut consumption on blood lipids: An updated systematic review and meta-analysis of randomized controlled trials.* Nutrition, Metabolism and Cardiovascular Diseases, 2025. **35**(5): p. 103771.
67. Cao, X., et al., *The Effect of MUFA-Rich Food on Lipid Profile: A Meta-Analysis of Randomized and Controlled-Feeding Trials.* Foods, 2022. **11**(13).
68. Reynolds, A.N., et al., *Dietary fibre in hypertension and cardiovascular disease management: systematic review and meta-analyses.* BMC Med, 2022. **20**(1): p. 139.
69. Threapleton, D.E., et al., *Dietary fibre intake and risk of cardiovascular disease: systematic review and meta-analysis.* BMJ, 2013. **347**: p. f6879.
70. Schwab, U., et al., *Effect of the amount and type of dietary fat on cardiometabolic risk factors and risk of developing type 2 diabetes, cardiovascular diseases, and cancer: a systematic review.* Food Nutr Res, 2014. **58**.
71. Global Burden of Disease Cancer Risk Factors Collaborators, *The global burden of cancer attributable to risk factors, 2010-19: a systematic analysis for the Global Burden of Disease Study 2019.* Lancet, 2022. **400**(10352): p. 563–591.
72. Diet, N., Physical Activity and Cancer: a Global Perspective. Continuous Update Project,. *Diet, Nutrition, Physical Activity and Cancer: a Global Perspective. Continuous Update Project. Continuous Update Project Expert Report 2018*. 2018; Available from: dietandcancerreport.org.
73. Magalhães, B., B. Peleteiro, and N. Lunet, *Dietary patterns and colorectal cancer: systematic review and meta-analysis.* European Journal of Cancer Prevention, 2012. **21**(1): p. 15–23.
74. Fang, X., et al., *Landscape of dietary factors associated with risk of gastric cancer: A systematic review and dose-response meta-analysis of prospective cohort studies.* European Journal of Cancer, 2015. **51**(18): p. 2820–2832.
75. Grosso, G., et al., *Possible role of diet in cancer: systematic review and multiple meta-analyses of dietary patterns, lifestyle factors, and cancer risk.* Nutrition Reviews, 2017. **75**(6): p. 405–419.
76. Gianfredi, V., et al., *Diets, Dietary Patterns, Single Foods and Pancreatic Cancer Risk: An Umbrella Review of Meta-Analyses.* International Journal of Environmental Research and Public Health, 2022. **19**(22): p. 14787.
77. Morze, J., et al., *An updated systematic review and meta-analysis on adherence to mediterranean diet and risk of cancer.* European Journal of Nutrition, 2021. **60**(3): p. 1561–1586.
78. Zhu, Q., et al., *Adherence to the Mediterranean diet and risk of gastric cancer: a systematic review and dose–response meta-analysis.* Frontiers in Nutrition, 2023. **Volume 10 - 2023**.

