# Systematic Review of Dietary Patterns and Sustainability in the United States

# **Online Supplementary Material: Methods, Bias Assessment, and Evidence Grading Tools**

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## Systematic Review Methodology

To produce this systematic review, we first sought to replicate the original literature search performed by the US Department of Agriculture and 2015 Dietary Guidelines Advisory Committee (DGAC), which included studies published between January 2000 and March 2014, to verify whether the search terms provided in Appendix E-2.37 of the Scientific Report of the 2015 DGAC could reliably replicate the original search results. Because the original methods did not consistently detail the advanced search strings and scientific journal databases are not static (e.g., search terms are periodically updated, databases undergo structural changes, etc.), the search terms required some modifications to achieve the desired results.

To better understand how studies had been categorized in various databases in 2014 and how these categorizations may have changed over time, we utilized tools such as the MeSH (Medical Subject Headings) Analyzer. The search methodology was ultimately revised with additional geographical search terms in Embase, new MeSH terms and database specific descriptors, and greater specification of some fields searched in the original DGAC search. Several new MeSH terms were included because annual additions and changes are made to the MeSH thesaurus. For example, "Greenhouse Gases" became a new MeSH term between 2015 and 2019 and consequently it was added to the PubMed search we conducted. However, we found that inclusion of this MeSH term did not alter the search results.

Additionally, because the publicly available DGAC documentation did not indicate which fields were being searched in each of the three databases, the study team reviewed the original search of these databases, and then adjusted database-specific search terms using title, abstract, keyword or subject headings.

After these modifications, the search methodology could reproduce the original search performed by the 2015 DGAC, as indicated by a comparable quantity of studies returned, and the inclusion of those studies named in the DGAC evidence portfolio on food sustainability. We then used these search terms to rerun the search for the time frame of July 2015 to September 2019.

Personal communications reported that the Navigator interface used for their search included three databases: BIOSIS Citations, CAB Abstracts, and FSTA. The current study team did not have access to a federated search that included all three indexes. Consequently, each database was searched separately, enabling us to use the native thesaurus and taxonomies for each.

Below is the search methodology used for each database, including dates searched, year or date range, and number of studies returned.

**Dates Searched:** 09/20/2019

**Databases:** BIOSIS Citations

Year Range: [2015-2019]

**Results:** 99

Search Terms:

((TI=((Food OR environment\* OR diet) NEAR/4 (sustainab\*))) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Journal Article)

Indexes=BCI Timespan= All years

OR

(TI=("food insecurity" OR "food security" OR (greenhouse NEAR/1 effect\*) OR ("greenhouse gas" NEAR/1 emission\*) OR "land use" OR "water use")) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=BCI Timespan= All years

OR ((TI=((carbon OR environment\*) NEAR/2 footprint))) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=BCI Timespan= All years

AND

((TS=(MedDietScore or "adequacy index" or kidmed or (index or score) near/2 ("diet quality") or dietary or nutrient\* or eating or food or diet))) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=BCI Timespan=All years

OR TS=("diet quality" or "dietary approaches to stop hypertension" or vegan\* or vegetarian\* or "prudent diet" or "western diet" or omniheart or "Optimal Macronutrient Intake Trial to Prevent Heart Disease" or nordiet or "Nordic diet") *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=BCI Timespan=All years

OR (TI=((Okinawa\* or asia\* or Chinese or japan\* or Hispanic\* or ethnic or "plant based") near/3 diet\*)) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) AND TAXA NOTES: (Humans)

Indexes=FSTA Timespan=All years

OR (TI=((omni or Mediterranean or DASH) near/3 diet\*)) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Article)

Indexes=FSTA Timespan=All years

OR (TI=((Diet or dietary or eating or food) near/2 (pattern\* or profile\* or habit\* or guideline\* or recommendation\*))) LANGUAGE: (English) *AND* DOCUMENT TYPES: (Article) AND TAXA NOTES: (Humans)

Indexes=BCI Timespan=All years

PUBLICATION YEARS: 2015 OR 2016 OR 2017 OR 2018 OR 2019

**Dates Searched:** 09/20/2019

Databases: CAB Abstracts (Web of Science)

Year Range: [2000-2014], [2014-2015], [2015-2019]

Results: 86

## Search Terms:

((Diet or dietary or eating or food) adj (pattern\* or profile\* or habit\* or guideline\* or recommendation\*)).m\_titl.

