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# Commentary: The rough world of nutritional epidemiology: Does dietary fibre prevent large bowel cancer?

Debbie A Lawlor and Andy R Ness

‘Nutritional information seems awash with conflicting and contradictory messages, so it can be comforting to cling to advice that appears constant. One concept on which the nutritional cognoscenti are united is the value of eating a diet rich in fibre.’<sup>1</sup>

This quote from a doctor writing in a British broadsheet newspaper illustrates many of the problems faced by nutritional epidemiologists and health practitioners who try to determine the health damaging and health promoting aspects of a population’s diet and provide appropriate dietary advice to its members.<sup>1</sup> No doubt this doctor will be frustrated if he reads today’s volume of the *International Journal of Epidemiology* (IJE) in which the findings of a prospective cohort study by Mai *et al*. suggest that diets rich in dietary fibre are not protective against colorectal cancer.<sup>2</sup>

Burkitt is credited with first proposing that dietary fibre was protective against colorectal cancer and other gastrointestinal problems including diverticular disease and appendicitis.<sup>3,4</sup>

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However, discussions about the value of white (of low fibre content) and brown (of high fibre content) bread date back to antiquity. Interestingly, Hippocrates, in the 5th century BC, believed white bread to be more nutritious:

‘Wholemeal bread cleans out the gut and passes through as excrement. White bread is more nutritious as it makes less faeces.’<sup>5</sup>

In England the notion that wholemeal bread was good for health had emerged by the late 1500s, with Peter Stubbs writing in 1585

‘doe we not see the poore man that eateth browne bread healthe fuller, stronger, fayrer complectioned and longer living than the other that faredaintelie every day.’<sup>6</sup>

In 1683 Tyron wrote a book about the value of wholemeal bread, stating that it was the most important way to a long and happy life.<sup>7</sup> In the US in 1837 Sylvester Graham wrote on the importance of wholemeal bread as a natural food, and to this day wholemeal bread in the States is known as Graham bread.<sup>8</sup>

Wholemeal bread, known at that time in England as Graham bread, became popular among the upper classes, for the first time, when Queen Victoria took to eating it in 1847.<sup>5</sup>

