

Dietary Fibre for the Prevention of Cardiovascular Disease

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Abstract

Cardiovascular disease (CVD) remains the major cause of mortality worldwide. The importance of diet in optimising cardiovascular health has been illustrated in various studies. The role of dietary fibre in CVD prevention remains debatable. Dietary fibre helps to reduce total cardiovascular risk by engendering better cholesterol level and blood pressure, for example. The observed benefits, particularly for CVD mortality, seem to correlate with the level of dietary fibre intake in a dose-response fashion. Total aversion to foods with carbohydrates could potentially restrict the sources of dietary fibre that are available, particularly whole grain products which are recommended in the Mediterranean diet and the Eat-Lancet report on healthy diets. Further high-quality nutrition research is required to discern the absolute benefits of dietary fibre for CVD prevention. This may have implications for total healthcare expenditure, by means of public health and prevention policy that would serve to reduce the global burden of CVD.

Keywords: cardiovascular disease; dietary fibre; prevention; carbohydrates

Introduction

Cardiovascular disease (CVD) remains the major cause of death worldwide¹. Diet has been shown in various studies to be an integral player for the development of CVD, notably in the landmark INTERHEART study that comprised 52 countries globally². The importance of healthy diet is emphasised in the European guidelines on CVD prevention in clinical practice³. One particular dietary group that has gained traction in recent years is dietary fibre (hereafter termed 'fibre'). There have been numerous studies on the mechanisms of fibre in promoting cardiovascular health, although the full, and perhaps the exact, mechanisms have yet to be adjudicated⁴.

As the global burden of CVD escalates, prospective nutrition research pertaining to cardiovascular health is required to bolster the ongoing efforts in CVD prevention. This applies to both primary and secondary prevention of CVD. Fibre may serve as a promising strategy for augmenting CVD prevention. Indeed, foods that constitute a heart-healthy diet are often enquired in the clinical setting. This occasional piece aims to evaluate the benefits of fibre for CVD prevention, to discuss several diets from the perspective of fibre found in carbohydrates, and to identify gaps amid the available literature that may be amenable to future research.

Discussion

Fibre and cardiovascular disease prevention

A Cochrane review examined the role of fibre for the primary prevention of CVD⁵. The review included 23 randomised controlled trials (RCTs). Increased fibre intake was associated with a reduction in total cholesterol and low-density lipoprotein (LDL) cholesterol levels. This observed benefit did not apply to triglycerides or high-density lipoprotein cholesterol, however.

The effect of fibre on blood pressure (BP) generated more ambiguity, as results were significant only for diastolic BP. This review, though comprehensive, was not without limitations. There was a high degree of bias and heterogeneity between studies. The sample size of individual studies was small and, importantly, study duration was relatively short (mostly 12 weeks). Whether the benefits observed can be extrapolated beyond the mean duration of studies included in the review are unascertained and should be explored.

A meta-analysis of 15 prospective cohort studies provided an insight into the level of fibre intake and CVD mortality⁶. Fibre intake was shown to be inversely associated with CVD mortality in a discernible dose-response fashion. Ten grams per day increment in fibre intake was associated with a 9% relative risk reduction in CVD mortality. Confounding factors cannot be excluded due to the non-randomised nature of the studies analysed. Furthermore, conclusions drawn from food frequency questionnaire-based nutrition studies would be subject to recall bias and should be interpreted with caution.

While the focus of research has mostly been on primary prevention, there is a relative paucity of literature for fibre in the secondary prevention of CVD. A prospective cohort study of 716 post-coronary intervention patients specifically evaluated the use of oat fibre and subsequent cardiovascular outcomes⁷. The study illustrated that those who consumed two to four portions of products with oat fibre (e.g. breakfast cereals) daily for 26.75 ± 8.11 months had a more favourable biochemical profile, including lower LDL cholesterol and triglycerides levels. These individuals were also 38% less likely to develop future cardiovascular events. The effects observed may not be generalisable to other sources of fibre. Nevertheless, this study provided an insight into the plausible role of fibre beyond primary prevention of CVD.