OR ((MedDietScore or "adequacy index" or kidmed or index or score) adj ("diet quality" or dietary or nutrient\* or eating or food or diet)).mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

OR ("diet quality" or "dietary approaches to stop hypertension" or vegan\* or vegetarian\* or "prudent diet" or "western diet" or omniheart or "Optimal Macronutrient Intake Trial to Prevent Heart Disease" or nordiet or "Nordic diet")

OR ((omni or Mediterranean or DASH) adj diet\*).m\_titl.

OR ((Okinawa\* or asia\* or Chinese or japan\* or Hispanic\* or ethnic or "plant based") adj diet\*).m\_titl.

## AND

((Food or environment\* or diet) adj sustainab\*).m\_titl.

OR ((carbon or environment\*) adj footprint).mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

OR ("food insecurity" or "food security" or (greenhouse adj effect\*) or ("greenhouse gas" adj emission\*) or "land use" or "water use").m\_titl.

(English language and yr="2015-2019")

**Dates Searched:** 08/28/2019

Databases: Cochrane

**Year Range:** July 1, 2015 – August 15, 2019

**Results:** 15

#### **Search Terms:**

"diet quality" OR (dietary NEXT guideline\*) OR (dietary NEXT recommendation\*) OR ((food OR eating OR diet OR dietary) NEAR/3 (pattern OR profile OR habit)) OR (eating NEXT style\*) OR ("dietary approaches to stop hypertension" OR vegan\* OR vegetarian\* OR "prudent diet" OR "western diet" OR nordiet OR "Nordic diet" OR omniheart OR "Optimal Macronutrient Intake Trial to Prevent Heart Disease" OR ((asia\* OR western OR Okinawa\* OR "plant based" OR Mediterranean OR DASH) AND (diet\* OR food))) OR ((Index OR score OR indices OR scoring) NEAR/3 (dietary OR diet OR food OR eating)) OR "adequacy index" OR kidmed OR MedDietScore

((Food OR environment\* OR diet) NEAR/4 (sustainab\*)) OR ((carbon OR environment\*) NEAR/2 footprint) OR "food insecurity" OR "food security" OR (greenhouse NEAR/1 effect\*) OR ("greenhouse gas" NEAR/1 emission\*) OR "land use" OR "water use"

### **Dates Searched:** 09/11/2019

Databases: Embase

Year Range: [2000-2014], [2014-2015], [2015-2019]

Results: 322

#### Search Terms:

'adequacy index\*' OR meddietscore OR kidmed OR 'healthy eating index'

OR ((index OR score OR scoring) NEAR/3 ('diet quality' OR dietary OR nutrient\* OR eating OR food OR diet)):ti,ab

OR 'diet quality' OR 'eating habit'/exp OR 'mediterranean diet'/exp OR nordiet:ti,ab OR 'nordic diet':ti,ab OR dash:ti,ab OR 'dietary approaches to stop hypertension':ti,ab OR vegan\*:ab,ti OR

vegetarian\*:ab,ti OR 'vegetarian diet'/exp OR 'vegetarian'/exp OR 'prudent diet':ti,ab OR 'western diet':ti,ab OR omniheart:ti,ab OR omni:ti OR 'plant based diet'

OR ((dietary OR eating OR food OR diet) NEAR/2 (pattern? OR habit? OR profile? OR recommendation? OR guideline?)) OR (('ethnic, racial and religious groups'/exp OR okinawa\* OR 'mediterranean') AND ('diet'/exp OR 'eating'/exp OR 'food intake'/de))

AND 'environmental sustainability'/exp OR 'food security'/exp OR 'carbon footprint'/exp OR 'human impact (environment)'/exp OR 'greenhouse effect'/exp OR 'ecosystem'/de OR 'land use'/de OR 'plant water use'/exp OR (food NEAR/5 sustainab\*) OR 'food insecurity'/exp OR 'environmental impact' OR (environment\* NEAR/2 footprint) OR (diet\* NEAR/5 sustainab\*)

