A Comprehensive Database Linking Dietary Fibers and Health: Rationale and Methods

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Abstract

The term dietary fiber captures a broad category of compounds, from intrinsic fiber in plants defined as non-digestible carbohydrate and lignin to isolated non-digestible carbohydrates (functional fibers) added to foods. Functional fibers must have a physiological benefit on health to receive a fiber classification. Our objective is to present the rationale and approach taken to develop a comprehensive, publicly available, searchable database linking dietary fibers to health outcomes.

To build this database, we conducted a systematic literature search for human intervention studies published in English from 1946 to May 2015. Our search strategy included a broad definition of fiber terms, as well as search terms for nine physiological health outcomes. Inclusion and exclusion criteria were developed a priori, and publications were first screened at the abstract level and, later, at the full text level to determine database eligibility. The database was built and published in the Systematic Review Data Repository (SRDR™), a web-based, publicly available application.

The final database contains n=869 unique publications (n=919 total entries). The majority of studies were randomized controlled crossover (63.4%) or parallel (32.0%) designs. Guar gum was the most frequently studied exposure (8.7%), and total/LDL cholesterol was the most frequently studied outcome (16.9%).

This resource will reduce the unnecessary replication of effort in conducting systematic reviews by serving as both a central database archiving PICO (population, intervention, comparator, outcome) data on published studies and as a searchable tool through which data can be extracted and updated annually. The database will help scientists and policy-makers in evaluating evidence linking fibers with health outcomes and identifying missing information in published systematic reviews.

Background

Dietary fiber research is complex due to the fact that the literature embodies a large number of studies detailing a diverse range of fiber types. In addition, dietary fiber in food may function differently than isolated fiber, and the properties of fibers may change due to processing or cooking. Fibers can be grouped by a number of physical characteristics including solubility, viscosity, and fermentability, as well as by their associated physiological health outcomes.

Dietary fiber, while complex, has been recognized as playing an important role in human health, and research in the field is moving at a fast pace. A database capturing and organizing the vast and complex literature on dietary fiber and health is a resource that can assist researchers and policy-makers in efficiently evaluating the evidence. One use of such a database is to create an evidence map.[1]

Evidence mapping[2] involves capturing information on study population, intervention, comparator, and outcomes (PICO), thereby characterizing the existing research on a broad topic. It does not include data on study results or assess study quality; however, it is considered a rapid, cost-effective methodology for summarizing the research.

Objectives

(1) To develop a database capturing studies testing dietary fiber and physiological health outcomes
(2) To use new evidence mapping technology to summarize the body of literature

Methods

Development of the Database

1) Conducted systematic literature search in OVID Medline for fiber interventions and at least one of 9 health outcomes identified at the 9th Vahouny Fiber Symposium by ILSI in 2010[3] (Table 1)
   - Database Version 1 (original), released in April 2015, captured publications from 1946-Sept. 2013
   - Database Version 2, released in Dec. 2015, as an update to capture additional publications from Sept. 2013-May 2015
2) Screened abstracts applying broad inclusion criteria (see Table 1)
3) Screened full texts of accepted abstracts, applying additional exclusion criteria (see Table 1)
4) Extracted data from papers into web-based repository, SRDR™ (http://srdr.ahrq.gov)
5) During data extraction, all data were recorded as they were described in the publication