79. Liu, K., et al., *Associations between food groups and liver cancer: a systematic review and meta-analysis of observational studies.* Nutrition Journal, 2023. **22**(1): p. 30.
80. Luo, M.-Z., L. Shu, and X.-S. Ye, *Association between priori and posteriori dietary patterns and gastric cancer risk: an updated systematic review and meta-analysis of observational studies.* European Journal of Cancer Prevention, 2025. **34**(2): p. 157–172.
81. Hou, R., et al., *Healthy dietary patterns and risk and survival of breast cancer: a meta-analysis of cohort studies.* Cancer Causes & Control, 2019. **30**(8): p. 835–846.
82. Shin, S., et al., *Association of food groups and dietary pattern with breast cancer risk: A systematic review and meta-analysis.* Clinical Nutrition, 2023. **42**(3): p. 282–297.
83. Toorang, F., et al., *Adherence to the DASH Diet and Risk of Breast Cancer.* Clinical Breast Cancer, 2022. **22**(3): p. 244–251.
84. Mohseni, R., et al., *The association of dietary approaches to stop hypertension (DASH) diet with the risk of colorectal cancer: a meta-analysis of observational studies.* Nutrition and cancer, 2020. **72**(5): p. 778–790.
85. Ali Mohsenpour, M., et al., *Adherence to Dietary Approaches to Stop Hypertension (DASH)-style diet and the risk of cancer: a systematic review and meta-analysis of cohort studies.* Journal of the American College of Nutrition, 2019. **38**(6): p. 513–525.
86. Dinu, M., et al., *Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies.* Critical Reviews in Food Science and Nutrition, 2017. **57**(17): p. 3640–3649.
87. Vernooij, R.W.M., et al., *Patterns of Red and Processed Meat Consumption and Risk for Cardiometabolic and Cancer Outcomes.* Annals of Internal Medicine, 2019. **171**(10): p. 732–741.
88. Han, M.A., et al., *Reduction of Red and Processed Meat Intake and Cancer Mortality and Incidence.* Annals of Internal Medicine, 2019. **171**(10): p. 711–720.
89. Farvid, M.S., et al., *Consumption of red and processed meat and breast cancer incidence: A systematic review and meta-analysis of prospective studies.* International Journal of Cancer, 2018. **143**(11): p. 2787–2799.
90. Strumylaitė, L., et al., *Salt-preserved foods and risk of gastric cancer.* Medicina (Kaunas), 2006. **42**(2): p. 1644–170.
91. Sun, Y., et al., *A Healthy Dietary Pattern Reduces Lung Cancer Risk: A Systematic Review and Meta-Analysis.* Nutrients, 2016. **8**(3): p. 134.
92. Aune, D., et al., *Nonlinear Reduction in Risk for Colorectal Cancer by Fruit and Vegetable Intake Based on Meta-analysis of Prospective Studies.* Gastroenterology, 2011. **141**(1): p. 106–118.
93. Conway, D.I., *Each portion of fruit or vegetable consumed halves the risk of oral cancer.* Evidence-Based Dentistry, 2007. **8**(1): p. 19–20.
94. Aune, D., et al., *Fruits, vegetables and breast cancer risk: a systematic review and meta-analysis of prospective studies.* Breast Cancer Research and Treatment, 2012. **134**(2): p. 479–493.
95. Aune, D., et al., *Dietary fructose, carbohydrates, glycemic indices and pancreatic cancer risk: a systematic review and meta-analysis of cohort studies.* Annals of Oncology, 2012. **23**(10): p. 2536–2546.
96. Aune, D., et al., *Dietary fiber and breast cancer risk: a systematic review and meta-analysis of prospective studies.* Annals of Oncology, 2012. **23**(6): p. 1394–1402.
97. Aune, D., et al., *Dietary fibre, whole grains, and risk of colorectal cancer: systematic review and dose-response meta-analysis of prospective studies.* BMJ, 2011. **343**: p. d6617.

98. Aune, D., et al., *Dairy products and colorectal cancer risk: a systematic review and meta-analysis of cohort studies.* Annals of Oncology, 2012. **23**(1): p. 37–45.

99. Dong, J.-Y., et al., *Dairy consumption and risk of breast cancer: a meta-analysis of prospective cohort studies.* Breast Cancer Research and Treatment, 2011. **127**(1): p. 23–31.

100. World Health Organization, *Guideline: sugars intake for adults and children*. 2015: World Health Organization.

101. World Health Organization, *Guideline: sodium intake for adults and children*. 2012: World Health Organization.

102. World Health Organization, *Saturated fatty acid and trans-fatty acid intake for adults and children: WHO guideline*. 2023: World Health Organization.

103. World Health Organization, *Carbohydrate intake for adults and children: WHO guideline*. 2023: World Health Organization.

104. World Health Organization, *Diet, Nutrition, and the Prevention of Chronic Diseases. Report of a WHO Study Group.* WHO Technical Report Series, 1990. **797**: p. 1–204.