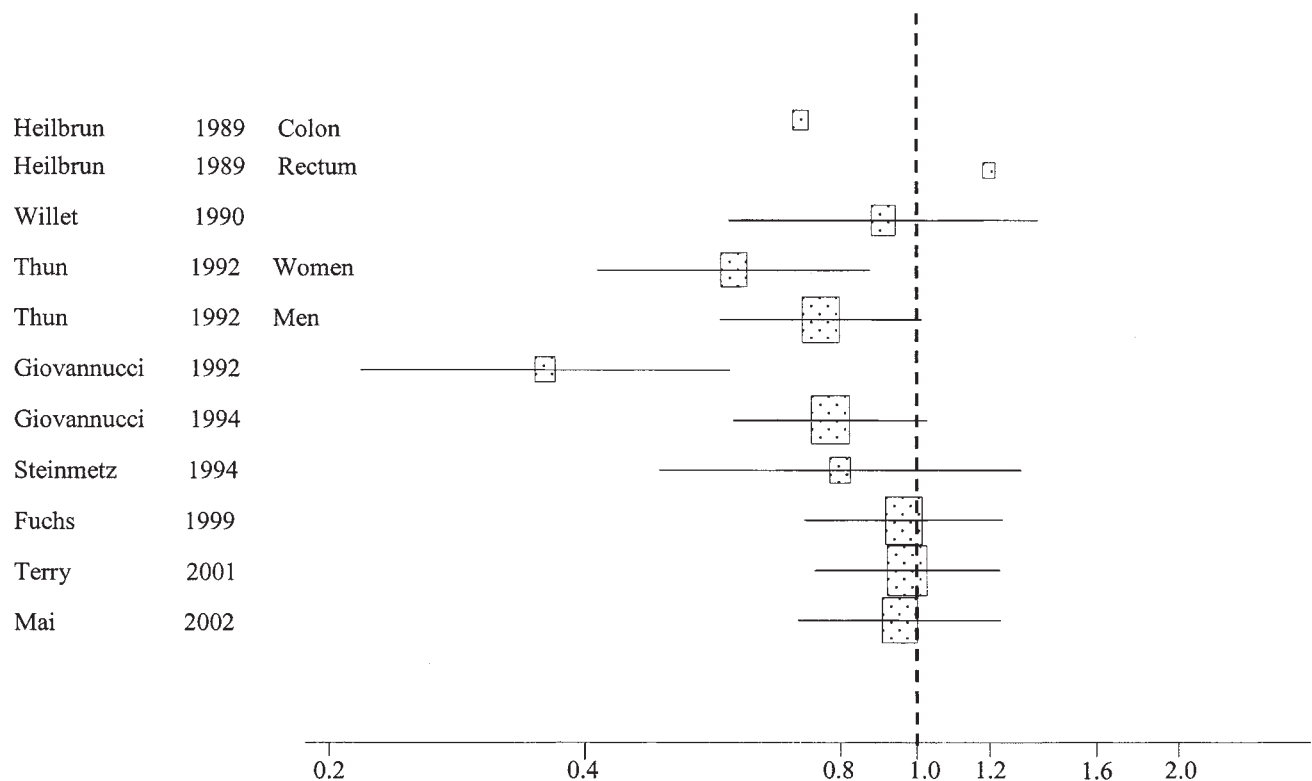
## Evidence from observational studies

The study by Mai *et al.* reported in this issue of the IJE examined the association between dietary fibre, estimated using a 62-item food frequency questionnaire, and colorectal cancer risk among 45 491 women who participated in the Breast Cancer Detection and Demonstration Project.<sup>2</sup> During a mean follow-up time of 8.5 years they observed no association between total dietary fibre and colorectal cancer; neither was there an association between specific types of dietary fibre and cancer nor between dietary fibre and cancer at different sites. Several limitations of this study may explain its null findings, and these are fully discussed by the authors. The mean fibre intake even amongst women in the highest quintile of intake in this study (16.7 g/day) was below the daily intakes recommended by US and UK advisory bodies (18–30 g/day),<sup>9,10</sup> and considerably lower than the amounts that Burkitt first proposed were necessary to protect against cancer (70 g/day).<sup>4</sup> Thus it may be that none of the women were consuming sufficient fibre to confer a protective effect. Misclassification may also have biased the results towards the null. Although there is debate about the validity of food frequency questionnaires, the degree of regression-dilution in estimating diet–disease outcomes may be considerable,<sup>11–14</sup> and there were no repeat measures of dietary intake over the follow-up period.

A number of, largely hospital-based, case-control studies have found that dietary fibre is inversely associated with colorectal cancer,<sup>15,16</sup> but the results from nested case-control studies or prospective cohort studies have been inconsistent, though results from three recent large studies, including that presented in today's IJE by Mai *et al.*, show no real benefit (Figure 1).<sup>17–24</sup> The differences between these studies may be due to the heterogeneous nature of fibre and differences in the ways in which fibre has been measured in different studies. The strong inverse association found in the US health professionals study<sup>20</sup> was for cancers occurring within the first 2 years of dietary assessment and it is possible that some individuals who developed cancer already had symptoms at baseline and had adjusted their diets to relieve these. A longer, 6-year follow-up, of the same cohort found that the association was considerably weaker than that reported earlier.<sup>21</sup> Although recent studies showing little or no protective effect of dietary fibre<sup>21–23</sup> have been large and well-conducted, these null results may at least in part be explained by the low overall mean fibre intake in the study populations and regression-dilution bias as discussed above.

