



The Benefits of Dietary Fiber Intake on Reducing the Risk of Cancer: An Umbrella Review of Meta-analyses

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ABSTRACT

Objective: The purpose of this study was to review previously published meta-analyses on the effectiveness of dietary fiber on reducing the incidence of cancer.

Methods: An umbrella review of all published meta-analyses was performed. A PubMed search from January 1, 1980 to June 30, 2017 was conducted using the following search strategy: (fiber OR fibre) AND (meta-analysis OR systematic review) AND (cancer OR carcinoma). Only English-language publications that provided quantitative statistical analysis on cancer were retrieved.

Results: Nineteen meta-analyses comparing highest vs lowest dietary fiber intake were retrieved for inclusion in this umbrella review. There was a statistically significant reduction in the relative risk (RR) of colorectal, esophageal, gastric, and pancreatic cancer (RR = 0.52-0.88); however, statistically significant heterogeneity was observed in the meta-analyses on esophageal, gastric, and pancreatic cancer. There was a statistically significant reduction in the RR of breast cancer (RR = 0.85-0.93).

Conclusion: This review suggests that those consuming the highest amounts of dietary fiber may benefit from a reduction in the incidence of developing colorectal cancer, and there also appears to be a small reduction in the incidence of breast cancer. (J Chiropr Med 2018;17:90-96)

Key Indexing Terms: *Dietary Fiber; Meta-analysis; Neoplasms*

INTRODUCTION

In 2017, in the United States, it is estimated that there will be approximately 1.67 million new cases of cancer diagnosed, and 600 000 deaths from this disease are projected to occur.¹ Epidemiologic studies show that dietary factors are believed to play an important role in the prevention of cancer, among which dietary fiber has received considerable interest.² Increased intake of dietary fibers has been associated with decreased risk of several cancers, such as colorectal and breast cancer.³⁻⁷ However, the results of many epidemiologic studies have shown conflicting results, with some showing a weak or null association.⁸⁻¹² Furthermore, the 2007 World Cancer Research Fund's second expert report concluded that the

data were too inconsistent to draw a conclusion on the association between dietary fiber and cancer risk.¹³

Given the inconsistency of the existing literature, a pooling of information from individual trials could provide a more precise and accurate estimate of dietary fibers role in reducing the incidence of cancer. To achieve this result, many investigators have turned to performing a powerful statistical method known as meta-analysis. Meta-analyses are fundamental to provide the highest level of evidence to best inform health care decision making. Because of the current inconsistency in the literature on the benefits of dietary fiber's ability to reduce cancer incidence, the purpose and objective of this paper is to summarize the evidence from previously published meta-analyses regarding the effectiveness of dietary fiber in reducing the incidence of cancer.

METHODS

An umbrella review was selected for this study. An umbrella review provides a summary of existing published meta-analyses and systematic reviews and determines whether authors addressing similar review questions independently observe similar results and arrive at similar conclusions.¹⁴ Inclusion criteria for assessing the

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effectiveness of dietary fiber to reduce cancer incidence will have to include meta-analyses that surveyed cancer incidence within normal populations (with no geographic, race, or sex restrictions) while comparing the relative rates (RRs) or odds ratios (ORs) of those with the highest vs lowest dietary fiber intakes.

As meta-analyses started appearing in medical literature in the early 1980s, a systematic literature search of PubMed and CINAHL from January 1, 1980 to June 30, 2017 was conducted using the following search strategy: (fiber OR fibre) AND (meta-analysis OR systematic review) AND (cancer OR carcinoma OR adenoma).

Abstracts, conference proceedings, and gray literature were not included as the focus of this umbrella review; it was restricted to peer-reviewed, full-length papers indexed only in PubMed and CINAHL. The titles and abstracts from the literature search were scanned, and only English-language publications that provided quantitative statistical analysis (RRs and ORs) on cancer incidence were retrieved. Meta-analyses or systematic reviews that did not present study-specific summary data using a minimum of 4 randomized controlled trials were excluded.

