

# BMJ Open How is food variety conceptualised and measured as a diet quality indicator in developed settings? Protocol for a systematic scoping review

Sara Chan,<sup>1</sup> Hadis Mozaffari,<sup>1</sup> Annalijn Ida Conklin <sup>1,2</sup>

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<sup>1</sup>Faculty of Land and Food Systems, The University of British Columbia, Vancouver, British Columbia, Canada

<sup>2</sup>Faculty of Pharmaceutical Sciences, The University of British Columbia, Vancouver, British Columbia, Canada

**Correspondence to**  
Dr Annalijn Ida Conklin;  
[aconklin@mail.ubc.ca](mailto:aconklin@mail.ubc.ca)

## ABSTRACT

**Objectives** Dietary diversity (DD) is a pillar of healthy eating guidance and can be used to assess diet quality. Despite being an established nutrition concept, many inconsistencies in its definition and measurement exist and meanings vary across the development spectrum. This protocol outlines a research trajectory, whereby a scoping review will be undertaken to illustrate and map the methodological approaches that have been utilised to measure diversity as a marker of diet quality in the general population. It seeks to determine the most common and less used methodological approaches to measure DD in the diet of healthy adults.

**Methods and analysis** Scoping review of peer-reviewed and grey literature from five bibliographic databases, supplemented by handsearching of reviews and reference lists. Search terms will include DD, food variety, mixed diet, balanced diet and food group variety. Eligible articles must include a measure for DD as an indicator of diet quality in the general population living in developed settings. Two independent reviewers will screen titles or abstracts, and read full-texts. Consensus will resolve any disagreements on study eligibility with a third reviewer consulted if needed. Data will be extracted using a standardised evidence table and analysed using a narrative synthesis approach. Data will be managed using Covidence.

**Ethics and dissemination** No ethics is required for this study using public documents. Results will be disseminated through peer-reviewed papers and scientific conferences.

**Discussion** This scoping review will help to map, classify and assess the methodological approaches used in the nutrition literature to measure DD as a diet quality indicator. We anticipate a wide range of DD measures and expect to identify the most prevalent DD measures used to assess diet quality. Our findings will inform standardisation to improve future research on this nutritional concept.

## INTRODUCTION

It is well-known that a healthy diet is one that involves eating a variety of foods; food variety (FV) is used interchangeably with dietary diversity (DD) and is a long-standing nutritional concept. Numerous countries have some form of recommendation of variety in their dietary guidelines, including Australia,

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This scoping review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Scoping Review extension (PRISMA-ScR) methodology.
- ⇒ Both peer-reviewed and grey literature will be searched using five databases and hand-referencing.
- ⇒ A systematic approach will be used to enhance transparency and reproducibility.
- ⇒ Full-text articles must be available in the research team's fluencies (English, French, Farsi, and Chinese).

Canada, China, the UK and the USA. DD has been a pillar of healthy eating guidance since the 1970s, and it serves as a conceptual benchmark for nutrient adequacy and diet quality.<sup>1–3</sup> From a nutrition standpoint, it is thought that individuals should strive to maximise their DD to meet their nutrient needs and optimise their health.<sup>1 2</sup> While DD may be a seemingly simple recommendation for healthy eating, guidelines typically lack any tangible advice to accompany this nutritional message, which results in vastly different interpretations of variety.<sup>1 2</sup> For example, Australia's guideline shows a plate with five food groups and recommends people 'enjoy a wide variety of nutritious foods from these core food groups every day', and also specifies that eating plenty of vegetables 'includes different types of colours'.<sup>4</sup> Thus, it remains unclear what is meant by DD, and how can this concept be operationalised to accurately measure whether a diet is diverse or not. That is, is DD a concern of having multiple food groups in the diet or having different foods from within a single food group, or both?

