

# Is the link between nutrients and foods understood? The case of fibre and folate

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## Abstract

**Objectives:** To assess and contrast awareness of the link between dietary fibre and folate and their major food sources (fruit, vegetables, bread and cereals).

**Design and setting:** Mailed questionnaire investigating changes made to dietary intake of fibre, folate, fruit, vegetables, bread and cereals in the previous six months.

**Setting:** The survey was conducted between June and November 1998 in the Australian Capital Territory.

**Subjects:** One thousand one hundred and twenty-six adults randomly selected from the electoral roll.

**Results:** More women than men in both older (50+ years) and younger (18–49 years) age groups reported increasing their consumption of folate, fibre, fruit and vegetables in the prior six months. In contrast, more men than women reported increased consumption of bread, cereals, rice and pasta in the previous six months. For food categories and fibre, less than 4% of respondents were unsure about changes in these food habits. However, 26% of men and women were ‘not sure’ about changes to folate intake. Similar proportions of men and women (about 33%) reported consuming more fruit, vegetables or cereal-based foods over the prior six months, yet only 6% of these men and 14% of these women reported consuming more folate. In contrast, 44% of men and 51% of women who reported consuming more plant foods also reported consuming more dietary fibre.

**Conclusions:** The results suggested that subjects, particularly the younger age group, had a poor understanding of the relationship between folate intake and its major food sources. The understanding of the relationship between fibre intake and its food sources appeared substantial, but confusion about specific food sources was still evident. These outcomes question the effectiveness of nutrition education used to date, particularly for the current priority of increasing folate intake in younger women in the new, ‘health claims’ environment.

**Keywords**  
Folate  
Fibre  
Health claims  
Beliefs

For 20 years Australia’s dietary references<sup>1–7</sup> have provided the framework for consistent public health messages promoting the foundations for a healthy diet: variety, increased consumption of plant-based foods (fruit, vegetables, bread and cereals), and decreased or moderate consumption of fat, sodium, alcohol and added sugars. Whereas Dietary Guidelines *per se*<sup>6,7</sup> define the desired attributes of the total diet, most nutrition promotion programmes have focused on single messages, usually expressed as a single nutrient or food component (e.g. fat, fibre, iron, folate) and sometimes as particular foods (e.g. milk, red meat, fruit and vegetables). When focused on nutrients, these narrow campaigns often give incomplete messages about the association between nutrients and their food sources (e.g. iron and red meat,

cereal based-foods and dietary fibre, saturated fats and animal foods, calcium and milk). Such single-focus nutrition education leaves it to the public to reconcile different and potentially conflicting messages (e.g. reconciling ‘red meats are important for adequate iron intake’ with ‘reduce animal fats’).

The potential for confusion and inappropriate interpretation of food–nutrient relationships may be exacerbated by the fortification and promotion of selected groups of foods with specific nutrients. In 1995 the Australian food regulatory body, the Australian New Zealand Food Authority (ANZFA), relaxed the regulations on the addition of vitamins and minerals to foods<sup>8</sup>. In 1998, ANZFA introduced a food–nutrient–health claims trial focused particularly on improving folate intake by

women of childbearing age<sup>9–11</sup>. Whereas fortification of foods is a strategy employed in a number of countries, the concurrent use of health claims is new to Australia, and still uncommon in Western countries.

By comparison, dietary fibre and its food sources (fruit, vegetables, bread and other cereal-based foods) have been promoted in public health education in Australia for close to 20 years. This promotion has been particularly strong in the last 15 years, as the evidence linking improved health with increased consumption of dietary fibre has mounted. Higher fibre products, particularly of cereal-based foods, have also been introduced on to the market. Although there is little evidence of the effectiveness of education about food sources of dietary fibre, there is some evidence that consumer understanding is good<sup>12,13</sup>, and the food link (plant foods) is a simple message.