Fibre in carbohydrates

A varying amount of fibre is generally found in foods that contain carbohydrates; however, fibre contents may be reduced in certain diets such as the low-carb diet. Kwok and colleagues reviewed the relationship between several dietary components and their risk of CVD and all-cause mortality⁸. For carbohydrates, a dose-related cardiovascular health benefit was evident for whole grain breads, whole grain breakfast cereals and bran, all of which are high in fibre. This benefit also applied to fibre when analysed in isolation. Seven grams of fibre consumption per day was associated with a 9% relative risk reduction for CVD. Other food groups with fibre (e.g. fruits and vegetables) also demonstrated similar benefits. This review exemplified the potential need to shift the emphasis on carbohydrates when considering cardiovascular health, from focusing on the quantity of carbohydrates to its quality counterpart.

Reynolds and colleagues examined the evidence base for quantitative recommendations for fibre intake, as well as the predictive potential of several markers of carbohydrate quality⁹. Their review included both prospective cohort studies and RCTs. High intakes of total fibre were associated with a decrease in cardiovascular-related mortality, in addition to an improvement in total cholesterol level, systolic BP and bodyweight. Detailed dose-response curve analyses showed that the higher the fibre intake, the better the protective benefits of fibre against CVD. The greatest benefit for CVD risk reduction was seen in daily fibre intake between 25 and 29 grams; however, benefits may also be evident beyond 29 grams. Data on whole grains were specifically explored and similar cardiovascular health benefits were identified. Conversely, several markers that had been used in previous studies to determine carbohydrate quality (e.g. glycaemic index and sources of fibre) were found to be of less importance when addressing CVD risk reduction. This review further supported the notion that the quality, not quantity, of carbohydrates may be of greater significance for optimising cardiovascular health.

Mediterranean diet and plant-based diet

The Mediterranean diet does not enforce tight restriction on carbohydrates intake. Instead, the consumption of whole grain products (e.g. bread, pasta and cereals), as far as carbohydrates are concerned, are recommended. These foods, together with fruits and vegetables which are also key constituents of the Mediterranean diet, are valuable sources of fibre. The effectiveness of Mediterranean diet for the primary and secondary prevention of CVD was summarised in a Cochrane review¹⁰. Despite illustrating benefits for modifying CVD risk factors in primary prevention, the quality of evidence was perceived to be low or moderate. This remains to be determined for secondary prevention due to a dearth of available studies. The comprehensive Eat-Lancet report by Willett and colleagues recommended a “planetary health diet” to reduce the number of non-communicable diseases globally, which include CVD¹¹. It is worth noting that the proposed diet, similar in part to the Mediterranean diet, is predominantly plant-based and encourages the consumption of select carbohydrates (e.g. whole grain products) to attain sufficient daily fibre intake.

Implications for clinical practice

Fibre could play a role in mitigating total healthcare expenditure by reducing the national burden of CVD. A Canadian cost-of-illness analysis¹², which assessed the potential annual savings in healthcare costs from a reduction in CVD incidence secondary to fibre consumption, found that every one gram per day increase in fibre consumption resulted in annual \$4.6 to 92.1 million Canadian dollars savings for CVD. Such finding may help to augment future public health and prevention policy, thereby targeting and resolving the time loss, as well as the costs accrued, secondary to cardiovascular events¹³.

Admittedly, a strong evidence base for fibre in optimising cardiovascular health is lacking. Future fibre research should strive to: 1) include larger sample sizes; 2) be randomised with regard to study design although this is not without inherent challenges; 3) have a longer study duration; and 4) standardise research outcomes for better comparison between studies. Notwithstanding the importance of evidence-based healthy diet, dietary advice should ideally be tailored to individuals' needs, which include underlying medical conditions such as diabetes mellitus and Coeliac disease. Educational initiatives targeted at the general public would help to improve fibre intake at the population level, the amount of which has remained relatively static over the years based on global cross-sectional data^{14,15}.