Variety, adequacy, moderation and balance are all related and critical components of diet quality.<sup>5</sup> Diet adequacy tends to refer to sufficient food and nutrient intake; moderation suggests non-excessive consumption of

food and nutrients; and balance implies even distribution of intake.<sup>5</sup> While the primary focus of this scoping review is on DD as a diet quality indicator, the interrelated nature of these factors means that the other three may be embedded into DD measures. DD refers to the degree to which an individual consumes heterogeneous foods across and within all food groups.<sup>1,2</sup> This heterogeneity has been captured through various approaches which will be investigated in our paper with a view to standardisation and comparability. For example, some researchers measure DD by counting the number of unique foods or food groups consumed in a week.<sup>1</sup> Other studies operationalise DD by measuring the relative distribution of calories consumed for each food.<sup>1</sup> The third type of DD measures estimates the degree of food item similarity based on characteristics or nutritional value.<sup>1</sup>

To our knowledge, no comprehensive, published review has detailed the various interpretations and measures of DD in the general population not at-risk of energy inadequacy/food insecurity. Without a standard measurement or summary of the varying conceptualisations, there remain significant limitations in the ability to compare findings across studies from more developed countries. As there continues to be interest and active research in DD and health outcomes,<sup>6–9</sup> it is important to clarify and potentially standardise the measures of DD as a diet quality indicator. A previous scoping review sought to consolidate DD indicators and summarise the evidence linking these indicators to health outcomes in adults and adolescents.<sup>8</sup> Although that review offers some insight into DD measures, its primary purpose was to review the link between DD and health, and therefore does not offer a detailed summary or analysis of the various measures to improve standardisation and cross-national comparisons. Moreover, the limitations of that review include: a search limited to English, no grey literature, few databases and publications up to July 2018.

Another scoping review by Marshall and colleagues<sup>10</sup> (2020) included just over 400 articles to reveal how fruit and vegetable variety has been operationalised. Looking only at the variety of fruits and vegetables, the researchers found that nearly all 51 included studies had different definitions of variety which makes it difficult to compare findings.<sup>10</sup> Given the growing interest in DD in recent years, an updated and more comprehensive scoping review on the measurement of DD beyond the variety of only fruits and vegetables is warranted. The scoping review process outlined in this protocol aims to fill this gap by systematically identifying the literature operationalising DD to summarise and critically compare the measurement of this long-standing dietary construct. Of particular interest is how DD is operationalised by considering food intake from *across* as well as *within* food groups.

An older 2003 review describes key interpretations and operationalisation of DD, but focuses primarily on developing countries where DD is used as a nutritional tool to address food penury rather than an indicator of diet quality.<sup>2</sup> While DD is an important dietary goal across the

development spectrum, the concept has different meanings and objectives in different contexts. In developing settings, where inadequate caloric intake or starvation is more prevalent, DD is commonly a measure of food security or minimal energy adequacy.<sup>2,7</sup> This is due to the fact that starchy foods (eg, rice or cassava) are a major source of calories and carbohydrates in less-resourced nations, whereas other nutrient-dense foods like meats, fruits and vegetables are harder to obtain and contribute less to the diet.<sup>2</sup> It is consequently more common to see DD measured in the global south by the accessibility of the different foods in one's community, and thus, DD is a reflection of environmental availability and not quality of a diet.<sup>10</sup> To fill a clear knowledge gap on DD as a diet quality indicator, this scoping review will determine how DD has been conceptualised, operationalised and measured as a diet quality indicator. This will improve our understanding of the most common and less frequently used methodological approaches to measure DD (or FV) in the diet of the general population in a developed setting. This scoping review will also determine whether DD scores are validated and against what markers. Most importantly, it will identify what main measurement issues require consideration to improve research on this long-standing nutritional concept.

## METHODS AND ANALYSIS

### Study objectives

This scoping review will consolidate the various methods researchers have measured DD as an indicator of diet quality in developed settings. The review has three objectives: (1) how DD is conceptualised, operationalised and measured; (2) whether DD is validated and against what markers; and (3) what main measurement issues require consideration to improve research on this nutritional concept.

### Study design

This protocol is informed by a methodological paper for conducting a scoping review<sup>11</sup> and the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols 2015 checklist (PRISMA-P) adapted for the scoping review process.<sup>12</sup> The presentation of final results will be guided by PRISMA's extension for Scoping Reviews 2018 checklist (PRISMA-ScR). A scoping review was selected over a systematic review as the goal of the study is to examine how research is conducted on a certain topic, that is, measuring DD.<sup>13</sup> However, the literature review will be conducted using a systematic, structured approach outlined in this protocol for transparency and reproducibility purposes.<sup>13</sup>

### Patient and public involvement

There were no patients or public involved in the design of this review protocol.