AND [humans]/lim AND [english]/lim AND [embase]/lim AND [2000-2014]/py NOT [medline]/lim

**Dates Searched:** 09/24/2019

Databases: FSTA

Year Range: 2015-2019

Results: 246

Search Terms:

(TI=((Food OR environment\* OR diet) NEAR/4 (sustainab\*))) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TI=("food insecurity" OR "food security" OR (greenhouse NEAR/1 effect\*) OR ("greenhouse gas" NEAR/1 emission\*) OR "land use" OR "water use")) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TI=((carbon OR environment\*) NEAR/2 footprint)) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

AND

OR (TI=((Diet or dietary or eating or food) near/2 (pattern\* or profile\* or habit\* or guideline\* or recommendation\*))) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TS=((omni or Mediterranean or DASH) near/3 diet\*)) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TI=((omni or Mediterranean or DASH) near/3 diet\*)) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TI=((Okinawa\* or asia\* or Chinese or japan\* or Hispanic\* or ethnic or "plant based") near/3 diet\*)) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TS=("diet quality" or "dietary approaches to stop hypertension" or vegan\* or vegetarian\* or "prudent diet" or "western diet" or omniheart or "Optimal Macronutrient Intake Trial to Prevent Heart Disease" or nordiet or "Nordic diet")) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

OR (TS=((MedDietScore or "adequacy index" or kidmed or index or score) near/2 ("diet quality" or dietary or nutrient\* or eating or food or diet))) *AND* LANGUAGE: (English) *AND* DOCUMENT TYPES: (Journal Article)

Indexes=FSTA Timespan=All years

Combine and Indexes=FSTA Timespan=2015-2019

**Dates Searched:** 09/18/2019

Databases: PubMed

Year Range: July 2015 – September 2019

Results: 804

(((((((((((((((((((((((((((()) Get (at quality "OR dietary pattern\* OR diet pattern\* OR eating pattern\* OR food pattern\* OR eating habit\* OR dietary habit\* OR food habit\* OR dietary profile\* OR food profile\* OR diet profile\* OR eating profile\* OR dietary guideline\* OR dietary recommendation\* OR food intake pattern\* OR dietary intake pattern\* OR diet pattern\* OR eating style\*) OR (DASH[ti] OR DASH[tw] OR ("dietary approaches"[ti] AND hypertension[ti]) OR "Diet, Mediterranean"[Mesh] OR Mediterranean [ti] OR vegan\* OR vegetarian\* OR "Diet, Vegetarian"[Mesh] OR "prudent diet" OR "western diet" OR nordiet OR omni[ti] OR omniheart[tiab] OR (Optimal Macronutrient Intake Trial to Prevent Heart Disease) OR ((Okinawa\* OR "Ethnic Groups"[Mesh] OR "plant based" OR Mediterranean[tiab]OR

Nordic[tiab] OR "heart healthy"[tiab] OR indo-mediterranean) AND (diet[mh] OR diet[tiab] OR food[mh]))) OR ("Guideline Adherence"[Mesh] AND (diet OR food OR eating OR eat OR dietary OR feeding OR nutrition OR nutrient\*)) OR (adherence AND (nutrient\* OR nutrition OR diet OR dietary OR food OR eat OR eating) AND (guideline\* OR guidance OR recommendation\*)) OR (dietary score\* OR adequacy index\* OR kidmed OR Diet Quality Index\* OR Food Score\* OR Diet Score\* OR MedDietScore OR Dietary Pattern Score\* OR "healthy eating index") OR ((index\*[ti] OR score\*[ti] OR indexes OR scoring[ti] OR indices[ti]) AND (dietary[ti] OR nutrient\*[ti] OR eating[tiab] OR food[ti] OR food[mh] OR diet[ti] OR diet[ti] OR diet[mh]) AND (pattern\* OR habit\* OR profile\*))))))

