RESEARCH
Systematic Review

Diet Quality as Assessed by the Healthy Eating Index, Alternate Healthy Eating Index, Dietary Approaches to Stop Hypertension Score, and Health Outcomes: An Updated Systematic Review and Meta-Analysis of Cohort Studies

Lukas Schwingshackl, MSc, PhD; Berit Bogensberger; Georg Hoffmann, PhD

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ABSTRACT

Background Diets of the highest quality have been associated with a significantly lower risk of noncommunicable diseases.

Objective It was the aim of this study to update a previous systematic review investigating the associations of diet quality as assessed by the Healthy Eating Index (HEI), Alternate Healthy Eating Index (AHEI), and Dietary Approaches to Stop Hypertension (DASH) score and multiple health outcomes. As an additional topic, the associations of these diet quality indices with all-cause mortality and cancer mortality among cancer survivors were also investigated.

Design A literature search for prospective cohort studies that were published up to May 15, 2017 was performed using the electronic databases PubMed, Scopus, and Embase. Summary risk ratios (RRs) and 95% CIs were estimated using a random effects model for high vs low adherence categories.

Results The updated review process showed 34 new reports (total number of reports evaluated=68; including 1,670,179 participants). Diets of the highest quality, as assessed by the HEI, AHEI, and DASH score, resulted in a significant risk reduction for all-cause mortality (RR 0.78, 95% CI 0.77 to 0.80; I^2=59%; n=13), cardiovascular disease (incidence or mortality) (RR 0.78, 95% CI 0.76 to 0.80; I^2=49%; n=28), cancer (incidence or mortality) (RR 0.84, 95% CI 0.82 to 0.87; I^2=66%; n=31), type 2 diabetes (RR 0.82, 95% CI 0.78 to 0.85; I^2=72%; n=10), and neurodegenerative diseases (RR 0.85, 95% CI 0.74 to 0.98; I^2=51%; n=5). Among cancer survivors, the association between diets for the highest quality resulted in a significant reduction in all-cause mortality (RR 0.88, 95% CI 0.81 to 0.95; I^2=38%; n=7) and cancer mortality (RR 0.90, 95% CI 0.83 to 0.98; I^2=0%; n=7).

Conclusions In the updated meta-analyses, diets that score highly on the HEI, AHEI, and DASH were associated with a significant reduction in the risk of all-cause mortality, cardiovascular disease, cancer, type 2 diabetes, and neurodegenerative disease by 22%, 22%, 16%, 18%, and 15%, respectively. Moreover, high-quality diets were inversely associated with overall mortality and cancer mortality among cancer survivors.

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IN FEBRUARY 2015, A SYSTEMATIC REVIEW AND META-analysis of prospective cohort studies investigating the associations between diet quality, as assessed by the Healthy Eating Index (HEI), Alternate Healthy Eating Index (AHEI), and Dietary Approaches to Stop Hypertension (DASH) score, and the risk of all-cause mortality, cardiovascular disease mortality or events, cancer mortality or incidence, type 2 diabetes, and neurodegenerative diseases was published.[1] Diets of the highest quality were associated with a lower risk of all-cause mortality, cardiovascular disease, cancer, and type 2 diabetes.[1] However, due to the large number of studies that have been published since the release of the previous meta-analysis, it seems important to update the original analysis.

According to the National Cancer Institute, the number of cancer survivors is growing rapidly, with an estimated number of 26.1 million by 2040 compared to 15.5 million in 2016.[2] Due to the urgent need to establish evidence-based nutrition recommendations for cancer survivors, it was decided not only to re-execute the original search, but to

include associations between diet quality and risk of mortality in cancer survivors as an additional research question.

Therefore, the aim of this study was to update the previous systematic review and meta-analysis conducted in prospective cohort studies that investigated the association of diet quality as assessed by the HEI, AHEI, and DASH score and health status (risk of all-cause mortality, cardiovascular disease mortality or incidence, cancer mortality or incidence, type 2 diabetes, and neurodegenerative disease). The second objective of this study was to summarize the evidence of diet quality as assessed by the HEI, AHEI, and DASH score and the risk of all-cause mortality and cancer mortality among cancer survivors.

RESEARCH SNAPSHOT

Research Question: Does diet quality, measured in term of the Healthy Eating Index, the Alternate Healthy Eating Index, and the Dietary Approaches to Stop Hypertension score, influence health status?

Key Findings: In this updated systematic review and meta-analysis of 68 reports including 1,670,179 participants, diets that score highly were associated with a significant reduction in the risk of all-cause mortality (22%), cardiovascular disease (22%), cancer (16%), type 2 diabetes (18%), and neurodegenerative disease (15%). High-quality diets were also associated with a significant reduction in the risk of overall mortality (12%) and cancer mortality (10%) among cancer survivors.