### Eligibility criteria

To be eligible for this systematic scoping review, the articles must include a quantitative measure of DD as an

indicator of diet quality, either within certain food groups or across food groups. Grey literature such as technical reports, government documents, working papers, evaluations and theses will also be eligible for inclusion. Inclusion criteria will be limited to literature involving human participants and including a measure for DD as either an outcome or an exposure. Studies that use other terminology for DD, such as FV, are still eligible for inclusion. Any measures of diet quality that do not explicitly mention DD or alike terms but intend to measure DD (ie, measure consumption frequency from different food groups or subgroups) will be considered (eg, Recommended Food Score). Diet quality and health indices (eg, the USDA Healthy Eating Index) that include DD as a component of multivariable measures will also be considered. Thus, this search is focused on the operationalisation of DD of individual and households living in developed settings, defined as Organisation for Economic Co-operation and Development (OECD) countries or World Bank upper-income countries.<sup>7 14</sup>

The search will exclude papers if the operationalisation of DD is focused exclusively on food quantity or caloric adequacy, which is common in many developing settings.<sup>2</sup> Articles focusing exclusively on the introduction of foods or increasing quantity of food intake in the paediatric population will also be excluded. Documents reflecting subjective, opinion-based information, such as editorials, commentaries or blogs, will be excluded. No language limits will be used as the databases used often translate titles and abstracts into English. However, final full-texts will be read in English, French, Persian/Farsi and Chinese which are the languages of the research team.

### Information sources

The systematic search of relevant literature is anticipated to take place between November 2022 and mid-January 2023. Five bibliographic databases will be used to find articles: CINAHL (EBSCOhost), Embase (Ovid), MEDLINE (Ovid), Scopus, and ProQuest Dissertations and Theses Global. These databases were selected as reputable sources of medical and health science literature and ProQuest offers a comprehensive inventory of graduate research globally. Citation chaining forward and backward will be completed by reviewing the reference lists of any review articles and all included full-text articles to capture possibly missed publications. We will search for grey literature using websites of food-related governmental and non-governmental organisations and professional societies (see [table 1](#)).

### Search strategy

Since DD is an emerging research topic, standardised terminology has not been well-established. To ensure a robust search strategy was adopted, we generated a list of common phrases used to reflect DD (eg, diet variety) and combined the concept of variety with major food groups such as fruits, meat and dairy. The search term ‘Recommended Food Score’ was also included in the strategy as

**Table 1** List of food organisations and websites in developed nations as information sources for grey literature

Organisation	Website
American Society for Nutrition (ASN)	<a href="https://nutrition.org">https://nutrition.org</a>
Canadian Nutrition Society (CNS)	<a href="https://cns-scnc.ca">https://cns-scnc.ca</a>
European Public Health Association Food and Nutrition section (EUPHA)	<a href="https://eupha.org/food-and-nutrition">https://eupha.org/food-and-nutrition</a>
Food Banks Canada	<a href="https://foodbanksCanada.ca">https://foodbanksCanada.ca</a>
Food Foundation in UK	<a href="https://foodfoundation.org.uk">https://foodfoundation.org.uk</a>
The Nutrition Society (UK based)	<a href="https://www.nutritionSociety.org">https://www.nutritionSociety.org</a>
UN Food and Agricultural Organisation (FAO)	<a href="https://www.fao.org/home/en">https://www.fao.org/home/en</a>
USDA Supplemental Nutrition Assistance Program	<a href="https://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program">https://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program</a>
World Food Programme WFP	<a href="https://www.wfp.org/">https://www.wfp.org/</a>
European Food Banks Federation—FEBA	<a href="https://www.eurofoodbank.org">https://www.eurofoodbank.org</a>
The Emergency Food Assistance Program (TEFAP)	<a href="https://www.feedingamerica.org/take-action/advocate/the-emergency-food-assistance-program">https://www.feedingamerica.org/take-action/advocate/the-emergency-food-assistance-program</a>
The Commodity Supplemental Food Program (CSFP)	<a href="https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/csfp">https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/csfp</a>
The Child and Adult Care Food Program (CACFP)	<a href="https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/child-and-adult-care-food-program">https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/child-and-adult-care-food-program</a>
The National School Lunch Program (NSLP)	<a href="https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/national-school-lunch-program">https://www.feedingamerica.org/take-action/advocate/federal-hunger-relief-programs/national-school-lunch-program</a>
The School Breakfast Program (SBP)	<a href="https://www.feedingamerica.org/need-help-find-food/school-breakfast">https://www.feedingamerica.org/need-help-find-food/school-breakfast</a>
The Summer Food Service Program (SFSP)	<a href="https://www.feedingamerica.org/our-work/hunger-relief-programs/summer-food-service-program">https://www.feedingamerica.org/our-work/hunger-relief-programs/summer-food-service-program</a>
Women, Infants, and Children (WIC)	<a href="https://www.feedingamerica.org/need-help-find-food/wic">https://www.feedingamerica.org/need-help-find-food/wic</a>