The aim of this study was to assess self-reported changes in consumption of fibre, folate, fruit, vegetables, bread and cereals, and to compare the current awareness of the food–folate and food–fibre links. An understanding of consumer awareness of food–nutrient links is important in terms of targeting future nutrition education, and for revision of current education approaches to increase the efficacy of the public health effort.

## Methods

### *Design and subjects*

One thousand one hundred and twenty-six adults completed a questionnaire mailed to a random sample of 2000 adults from the Australian Capital Territory (ACT) electoral roll. An election, two months prior to the study, required all citizens aged 18 years and over to register for the roll, ensuring it was up-to-date. While new migrants are not eligible for inclusion, the electoral roll represents the most complete register of adults available, and is widely used for population-based public health studies. The initial questionnaire and explanatory letter were sent out in July 1998. For those who did not respond, a reminder letter followed after three or four weeks. If necessary, a further letter and another copy of the original questionnaire were sent out after a further two to three weeks. Eighty-five questionnaires were undeliverable, and another 32 people were overseas or incapable of completing the questionnaire (effective response rate of 60%). The study was approved by the University of Canberra's Committee for Ethics in Human Research.

### *Measures*

A questionnaire was developed based on a review of the literature, including of instruments and recommendations for measures for use in monitoring and surveillance of knowledge, attitudes and behaviours<sup>14–16</sup>. The questionnaire collected information about changes made to dietary intake (i.e. 'In the past six months, have you

made any changes to any of the following in your diet?', and options of 'eat more', 'eat less', 'haven't changed', 'not sure') of nine nutrients and foods in the past six months (including fibre, folate, fruit (excluding juice), vegetables and/or salads, bread and/or cereals), as well as relevant demographic characteristics. The term 'folate' was used in the questionnaire as it was the term currently in use on food labels and education materials. The questionnaire was pre-tested on adults for reliability, respondent acceptability in terms of language, instructions, and the average, and range of times, for completion.

### *Data analysis*

Respondents were categorised into two groups, those aged less than 50 years (younger) and those aged 50 years and older (older). This division is consistent with the median age of menopause in Western women<sup>17,18</sup>. Analysis was performed using SPSS PC, Version 8.0 (SPSS Inc., Chicago, IL). Analyses of variance were used for continuous variables and  $\chi^2$  tests were made for unpaired categorical data. An alpha level of  $P < 0.05$  was adopted for statistical comparisons. The kappa statistic (i.e. chance-corrected proportional agreement) was used to measure agreement between responses to the changes in nutrients and the changes in foods (an unweighted kappa value of  $<0.2$  indicates poor agreement, kappa =  $0.2–0.4$  indicates fair agreement and kappa =  $0.4–0.6$  indicates moderate agreement<sup>19</sup>). Results are presented as mean  $\pm$  standard deviation unless indicated otherwise.

## Results

### *Profile of participants*

Forty-eight per cent of participants were male and 52% female. The mean age of males was 45 ( $\pm 15.6$ ) years, with 63% aged less than 50 years (mean 35  $\pm$  9.2 years) and 37% aged 50 years or older (mean 61  $\pm$  9.1 years). For women, the mean age was 42 ( $\pm 15.6$ ) years with 69% aged less than 50 years (mean 34  $\pm$  8.9 years) and 31% aged 50 years or older (mean 61  $\pm$  9.6 years). Forty-four per cent of younger males and 41% of younger females ( $<50$  years) had a university qualification, a further 33% and 32% respectively having completed secondary education. For those older participants (50+ years), 19% of males and 30% of females had completed secondary school with 45% of males and 33% of females having completed a university degree. Sixteen per cent of both younger men and women had technical or trade qualifications compared with 21% and 15% of older men and women, respectively. Education levels were significantly different between men and women ( $P = 0.007$ ), as were differences between the age groups (men  $P < 0.001$ ; women  $P = 0.013$ ).