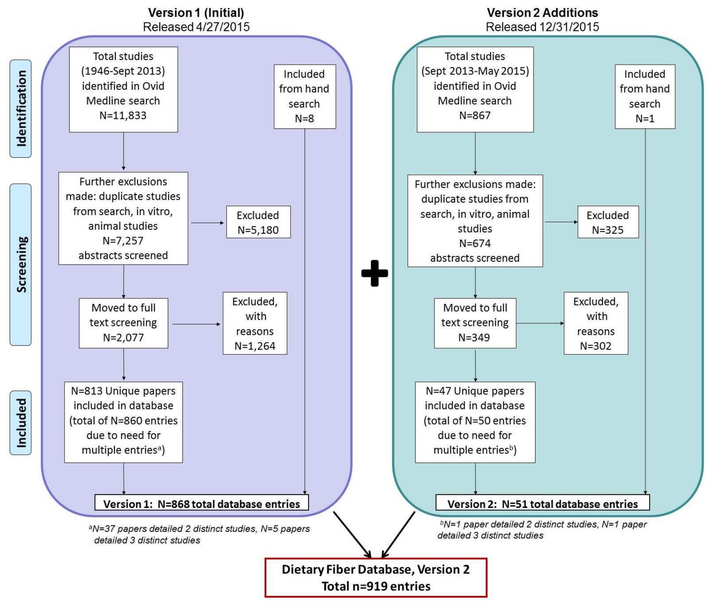
Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
-Published 1946- May 2015 -Published in English -Abstract contained a fiber term and one of the following 9 Vahouny health outcomes: 1.Total & LDL cholesterol 2. Post-prandial glucose & insulin 3. Blood pressure 4. Fecal bulk & laxation 5. Transit time 6. Colonic fermentation & SCFA production 7. Modulation of colonic microflora 8. Weight/adiposity 9. Increased satiety	-Reviews, bibliographies, case reports -Observational studies -Intervention was via tube feeding or enteral nutrition -Population was infants (<3 years), pregnant or breastfeeding women, has any type of cancer, bowel disease, renal failure, or other chronic disease condition -Intervention has no concurrent control -Fiber dose was not clearly reported -Intervention was not sufficiently controlled to isolate fiber effect -Animal-only studies -In vitro studies

Evidence Map Data Analysis

- Descriptive analyses used to characterize study design, population characteristics, and outcomes
- Fibers and outcomes reviewed and grouped into pre-defined categories (i.e. psyllium seed husk, ispaghula husk, ispaghula, isabgol, and Metamucil were grouped as "psyllium")

Figure 1: Flow Diagram of Included Studies



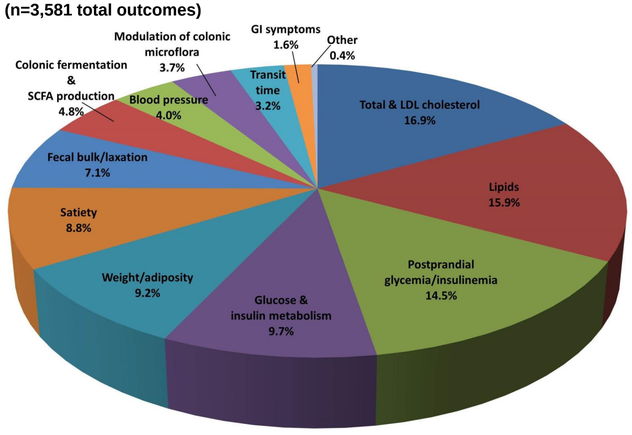
Results: Evidence Map

Table 2: Characteristics of Studies Captured in Database (n=919)