it is a DD measure known to the research team that is missed when only searching for DD-related terminology. The search terms to be used include: ‘dietary diversity’, ‘diet diversity’, ‘food variety’, ‘fruit variety’, ‘vegetable variety’, ‘meat variety’, ‘dairy variety’ and ‘recommended food score’. [Table 2](#) provides the full electronic search strategy including final search syntaxes and limits used in each database. This search strategy is the product of many test searches on each database to ensure focused yet

**Table 2** Search strategy for each bibliographic database

Database	Search syntax
CINHAL (EBSCOhost)	<ol style="list-style-type: none"> <li>TI ('balanced diet*' OR 'dairy diversity' OR 'dairy variety' OR 'diet diversity' OR 'diet variety' OR 'dietary diversity' OR 'dietary variety' OR 'diversified diet*' OR 'food diversity' OR 'food group diversity' OR 'food group variety*' OR 'food variety' OR 'fruit diversity' OR 'fruit variety' OR 'grain diversity' OR 'grain variety' OR 'meat diversity' OR 'meat variety' OR 'mixed diet*' OR 'protein diversity' OR 'protein variety' OR 'Recommended Food* Score*' OR 'starch diversity' OR 'starch variety' OR 'variety in fruit*' OR 'variety in vegetable*' OR 'variety of fruit*' OR 'variety of vegetable*' OR 'vegetable diversity' OR 'vegetable variety')</li> <li>AB ('balanced diet*' OR 'dairy diversity' OR 'dairy variety' OR 'diet diversity' OR 'diet variety' OR 'dietary diversity' OR 'dietary variety' OR 'diversified diet*' OR 'food diversity' OR 'food group diversity' OR 'food group variety*' OR 'food variety' OR 'fruit diversity' OR 'fruit variety' OR 'grain diversity' OR 'grain variety' OR 'meat diversity' OR 'meat variety' OR 'mixed diet*' OR 'protein diversity' OR 'protein variety' OR 'Recommended Food* Score*' OR 'starch diversity' OR 'starch variety' OR 'variety in fruit*' OR 'variety in vegetable*' OR 'variety of fruit*' OR 'variety of vegetable*' OR 'vegetable diversity' OR 'vegetable variety')</li> <li>1 OR 2</li> <li>MH (animals+) OR MH (animal studies) OR TI (animal model*)</li> <li>MH (human)</li> <li>4 NOT 5</li> <li>3 NOT 6</li> </ol>
EMBASE (Ovid)	<ol style="list-style-type: none"> <li>('balanced diet*' or 'dairy diversity' or 'dairy variety' or 'diet diversity' or 'diet variety' or 'dietary diversity' or 'dietary variety' or 'diversified diet*' or 'food diversity' or 'food group diversity' or 'food group variety*' or 'food variety' or 'fruit diversity' or 'fruit variety' or 'grain diversity' or 'grain variety' or 'meat diversity' or 'meat variety' or 'mixed diet*' or 'protein diversity' or 'protein variety' or 'Recommended Food* Score*' or 'starch diversity' or 'starch variety' or 'variety in fruit*' or 'variety in vegetable*' or 'variety of fruit*' or 'variety of vegetable*' or 'vegetable diversity' or 'vegetable variety').ti,ab,kf.</li> <li>Limit 1 to 'humans only (removes records about animals)'</li> </ol>