105. National Health Service and Office for Health Inprovement and Disparities. *The Eatwell Guide*. 2024; Available from: https://www.nhs.uk/live-well/eat-well/food-guidelines-and-food-labels/the-eatwell-guide/.

106. U. S. Department of Agriculture and U. S. Department of Health and Human Services, *Dietary Guidelines for Americans, 2020-2025.* 2020.

107. Ministry of Health. *Dietary guidelines for the Argentinian population*. 2016; Available from: https://www.argentina.gob.ar/salud/alimentacion-saludable/grafico.

108. Ministry of Education, Ministry of Health and Welfare, and Ministry of Agriculture Forestry and Fisheries. *Dietary guidelines for Japanese*. 2016; Available from: https://www.maff.go.jp/e/policies/tech_res/attach/pdf/shokuiku-3.pdf.

109. Chinese Nutrition Society. *Dietary Guidelines for Chinese*. 2022; Available from: http://dg.en.cnsoc.org/.

110. Willett, W., et al., *Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems.* The Lancet, 2019. **393**(10170): p. 447–492.

111. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses.* Paragraph 91. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 1995. Bonn Bad Godesberg, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/input/download/report/247/al95_26e.pdf.

112. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses*. Paragraphs 105–107. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 1996. Bonn Bad Godesberg, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/input/download/report/248/al97_26e.pdf.

113. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses*. Paragraphs 128–131. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 2000. Berlin, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/4/x7839e/x7839e0j.htm.

114. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses*. Paragraphs 138–143. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 2001. Berlin, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-720-23%252Fal03_26e.pdf.

115. JOINT FAO/WHO FOOD STANDARDS PROGRAMME CODEX COMMITTEE ON NUTRITION AND FOODS FOR SPECIAL DIETARY USES. *Agenda Item 10: Discussion Paper on the Application of Methodology of Risk Assessent for Nutrition Issues: The Incorporation of Nutrient INtake Assessment in a Risk-based Approach to Assist Decision Making Processes of CCNFSDU*. Paragraph 10. 2001. Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FShared%2BDocuments%252FArchive%252FMeetings%252FCCNFSDU%252Fccnfsdu23%252Fnf01_10e.pdf.

116. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses*. Agenda Item 9. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 2002. Berlin, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FShared%2BDocuments%252FArchive%252FMeetings%252FCCNFSDU%252Fccnfsdu24%252Fnf02_09e.pdf.

117. CCNFSDU. *Report of the Codex Committee on Nutrition and Foods for Special Dietary Uses*. Paragraphs 145–149. in *Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU)*. 2003. Bonn, Germany. Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, 00100 Rome, Italy. Available from: https://www.fao.org/input/download/report/34/al04_26e.pdf.

118. FAO & WHO. *Codex Alimentarius Commission Procedural Manual - Twelfth edition*. Appendix IV. 2001; Available from: https://www.fao.org/4/y4800e/y4800e0o.htm#bm24.

119. FAO & WHO. *Guidelines on Nutrition Labeling CAC/GL 2-1985*. Paragraph 3.4.4.2. 2015; Available from: https://www.fao.org/input/download/standards/34/CXG_002e_2015.pdf.

120. FAO & WHO. *General Standards for Food Additives CXS 192-1995, Annex B*. 2025; Available from: https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXS%2B192-1995%252FCXS_192e.pdf.

121. Krenek, A. and C.D. Gardner, *Evolution of Food Classification Systems and Assessing Diet Quality.* Advances in Nutrition, 2026. **17**(4): p. 100596.

122. Bernstein, J.T., et al., *Guiding Principles for Science-Based Food Classification Systems Focused on Processing and Formulation.* Advances in Nutrition, 2026: p. 100577.

123. FAO & WHO. *Working Principles for Risk Analysis for Application in the Framework of Codex Alimentarius*. 20032; Available from: https://www.fao.org/4/y5817e/y5817e04.htm.

124. Springmann, M., et al., *International food trade contributes to dietary risks and mortality at global, regional and national levels.* Nature Food, 2023. **4**(10): p. 886–893.