## Evidence from randomized controlled trials

It is difficult to make sense of the findings from these observational studies. Dietary fibre may be protective but poor assessment tools and lack of repeat measures in most studies may bias the estimates towards the null. On the other hand it is possible that the protective effects in some studies are due to



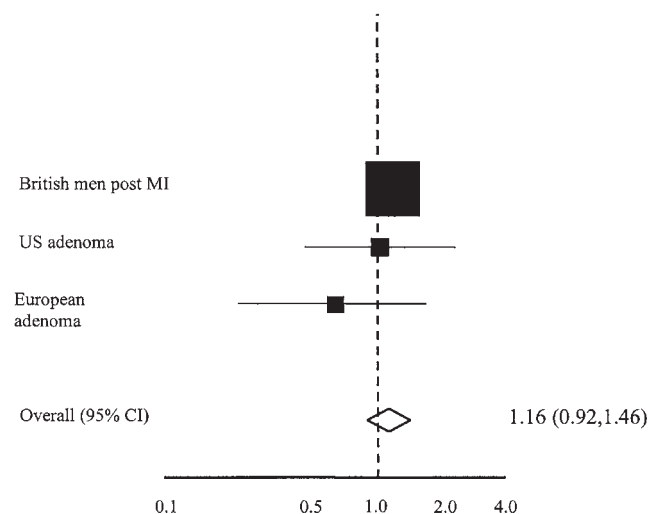
**Figure 1** Relative risks (95% CI) comparing highest with lowest intakes of dietary fibre in nested case-control and prospective cohort studies. Produced using results from references 14–21

confounding. Randomized controlled trials could clarify this and are feasible. Dietary fibre intake can be substantially increased by simply adding a bran supplement to the diet or advising people to make simple changes such as switching to a high fibre breakfast cereal and changing to wholemeal bread, without the need for altering other aspects of the diet.<sup>25</sup> To date there have been five randomized trials of dietary fibre in high-risk patients—those with a previous history of an adenomatous polyp but no previous history of cancer.<sup>26</sup> None of these trials has found fibre to be effective at reducing the recurrence of polyps or the occurrence of colorectal cancer.<sup>26</sup> The follow-up time in these trials was 3–4 years and it is possible that a longer period is required for a protective effect to be detected. It is also possible that fibre may have a protective effect earlier in the disease process so that once adenomatous polyps have formed it is no-longer effective.

Mai *et al.* conclude that although their results suggest that fibre is not protective against bowel cancer the public should still be encouraged to consume a high fibre diet since there is good evidence that it is protective against cardiovascular and other chronic diseases.<sup>2</sup> However, if fibre really is protective against heart disease and cancers (the two biggest killers in the Western world) then one would expect it to have an important impact on all-cause mortality. To date randomized trials have found no evidence that dietary fibre confers any short-term benefit on all-cause mortality (Figure 2).<sup>27–29</sup> Indeed, a large study on British men post myocardial infarction suggested, if anything, that mortality was higher among those allocated to dietary advice aimed at increasing fibre consumption.<sup>27</sup>

## Why was fibre thought to protect against colorectal cancer?

Burkitt's original hypothesis was that colorectal cancer, benign bowel tumours, diverticular disease, and appendicitis all shared a common aetiology: low levels of dietary fibre.<sup>3,4</sup> This



**Figure 2** Pooled relative risk (95% CI) of all-cause mortality from randomized controlled trials of dietary fibre that reported on mortality

suggestion was largely based on geographical comparisons. He noted that in the 1960s the age-standardized incidence rate for colorectal cancer among men aged 35–64 years varied from 3.5/100 000 in Uganda and 5.3/100 000 in Moçambique to 51.5/100 000 in Scotland and 51.8/100 000 in Connecticut, USA. Although Burkitt did not have data on dietary fibre intake for any of these countries his hypothesis was supported by his own knowledge of typical diets in Africa, Europe, and the US, and substantiated by his studies showing marked differences in bowel transit times between Africans and Europeans and in mean daily stool weight (500 g for African village children, 200 g for African children in missionary boarding schools, and 100 g for children in English boarding schools in one of Burkitt's studies).<sup>4</sup> Further, he noted that African Americans had bowel cancer rates similar to those of European Americans, strongly suggesting environmental factors in its aetiology.