# AND

((environmental footprint\* OR Carbon Footprint\*[tiab] OR environmental impact\* OR food security\* OR food insecurity\* OR "Conservation of Natural Resources"[Mesh] OR "Greenhouse Effect"[Mesh] OR "Greenhouse Gases"[Mesh] OR "Carbon Footprint"[Mesh] OR "Environmental Monitoring"[Mesh] OR ((environment\*[tiab] OR food[major:noexp] OR food[ti] OR diet[major]) AND sustainab\*[tiab])) OR ("Conservation of Natural Resources"[major:noexp] OR "Greenhouse Effect"[major:noexp] OR "Greenhouse Gases"[major:noexp] OR "Carbon Footprint"[major:noexp] OR "Environmental Monitoring"[major:noexp]) OR ("Ecosystem"[Mesh] OR ecological system\*[tiab] OR greenhouse\*[tiab] OR "Ecosystem"[major] OR ecological system\*[tiab] OR greenhouse\*[tiab] OR "water use"[tiab])))

# AND

( "2015/07/01"[PDat] : "2019/09/17"[PDat] ) AND English[lang])) AND (("Study Characteristics" [Publication Type] OR "clinical trial"[ptyp] OR "Epidemiologic Studies"[Mesh] OR "Support of Research"[ptyp]) NOT (editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR letter[ptyp] OR review[ptyp]))

# Systematic Review Critical Appraisal Checklist

The modified critical appraisal checklist was developed by USDA's Center for Nutrition Policy and Promotion specifically for the 2015 Dietary Guidelines Advisory Committee. The tool was developed to assess bias among the studies related to sustainable diets and dietary patterns. For more information on the development of the Critical Appraisal Checklist, see the 2015 DGAC report.

Mode	ing assessments should include:	Yes/No
1	A statement of the problem	
2	A discussion of the need for modeling vs. alternative methodologies	
3	A description of the relevant factors and outcomes	
4	A description of the model including reasons for this type of model and a specification of the scope including boundary conditions for analysis	
5	A listing of data sources (including subjective estimates), with a description of the strengths and weaknesses of each source	
6	A list of assumptions pertaining to the structure of the model and the data	
7	A list of parameter values that will be used for a base case analysis	
8	The results derived from applying the model for the base case	
9	A discussion of how the modelling assumptions might affect the results, indicating both the direction of the bias and the approximate magnitude of the effect	
10	A description of the validation undertaken, including the following where appropriate: concurrence of experts, internal consistency, external consistency, or predictive validity	
11	A description of the settings to which the results of the analysis can be applied and a list of factors that could limit the applicability of the results	
12	A description of research in progress that could yield new data that could alter the results of the analysis	

# Evaluation of the quality of studies meeting inclusion criteria using the Critical Appraisal Checklist

The quality of studies meeting inclusion criteria, as determined by the modified critical appraisal checklist, was high, with all studies receiving scores of 8 out of 12 to 11 out of 12 with a mean of 10.5. All of the studies provided a statement of the problem which precipitated a need to complete the study (Criterion 1). Of the 22 included papers, only one paper provided a discussion of the need for modeling vs. alternative methodologies (Criterion 2) (1). In order to maintain consistency with previous reviews performed by the DGAC in 2015 and Nelson et al. in 2016, this question was included in the checklist; however, it may not warrant inclusion in the checklist for future applications, as modeling is currently the only viable methodology capable of measuring the impact of diets on environmental outcomes and climate change, and a discussion of alternative methodologies is not necessary.

All of the studies provided description of the relevant factors and outcomes, as well as a description of the models used (Criterion 3 and 4). Explanations of the rationale for the use of modeling was less common, although some papers provided this explanation as a strength of the methodology used. In the explanation of the data sources used, many studies cited literature reviews or analysis performed in previously published articles. This was commonly done with respect to Life Cycle Assessments (LCA) and water footprint analysis (Criterion 5) (2–17). Discussion of the assumptions in the analysis was completed by all but one of the studies with varying degrees of explanation (8). Supplemental materials often contained additional support for various assumptions (Criterion 6) (3,9,18). All articles had sufficient discussion of the base case analysis; however, the presentation of outcomes associated with the base case scenario varied (Criterion 7). Many studies examined the base case in the analysis, while others calculated only the impact of shifting current consumption to recommended diets. In the case of the latter, it was possible to have the results presented as the percent change to the recommended diet without outcomes reported on baseline conditions, although this occurred in a minority of cases (Criterion 8) (1).