**Table 1** Dietary change in intake of fruit, vegetables and salads, bread and cereals, folate in the past six months (percentage of respondents)

		<i>n</i>	Eat more (%)	Eat less (%)	Haven't changed (%)	Not sure (%)	<i>P</i> *
<b>Folate</b>							
Males	<50 years	326	2.8	0.9	66.6	29.8	<i>P</i> = 0.040
	50+ years	177	2.3	0.0	78.0	19.8	
Females	<50 years	390	9.2	1.3	62.3	27.2	NS
	50+ years	160	4.4	1.3	73.1	21.3	
<b>Fibre</b>							
Males	<50 years	332	22.6	2.7	72.9	1.8	NS
	50+ years	184	18.5	0.0	80.4	1.1	
Females	<50 years	397	29.0	2.5	64.5	4.0	<i>P</i> = 0.030
	50+ years	172	21.5	2.9	75.0	0.6	
<b>Fruit</b>							
Males	<50 years	333	22.5	8.4	67.9	1.2	<i>P</i> < 0.001
	50+ years	187	10.2	2.1	87.2	0.5	
Females	<50 years	397	27.0	10.8	61.2	1.0	<i>P</i> < 0.001
	50+ years	173	16.8	2.9	80.3	0.0	
<b>Vegetables/salads</b>							
Males	<50 years	331	19.0	6.0	74.0	0.9	<i>P</i> < 0.001
	50+ years	185	11.9	0	87.6	0.5	
Females	<50 years	398	26.4	5.5	67.6	0.4	<i>P</i> = 0.001
	50+ years	173	15.6	1.2	83.2	0.0	
<b>Bread and cereals</b>							
Males	<50 years	332	16.3	6.9	75.9	0.9	<i>P</i> = 0.001
	50+ years	187	6.4	3.2	90.4	0.0	
Females	<50 years	398	14.6	7.5	76.9	1.0	<i>P</i> = 0.014
	50+ years	175	6.9	5.1	88.0	0.0	

\* Statistical differences between age groups, within gender categories.

*n* = number of participants.

NS = not significant.

### **Reported changes in intake of folate, fibre and plant foods**

Less than 40% of subjects reported changing their dietary intakes of folate, dietary fibre, fruit, vegetables or bread and cereals in the previous six months (Table 1). Less than one in 10 reported reduced consumption of any of these nutrients or foods. Although few people reported changing their intake of folate in the previous six months, more women than men reported consuming more folate. It is also noteworthy that a substantial proportion of subjects were unsure of whether their intake of folate had changed (one in three of the younger group and one in five of the older group).

More younger men and women (22.6% and 29%) reported consuming more fibre than older men and women (18.5% and 21.5%). More women than men reported eating more fruit, and more younger people reported this change in behaviour than older people. A similar pattern of change was reported for vegetable and bread/cereal consumption, although the number of people reporting eating more vegetables or bread/cereals was less than that for fruit. Few older people reported consuming more bread and cereals in the previous six months.

### **Agreement between changes to food and nutrient intake**

Table 2 compares reported increase in foods with increases in nutrients among younger men and women. This age group is reported because it is women of reproductive age<sup>17,18</sup> to whom folate fortification, health claims and education programmes are targeted. Of the 166 women who reported increasing their intake of one or more of the three groups of plant foods, only 13% reported consuming more folate, compared with 49% who reported consuming more fibre. For the 132 men who reported consuming more of any of the plant foods, the pattern was similar: 5% reported consuming more folate and 41% reported consuming more fibre. Of those men and women who reported consuming more folate (nine and 36, respectively), 58% of the women and six out of the nine men reported consuming more of any of the plant foods, with increased fruit consumption being the food most likely to be so linked. Just over 70% of men and women who reported consuming more fibre also reported consuming one or more of the plant food groups, with similar levels of expected associations with the three individual food types (fruit, vegetable and cereal foods) being reported by men

**Table 2** Inter-relationship of foods and nutrients consumed 'more' in the previous six months, women and men aged <50 years (percentage of respondents)