Medline (Ovid)	<ol style="list-style-type: none"> <li>('balanced diet*' or 'dairy diversity' or 'dairy variety' or 'diet diversity' or 'diet variety' or 'dietary diversity' or 'dietary variety' or 'diversified diet*' or 'food diversity' or 'food group diversity' or 'food group variety*' or 'food variety' or 'fruit diversity' or 'fruit variety' or 'grain diversity' or 'grain variety' or 'meat diversity' or 'meat variety' or 'mixed diet*' or 'protein diversity' or 'protein variety' or 'Recommended Food* Score*' or 'starch diversity' or 'starch variety' or 'variety in fruit*' or 'variety in vegetable*' or 'variety of fruit*' or 'variety of vegetable*' or 'vegetable diversity' or 'vegetable variety').ti,ab,kf.</li> <li>Limit 1 to 'humans only (removes records about animals)'</li> </ol>
ProQuest Dissertations & Theses Global	<ol style="list-style-type: none"> <li>TI ('balanced diet*' OR 'dairy diversity' OR 'dairy variety' OR 'diet diversity' OR 'diet variety' OR 'dietary diversity' OR 'dietary variety' OR 'diversified diet*' OR 'food diversity' OR 'food group diversity' OR 'food group variety*' OR 'food variety' OR 'fruit diversity' OR 'fruit variety' OR 'grain diversity' OR 'grain variety' OR 'meat diversity' OR 'meat variety' OR 'mixed diet*' OR 'protein diversity' OR 'protein variety' OR 'Recommended Food* Score*' OR 'starch diversity' OR 'starch variety' OR 'variety in fruit*' OR 'variety in vegetable*' OR 'variety of fruit*' OR 'variety of vegetable*' OR 'vegetable diversity' OR 'vegetable variety')</li> <li>AB ('balanced diet*' OR 'dairy diversity' OR 'dairy variety' OR 'diet diversity' OR 'diet variety' OR 'dietary diversity' OR 'dietary variety' OR 'diversified diet*' OR 'food diversity' OR 'food group diversity' OR 'food group variety*' OR 'food variety' OR 'fruit diversity' OR 'fruit variety' OR 'grain diversity' OR 'grain variety' OR 'meat diversity' OR 'meat variety' OR 'mixed diet*' OR 'protein diversity' OR 'protein variety' OR 'Recommended Food* Score*' OR 'starch diversity' OR 'starch variety' OR 'variety in fruit*' OR 'variety in vegetable*' OR 'variety of fruit*' OR 'variety of vegetable*' OR 'vegetable diversity' OR 'vegetable variety')</li> <li>1 or 2</li> </ol>
Scopus	<ol style="list-style-type: none"> <li>TITLE-ABS-KEY ('balanced diet*' OR 'dairy diversity' OR 'dairy variety' OR 'diet diversity' OR 'diet variety' OR 'dietary diversity' OR 'dietary variety' OR 'diversified diet*' OR 'food diversity' OR 'food group diversity' OR 'food group variety*' OR 'food variety' OR 'fruit diversity' OR 'fruit variety' OR 'grain diversity' OR 'grain variety' OR 'meat diversity' OR 'meat variety' OR 'mixed diet*' OR 'protein diversity' OR 'protein variety' OR 'Recommended Food* Score*' OR 'starch diversity' OR 'starch variety' OR 'variety in fruit*' OR 'variety in vegetable*' OR 'variety of fruit*' OR 'variety of vegetable*' OR 'vegetable diversity' OR 'vegetable variety') AND SUBJAREA (medi OR nurs OR heal OR mult)</li> </ol>

comprehensive results. Notably, no MeSH terms (medical subject headings) will be integrated into the strategy as relevant terms were not available or were too broad (eg, diet) to provide relevant results.