For the published meta-analyses that were accepted into this review, the following information was extracted and entered into a Microsoft Excel spreadsheet: number of publications included in the meta-analysis, number of total participants, and pooled treatment effects for RRs or ORs. Although not always present, the meta-analyses were also analyzed for their disclosure of quality assessment, statistical heterogeneity (Cochran's Q test and I^2 statistic), and publication bias (visual inspection of funnel plots and Egger or Begg regression test). A methodological quality appraisal was conducted for all meta-analyses using the Critical Appraisal Checklist for Systematic Reviews, which was developed by the Umbrella Review Methodology Working Group.¹⁴ This checklist consists of 10 items, in which each item within the instrument can receive 1 point for an overall quality score that could range from 0 to 10. Meta-analyses with quality scores ranging from 0 to 4 were labeled as low quality, those with scores between 5 and 7 were labeled as medium quality, and those with scores of 8 to 10 were labeled as high quality. Because this is a descriptive summary review of meta-analyses, no statistical analyses were performed.

RESULTS

The initial search strategy identified 88 articles; after careful review, 19 meta-analyses were retrieved for inclusion into this umbrella review.¹⁵⁻³³ A flow chart of the meta-analyses selection process is provided in Figure 1. The 2 meta-analyses by Hajishafiee et al³⁴ and Kim and Je³⁵ were not included in the umbrella review because they used only 2 and 3 clinical studies, respectively, to calculate their effect size on cancer mortality RR.

In regard to the methodological quality of the 19 meta-analyses in this umbrella review, the mean quality appraisal score was 8 of 10, where 14 (74%) meta-analyses scored as high quality; 2 (10%) satisfied medium quality; and 3 (16%) satisfied low quality. These 3 low quality meta-analyses included a paper by Trock et al¹⁵ and 2 papers by Howe et al.^{16,25} Although these 3 meta-analyses have been deemed lower quality, they were still included in this umbrella review because they provide useful information regarding the role dietary fiber has for reducing the incidence of colorectal cancer and breast cancer.

The meta-analyses presented in Tables 1 and 2 are based on dietary surveys, which compare the highest vs lowest daily dietary fiber consumption on the incidence of developing gastrointestinal related cancers (Table 1) and nongastrointestinal cancers, such as breast, prostate, endometrial, and renal cancer (Table 2). However, the meta-analysis by Liu et al³³ was not entered into either table because this was the only meta-analysis that investigated the impact of fiber consumption on cancer mortality and not cancer incidence. This particular meta-analysis assessed 5 clinical studies with a total population of 640,482 participants and provided a hazard ratio of 0.83, which was statistically significant ($P < .05$). There was no statistically significant observation of either heterogeneity or publication bias in this particular meta-analysis.

For populations that consumed the highest dietary fiber intake, the incidence of colorectal cancer was significantly reduced in 4 of the 5 meta-analyses, with the RR ranging between 0.53 and 0.88 for those that were statistically significant (Table 1). However, for 2 of these 4 meta-analyses, statistically significant heterogeneity was observed. The only nonsignificant meta-analysis, by Asano and McLeod,¹⁷ had an RR of 1.04.

Esophageal, gastric, and pancreatic cancers were also significantly reduced in all 5 meta-analyses, with the OR ranging between 0.52 and 0.66 (Table 1). However, statistically significant heterogeneity was observed in 4 of the 5 of these meta-analyses.

The incidence of breast cancer was significantly reduced in all 3 meta-analyses, with the RR ranging between 0.85 and 0.93 (Table 2). Although the incidence of endometrial cancer was significantly reduced (OR = 0.71), the reduction in the incidence of prostate cancer was not statistically significant. Finally, the incidence of renal cell cancer was significantly reduced with an RR of 0.84.

DISCUSSION

When comparing participants with the highest intakes of total dietary fiber to those with the lowest intakes relative to the incidence of developing colorectal cancer, 4 of the 4 meta-analyses in this umbrella review presented statistically significant reductions that ranged between 12% and

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