All studies indicated, to some degree, the use of assumptions in the analysis; however, there were substantial disparities in how study authors discussed how the modeling assumptions might affect the results, including the direction and magnitude of bias (Criterion 9). Various validation techniques were undertaken, including Monte Carlo Simulations, providing upper and lower limits of estimates, internal data consistency checks, and others There was consistent discussion of studies applying similar methodologies or examining similar research questions and how the findings of the current study compared (Criterion 10).. All studies addressed settings in which results could be applied (Criterion 11). All but one study indicated the need for future research and how future analyses could be improved upon (Criterion 12) (13,17). However, there was little discussion of whether future improvements to the body of research could alter the results of the analysis at hand.

Rubric
Grading
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Nutrition Evidence Systematic Review Graumy Nutrition Evidence Systematic Review (NESR) | NESR.usda.gov US Department of Agriculture Nutrition Evidence Systematic Review (NESR) | NESR.usda.gov

	Strong	Moderate	Limited	Grade Not
	8			Assignable
Risk of bias	Across the body of evidence, there is	Across the body of evidence, there is	Across the body of evidence, there is	A grade is not
	a strong likelihood that the design	a moderate likelihood that the design	a <i>limited</i> likelihood that the design	assignable for this
	and conduct of the studies has	and conduct of the studies has	and conduct of the studies has	element because it
	prevented or minimized bias such	prevented or minimized bias such that	prevented or minimized bias such that	cannot be
	that the reported results are the true	the reported results are the true effects	the reported results may not be the	adequately
	effects of the intervention/ exposure,	of the intervention/ exposure, and	true effects of the intervention/	assessed
	and plausible bias and/or potential	plausible bias and/or potential	exposure, and plausible bias and/or	
	limitations are unlikely to alter the	limitations are unlikely to alter the	potential limitations may have altered	
	results	results	the results	
Consistency	The body of evidence demonstrates	The body of evidence demonstrates	The body of evidence demonstrates	A grade is not
	findings with strong consistency in	findings with moderate consistency in	findings with <i>limited</i> consistency in	assignable for this
	direction and magnitude of effect; or,	direction and magnitude of effect;	direction and magnitude of effect; few	element because it
	any inconsistencies in findings can be	some of the inconsistencies in	of the inconsistencies in findings can	cannot be
	explained by methodological	findings can be explained by	be explained by methodological	adequately
	differences	methodological differences	differences	assessed
Directness	The body of evidence demonstrates	The body of evidence demonstrates	The body of evidence demonstrates	A grade is not
	strong directness, such that studies	moderate directness, such that some	limited directness, such that few	assignable for this
	are designed to directly examine the	studies are designed to directly	studies are designed to directly	element because it
	relationships among	examine the relationships among	examine the relationships among	cannot be
	intervention/exposure, comparator,	intervention/exposure, comparator,	intervention/exposure, comparator,	adequately
	and outcomes of primary interest in	and/or outcomes of primary interest in	and/or outcomes of primary interest in	assessed
	the systematic review question	the systematic review question	the systematic review question	
Precision	The body of evidence demonstrates	The body of evidence demonstrates	The body of evidence demonstrates	A grade is not
	strong precision based on a	moderate precision based on an	limited precision based on an	assignable for this
	substantial number of sufficiently-	adequate number of sufficiently-	inadequate number of sufficiently-	element because it
	powered studies with a narrow	powered studies with a narrow	powered studies with a narrow	cannot be
	assessment of variance	assessment of variance	assessment of variance	adequately
				assessed
Generalizability	The body of evidence demonstrates	The body of evidence demonstrates	The body of evidence demonstrates	A grade is not
	strong generalizability to the U.S.	moderate generalizability to the U.S.	<i>limited</i> generalizability to the U.S.	assignable for this
	population of interest with regard to:	population of interest with regard to:	population of interest with regard to:	element because it
	a) the participant characteristics b) the	a) the participant characteristics b) the	a) the participant characteristics b) the	cannot be
	intervention/exposure and outcomes	intervention/exposure and outcomes	intervention/exposure and outcomes	adequately
	studied	studied	studied	assessed

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