Ovid best practices will be followed for Medline and Embase; that is, the 'Humans only (removes records about animals)' special Ovid filters will be used rather than the standard 'Humans only' filter to avoid unintentional exclusion of non-indexed articles.<sup>15</sup> This filter will assist

with removing articles that are focused on only animals, plants or fungi. A similar filter will be used for CINHALL (Embase) by adapting a strategy outlined in a Cochrane Handbook for systematic reviews.<sup>16</sup> The remaining databases do not offer a human filter, so studies will be manually screened for human participants according to the search criteria. A reference librarian with subject expertise in human nutrition will also be consulted to review and pilot the search strategies and techniques. Simple searches of grey literature will be conducted on relevant websites using 'food variety' or 'diet diversity'.

## Study records

### Data management

The systematic and scoping review software, Covidence with data extraction 2.0, will be used to organise, review and extract data from the database results. The included articles will be exported to EndNote V.20 for reference management to manage citations.

### Selection process

Covidence will automatically identify and remove duplicate results. Once duplicates are removed, two reviewers will jointly screen the results in a two-stage process. First, titles or abstracts will be screened by each reviewer and eligibility marked as 'yes', 'no' or 'maybe' according to the inclusion criteria. All 'yes' and 'maybe' titles will be retrieved for full-text screening for eligibility.<sup>17</sup> All articles not eligible for inclusion will have the reason for exclusion noted and reported in a PRISMA flow diagram. A third reviewer will screen a random sample of 10% of the screened records and all excluded articles.<sup>18</sup> This approach to partial double screening is to increase the reliability of the screening process while balancing the capacity and time required to conduct a second screening and resolve related discrepancies. Any discrepancy in inclusion eligibility will be resolved through a clear process. Initially, the three reviewers will independently evaluate the studies and record their findings separately, including adding notes to the record. The group will hold regular meetings to resolve disagreements or discrepancies during the process. When conflicts remain unresolved, the senior author, an epidemiology expert with extensive experience in nutrition research, will serve as an arbitrator and will have final decision if consensus is not reached. All decisions made to resolve discrepancies will be thoroughly recorded, including the rationale behind each determination.

### Data extraction process

Two reviewers will jointly extract data using Covidence. In alignment with PRISMA recommendations to implement strategies to reduce data extraction error,<sup>19</sup> the two reviewers will pilot the data extraction process with 25 studies. In addition, Covidence will allow the research team to compare data extraction and inform the team of any discrepancies. Data extraction will include the following elements: (a) source and publication year of

studies; (b) location and population; (c) DD assessment tool; (d) definition of DD; (e) scoring system (count, proportion, etc); (f) food compositions of diversity scores; (g) threshold for counting foods toward diversity score; (h) timeframe; (i) validation status of the measure. The information collected on DD measures is adapted from 'Trijsburg and colleagues'<sup>20</sup> (2019) extraction method and will include: the dietary instrument (eg, 7 day food record, FFQ, 24 hours recall); theoretical basis; country and target population; food components; DD scoring system (timeframe, unit); and other notes such as whether the measure has been validated.

## Outcomes

There is no primary outcome of interest as this is a scoping review of the operationalisation of DD. Intervention studies will be included insofar as they measure DD either as an outcome or as an exposure.

## Data synthesis

The scoping review process will be presented in PRISMA's four-phase flow diagram<sup>12</sup> and the included research will be synthesised through summary statistics and graphical display as we anticipate a large volume of relevant results. We will calculate the proportion of publications across time (year) and location (country); we will calculate the mean timeframe for each type of DD score. We will use a histogram to display the prevalence of different consumption cut-points used for each type of DD score. We will calculate and display the mean number of studies using each type of DD score, and we will classify and group scores based on their definition and scoring method. We will construct a heatmap to display the proportion of a food item used in each type of DD score. We will use a pie chart to show the proportion of DD scores that have been validated. All interpretations of the data will be discussed among the reviewers, and any disagreements will be resolved by the senior author. As a scoping review, no critical appraisal of the quality of evidence or methods used in the included studies will be completed.<sup>17</sup> Nevertheless, the research team will evaluate the methodological strengths and limitations of the reported DD/FV measures with a view to understanding the main measurement issues to address comparability and standardisation across nutrition and food studies.