Epidemiologists are aware of the limitations of ecological studies and the need for individual-based analytical studies to provide good evidence of causation. At the same time, as Burkitt pointed out, and others have recently re-emphasized, explaining population differences in disease occurrences is also important.<sup>3,30</sup> African populations today continue to experience lower levels of bowel cancer than Western populations,<sup>31</sup> and the question remains as to whether this is due to differences in dietary patterns, and if so, what particular features of the diet are healthy or unhealthy.

Many people believe that the dietary habits adopted by Western societies over the last 150 years make important contributions to colorectal and other cancers, hypertension, diabetes, and coronary heart disease. It has been suggested that humans evolved to consume a Paleolithic diet (high animal protein, high fibre, low refined carbohydrate), and that we are therefore genetically determined to eat diets very different to those of today's Western societies.<sup>32</sup> Recent evidence has challenged the idea that Paleolithic diets were high in animal fat and protein but the fibre content is likely to have been high.<sup>33–35</sup> However, the fibre in Paleolithic diets was certainly of plant origin rather than cereal fibre that has been the major source of dietary fibre in Western and African diets for several hundred years.<sup>33–35</sup> To this extent the notion that we need to consume a diet closer to our earliest origins is not consistent with Burkitt's hypothesis which was based on dietary fibre derived largely from cereals.<sup>3,4</sup> The differences in dietary fibre content noted by Burkitt continue to present times. The mean consumption of cereal and starchy foods in Sub-Saharan Africa and South Asia greatly exceed those of Europe, the US, Australia, and New Zealand. However, the consumption of fruit and vegetables is considerably lower in Sub-Saharan Africa and South Asia than it is in Western countries.<sup>36</sup> Ecological data does not, therefore, suggest that fibre or other nutrients from fruit and vegetables protect against bowel cancer. Further, large cohort studies, including results from the Breast Cancer Detection and Demonstration Project published elsewhere suggest that fruit and vegetable consumption does not protect against colon cancer.<sup>37–39</sup>

## Conclusions

Thus, although the ecological differences in bowel cancer rates and consumption of cereal based dietary fibre noted over 30 years

ago by Burkitt persist, recent evidence from prospective cohort studies and randomized controlled trials suggest that the two are not causally related. Examining ecological differences in disease can provide epidemiologists with clues as to the aspects of a population's habits that are health protective and those which are damaging to health. Further work is required to determine what aspect or aspects of African life styles protect from bowel cancer.

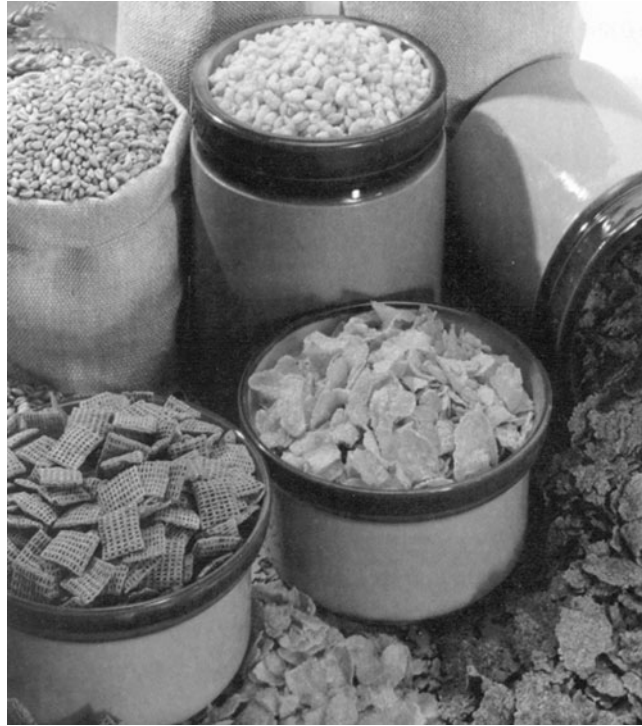
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High fibre cereals may not be all that good for you after all