	Total	RCT Crossover	RCT Parallel	Other[1]
	919	583 (63.4%)	294 (32.0%)	42 (4.6%)
Blinding				
Unspecified	424 (46.1%)	307 (52.7%)	86 (29.2%)	31 (73.8%)
Double-blind	319 (34.7%)	158 (27.1%)	156 (53.1%)	5 (11.9%)
Single-blind	129 (14.0%)	94 (16.1%)	32 (10.9%)	3 (7.1%)
Not blinded	42 (4.6%)	22 (3.8%)	17 (5.8%)	3 (7.1%)
Other[2]	5 (0.5%)	2 (0.3%)	3 (1.0%)	0 (0.0%)
Age Category				
Adults	733 (79.8%)	461 (79.1%)	237 (80.6%)	35 (83.3%)
Adults & adolescents	153 (16.6%)	102 (17.5%)	46 (15.6%)	5 (11.9%)
Other[3]	33 (3.6%)	20 (3.4%)	11 (3.7%)	2 (4.8%)
Study Diet				
Isocaloric/maintenance	416 (45.3%)	227 (38.9%)	170 (57.8%)	19 (45.2%)
Acute feeding study	288 (31.3%)	262 (44.9%)	11 (3.7%)	15 (35.7%)
Unspecified	143 (15.6%)	72 (12.3%)	66 (22.4%)	5 (11.9%)
Weight loss	51 (5.5%)	12 (2.1%)	37 (12.6%)	2 (4.8%)
Other[4]	21 (2.3%)	10 (1.7%)	10 (3.4%)	1 (2.4%)
Baseline Health				
Healthy	492 (53.5%)	374 (64.1%)	90 (30.6%)	28 (66.7%)
Metabolically at risk	350 (38.1%)	166 (28.5%)	173 (58.8%)	11 (26.2%)
GI condition[5]	29 (3.2%)	11 (1.9%)	18 (6.1%)	0 (0.0%)
Mixed population	40 (4.3%)	29 (5.0%)	9 (3.1%)	2 (4.8%)
Other[6]	8 (0.9%)	3 (0.5%)	4 (1.4%)	1 (2.4%)

[1] includes controlled trials with unspecified randomization, non-randomized trials, combined crossover & randomized controlled trial, & switch-back ; [2] includes mixture of double/single blind, allocation-concealed, time-blinded, and triple blind; [3] Includes combined populations of adults, adolescents, and/or children (3-11 y), as well as n=3 studies where age information was not provided; [4] includes AHA & NCEP diets, restricted diets (ie. carbohydrates, energy, fat), low-fiber background diets, and combinations of maintenance and/or weight loss diets; [5] includes constipation, digestive problems, diverticular disease, fecal incontinence, loose stools, and hemorrhoids; [6] includes hospitalized for orthopedic surgery, in-patients prescribed antibiotics, recently removed colonic adenomas, or not reported

Figure 2: Frequency of Health Outcomes Captured in Database (n=3,581 total outcomes)



Note: If space allowed, non-Vahouny outcomes were captured in the database. Upon reviewing the data, three salient non-Vahouny outcome groups emerged (lipids, glucose & insulin metabolism, GI symptoms) and are also illustrated in fig 2.

Table 3: Top 3 most frequently reported fiber interventions in database

Fiber Type	n (%)
Guar gum	129 (8.7%)
Combination/mixture *16 (14.4%) contained some form of guar*	111 (7.5%)
Psyllium	100 (6.7%)
Dietary fiber *Largely whole diet interventions where goal was to ↑ total fiber through intake of high fiber foods*	97 (6.5%)
Resistant starch	78 (5.3%)
Wheat bran	65 (4.4%)
Oat β-glucan	58 (3.9%)

Conclusions

Database Overview

- Version 2 of the Fiber Database is publicly available (http://srdr.ahrq.gov/projects/716)
- It contains 919 entries detailing controlled, metabolic studies designed to provide evidence linking dietary fibers to at least one of 9 physiological health benefits
- The 919 entries detail 869 unique studies and capture 1,483 fiber exposures
- Of the 1,483 exposures, 130+ unique fiber types are captured
- The database is scheduled to be updated annually for at least the next two years to incorporate new literature

Evidence Map Summary

- Over 80% of studies were conducted in adults
- Over 90% were metabolic or partial metabolic studies
- Guar gum was the most frequently studied exposure
- Top health outcomes captured in the database included: total & LDL cholesterol, postprandial glycemia/ insulinemia, and lipid outcomes

Database Applications

- May provide a starting point for systematic reviews and facilitating evidence mapping
- May be particularly useful for food manufacturers developing fibers and fiber-enriched foods, agencies defining fiber for food labeling, and health researchers and organizations evaluating the health benefits of different fiber sources
- Fiber exposures should be reviewed by users to determine whether groupings are desirable

References:

[1]Livingston et al. (under review).
[2]Althuis et al. Am J Clin Nutr. 2013; 98(3):755-68.
[3]Howlett et al. Food Nutr Res. 2010; 54.

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