METHODS

The systematic review protocol of the previous meta-analysis is registered in PROSPERO International Prospective Register of Systematic Reviews (crd.york.ac.uk/prospero/index.asp Identifier: CRD42013006561). The protocol has meanwhile been adapted to the updated version of this systematic review.

Data Sources and Searches

A literature search was performed to identify studies published from May 2014 up to May 15, 2017 using the electronic databases PubMed, Embase, and Scopus. For PubMed, the following search terms were used: *healthy* [All Fields] AND (*eating* [medical subject heading {MeSH} Terms] OR *eating* [All Fields]) AND (*abstracting and indexing as topic* [MeSH Terms] OR (*abstracting* [All Fields] AND *indexing* [All Fields] AND *topic* [All Fields]) OR *abstracting and indexing as topic* [All Fields] OR *index* [All Fields]) OR (*dash* [All Fields] AND (*diet* [MeSH Terms] OR *diet* [All Fields]).

The literature search investigating the association of diet quality indices and all-cause mortality and cancer mortality among cancer survivors was based on a recently published meta-analysis[3] using Scopus as an additional database and was updated to include studies published up to May 15, 2017. The following search terms were used for PubMed: (*healthy* [All Fields] AND (*eating* [MeSH Terms] OR *eating* [All Fields]) AND (*abstracting and indexing as topic* [MeSH Terms] OR (*abstracting* [All Fields] AND *indexing* [All Fields] AND *topic* [All Fields]) OR *abstracting and indexing as topic* [All Fields] OR *index* [All Fields]) OR (*dash* [All Fields] AND (*diet* [MeSH Terms] OR *diet* [All Fields]) AND (*cancer* [All Fields]) AND (*survivors* [All Fields] OR *survivor* [All Fields] OR *recurrence* [All Fields] OR *mortality* [All Fields]) AND (*prospective* [All Fields] OR *cohort* [All Fields] OR *longitudinal* [All Fields] OR *follow up* [All Fields]).

Both search strategies had no language restrictions. Moreover, the reference lists from retrieved articles were checked to search for further relevant studies. Literature searches were conducted by one author (L.S.), with questions or uncertainties resolved by discussion with another author.

Study Selection

Prospective cohort studies were included in the meta-analysis if they met all of the following criteria: evaluated the association of diet quality as assessed by the HEI, and/or AHEI, and/or DASH score on all-cause mortality, and/or cardiovascular disease mortality or incidence, and/or cancer mortality or incidence, and/or type 2 diabetes, and/or neurodegenerative disease; presented risk ratios (RRs) and/or hazard ratios (HRs) with corresponding 95% CI. In addition, the meta-analysis was expanded to include cancer survivors from cohort studies investigating the association of diet quality as assessed by the HEI, and/or AHEI, and/or DASH score and all-cause mortality and/or cancer mortality among cancer survivors. Detailed description of study selection is reported in the previous version,[1] the same study selection strategy was used for the additional research questions of the updated systematic review.

Data Extraction and Quality Assessment

The following data were extracted from each study as reported in the previous version[1]: the first author's last name, year of publication, study origin, cohort name, outcome parameter, sample size, study length (follow up in years), age at entry, sex, diet quality score, adjustment factors, study quality score, and risk estimates (most adjusted HR or RR or highest vs lowest category) with their corresponding 95% CIs. The Newcastle-Ottawa Quality Assessment Scale[4] was used to assess study quality. Data extraction and quality assessment were performed by one author and checked by another (B.B.) for accuracy.

HEI, AHEI, and DASH Components and Scoring

A detailed description of the HEI[5-10] (HEI-2005[11-23] and HEI-2010[24-37]), AHEI[5,12,15,38-51] (AHEI-2010[11,20,23,25-33,35,36,52-59]), and DASH score[9,12,20,21,25-36,40,44-47,54-57,59-72] and its different updates and modifications are reported in the previous version of the systematic review.[1,11]

Statistical Analysis

The meta-analysis was performed by combining the multivariable adjusted RRs, HR, or ORs of the highest compared with the lowest quantiles of HEI, AHEI, and DASH scores conformance category based on random-effects model using the DerSimonian-Laird method.[73] Because outcomes were not very rare and heterogeneity modeling was deemed important, the random-effects model was used. To evaluate the weighting of each study, the standard error for the logarithm HR/RR/OR of each study was calculated and regarded as the estimated variance of the logarithm HR/RR/OR, using