Conclusion

There is evidence supporting fibre as an effective preventive measure for CVD. In particular, whole grain products have illuminated favourable cardiovascular health benefits in various studies and should be recommended. The observed benefits of fibre seem to correlate with the amount consumed, as suggested by the dose-response phenomenon. It is apparent that the quality, not quantity, of carbohydrates matters more to achieve optimal daily fibre consumption. Mindful selection of foods that are rich in fibre, including those with carbohydrates, may help to improve cardiovascular health accordingly. Future scholarly efforts of higher methodological quality involving fibre are required to advance the science of CVD prevention and to reduce the global burden of healthcare expenditure attributable to cardiovascular events.

Declaration of Conflicts of Interest:

None declared.

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References:

1. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. *J Am Coll Cardiol*. 2017;70:1-25.
2. Iqbal R, Anand S, Ounpuu S, Islam S, Zhang X, Rangarajan S, et al. Dietary patterns and the risk of acute myocardial infarction in 52 countries: results of the INTERHEART study. *Circulation*. 2008;118:1929-1937.
3. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J*. 2016;37:2315-2381.
4. Grundy MM, Edwards CH, Mackie AR, Gidley MJ, Butterworth PJ, Ellis PR. Re-evaluation of the mechanisms of dietary fibre and implications for macronutrient bioaccessibility, digestion and postprandial metabolism. *Br J Nutr*. 2016;116:816-833.

5. Hartley L, May MD, Loveman E, Colquitt JL, Rees K. Dietary fibre for the primary prevention of cardiovascular disease. *Cochrane Database Syst Rev.* 2016;1:CD011472.
6. Kim Y, Je Y. Dietary fibre intake and mortality from cardiovascular disease and all cancers: a meta-analysis of prospective cohort studies. *Arch Cardiovasc Dis.* 2016;109:39-54.
7. Wu JR, Leu HB, Yin WH, Tseng WK, Wu YW, Lin TH, et al. The benefit of secondary prevention with oat fiber in reducing future cardiovascular event among CAD patients after coronary intervention. *Sci Rep.* 2019;9:3091.
8. Kwok CS, Gulati M, Michos ED, Potts J, Wu P, Watson L, et al. Dietary components and risk of cardiovascular disease and all-cause mortality: a review of evidence from meta-analyses. *Eur J Prev Cardiol.* 2019;26:1415-1429.
9. Reynolds A, Mann J, Cummings J, Winter N, Mete E, Te Morenga L. Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *Lancet.* 2019;393:434-445.
10. Rees K, Takeda A, Martin N, Ellis L, Wijesekara D, Vepa A, et al. Mediterranean-style diet for the primary and secondary prevention of cardiovascular disease. *Cochrane Database Syst Rev.* 2019;3:CD009825.
11. Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet.* 2019;393:447-492.
12. Abdullah MM, Gyles CL, Marinangeli CP, Carlberg JG, Jones PJ. Cost-of-illness analysis reveals potential healthcare savings with reductions in type 2 diabetes and cardiovascular disease following recommended intakes of dietary fiber in Canada. *Front Pharmacol.* 2015;6:167.
13. Kotseva K, Gerlier L, Sidelnikov E, Kutikova L, Lamotte M, Amarenco P, et al. Patient and caregiver productivity loss and indirect costs associated with cardiovascular events in Europe. *Eur J Prev Cardiol.* 2019;26:1150-1157.
14. King DE, Mainous AG 3rd, Lambourne CA. Trends in dietary fiber intake in the United States, 1999-2008. *J Acad Nutr Diet.* 2012;112:642-648.
15. Wang HJ, Wang ZH, Zhang JG, Du WW, Su C, Zhang J, et al. Trends in dietary fiber intake in Chinese aged 45 years and above, 1991-2011. *Eur J Clin Nutr.* 2014;68:619-622.