## Ethics and dissemination

An ethics review will not be conducted as this study will not involve primary data collection. Findings from this scoping review are expected to be disseminated as scientific conference presentations and a peer-reviewed publication. If amendments to this published protocol are required, the date of the modification, description and rationale will be reported in the final scoping review publication. All data will be available in the final publication.



## DISCUSSION

This scoping review is expected to generate a comprehensive inventory of DD measures and a summary of research approaches to the measurement of DD as a diet quality indicator in developed settings. To date, little attention has been given to the actual composition of DD scores or to the numerous methodological choices involved in constructing DD scores. However, these issues are crucial for assessing the usefulness and validity of a specific index as a tool for dietary assessment. It will include a broader range of scores, thus adding to previous literature on DD operationalisation that tends to focus only on variety of specific food groups (eg, fruits and vegetables).<sup>10</sup> And, while other scoping reviews include DD scores for the whole diet, their objective is to scope the evidence on the health effects of DD scores<sup>8</sup> rather than showcase score characteristics and measurement concerns.

Another strength of this scoping review study is the clear criteria for searching the literature on DD scores as a measure of diet quality (ie, nutrient-dense diets) rather than a measure of energy adequacy. Much of the current literature has a focus on DD as a nutritional tool for public health surveillance of child undernutrition and the risk of caloric insufficiency of the diet from food penury<sup>21</sup> and thus predominantly comes from research in developing settings.<sup>7</sup> Knowing the range of interpretations and measures of DD as an indicator of diet quality and healthy eating in the literature can help to identify knowledge gaps and common approaches for better comparability of future studies of diet quality and health. A standardised measure of DD is needed to provide tangible, specific recommendations beyond 'eat a variety of food'. This scoping review will therefore expand awareness of the various interpretations and measures of DD by following the rigorous review process outlined in this protocol.

This scoping review is designed to answer three broad questions about DD as a diet quality indicator: (a) What is the extent, range and nature of existing DD research? (b) What are the areas where significant progress in measurement has been made? and (c) What are the potential gaps and limitations of current approaches? This review will provide an inventory of key characteristics of DD scores to map common approaches and assess the potential for standardisation to improve research and future evidence for this nutritional concept as a marker of diet quality and healthy eating. Our research question is framed to capture literature from developed countries because in this context food is more abundant, and DD correlates more closely with nutrient density of the diet.<sup>7</sup> The focus of this scoping review is purposeful to ensure that the context and population under study in the relevant literature align with how DD is defined for the purpose of identifying a high-quality diet.

Another strength of this research is the search of multiple bibliometric databases of peer-reviewed and grey literature, using broad keywords and specific names (eg, Recommended Food Score) that have been overlooked in previous reviews.<sup>1 2 8 10</sup> Screening and data extraction

will be conducted by at least two independent reviewers to minimise bias and enhance accuracy. Comprehensive data extraction will also help to better identify emerging themes, concepts or patterns within the included studies. Finally, the scoping review will be conducted using Covidence, a web-based software platform that keeps a detailed audit trail of decisions made during screening and data extraction so that others can follow and verify the process. This transparency enhances the scoping review's credibility and facilitates future updates or revisions.

Finally, it is important to acknowledge certain limitations in our scoping review. First, language restrictions were imposed to reflect literacy of the research team and thus some literature may be missed, although major languages are covered (ie, English, French, Persian/Farsi and Chinese). Second, the breadth of the topic may result in a large volume of literature that may require quantification that can lose nuance and detailed information. Moreover, the broad scope of the DD literature may result in a wide range of publications with varying levels of detail that could limit data quality and rigour of this review which does not include a quality appraisal of the literature. Third, this review will be limited by the publication bias that may exist for DD scores that are over-represented because they showed significant effects on health outcomes.

**Twitter** Annalijn Ida Conklin @AnnalijnConklin

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## ORCID iD

Annalijn Ida Conklin <http://orcid.org/0000-0002-6532-8790>

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