	Folate (%)	Fruit (%)	Vegetables/ salads (%)	Bread/ cereals (%)	Fibre (%)	Fruit, vegetables or bread & cereals (%)
<b>Women</b>						
<i>n</i>	36	107	105	58	115	166
Ate more folate	–	15.2	14.0	11.1	23.6**	13.0
Ate more fruit	44.4	–	61.2	40.4	51.3	64.5
Ate more vegetables/salads	38.9**	58.9	–	56.9	48.2	62.5
Ate more bread/cereals	16.7	21.7	31.7	–	27.2	34.7
Ate more fibre	72.2	55.1**	53.4*	54.4	–	49.4**
Ate more fruit, vegetables or cereals	58.3	–	–	–	71.3	–
<b>Men</b>						
<i>n</i>	9	75	63	54	75	132
Ate more folate	–	7.0	6.7	5.6	5.5	4.7
Ate more fruit	†	–	52.4	27.8	44.0	56.8
Ate more vegetables/salads	†	44.0	–	38.9	36	47.7
Ate more bread/cereals	†	20.0	33.3	–	34.7	40.9
Ate more fibre	†	44.0**	42.9*	48.1	–	40.9**
Ate more fruit, vegetables or cereals	–	–	–	–	72.0	–

\*  $P < 0.05$  males vs. females.\*\*  $P < 0.01$  males vs. females.

† Data not included because of small numbers.

(44%, 43% and 48%, respectively) and women (55%, 53% and 54%, respectively).

The level of agreement between folate and fibre and their food sources was assessed. Because only small numbers of participants reported consuming more folate, data were pooled into three groups: all men, all women, and women under 50 years. All comparisons were statistically significant. The agreement between folate and all plant food sources was poor for both men and women ( $\kappa < 0.2$ ). Compared with a fair agreement for fibre and all plant food sources, women demonstrated a better-than-expected agreement between fibre and fruit or vegetables than men, and similar agreements for bread and cereals. The level of agreement between fibre and its food sources was fair for men and women ( $0.2 < \kappa < 0.4$ ). Younger women demonstrated a poorer agreement than all women between fibre or folate and their plant food sources.

## Discussion

Participants were confident about reporting changes in their consumption of fruit, vegetables, cereal foods or fibre. However, there was evidence of uncertainty of the food sources of folate. The high proportion of adults who were confident about expressing changes in consumption of foods (i.e. 'eat more', 'eat less' or 'haven't changed'), but 'not sure' about changes in folate, suggests ignorance of the large contribution plant foods make to folate intake (around 50%) in the diets of Australian adults<sup>20</sup>. Younger women, the target for folate education programmes, appeared less certain of these links than older women.

There was greater consistency between reported changes in fibre and in its food sources than for folate and its food sources. Although the level of agreement

between either nutrient and its food sources was not high, the food–nutrient link rated better for fibre than for folate. Of those who had increased their consumption of plant foods, the responses of just 5% of younger men and 13% of younger women were consistent with the recognition that they had also increased their consumption of folate. Further, this small number of younger women who reported increasing their consumption of folate may be enhanced by those who are increasing their intake through folate supplement use. For fibre, 49% of younger women and 41% of younger men seemed to recognise this link. For both men and women, far more of those who reported change in the nutrient also reported change in the food than the reverse (e.g. for fibre, 70% versus 41–49%). This suggests that it is the 'foods' message that is being acted on. Only a minority gave responses consistent with knowledge of the specific attributes of those foods. This was despite the community under study having the highest education levels in Australia<sup>21</sup>.

These outcomes have implications for future nutrition education. First, the traditional education framework of Dietary Guidelines and of Food Guides for the past 20 years may not have been as effective as might be expected. Breakfast cereals and breads have been promoted on the basis of their dietary fibre content for many years and we expected that this link would be stronger. Early promotion focused on the fibre–bowel function or constipation link. A change in focus to the soluble fibre–heart disease link, with emphasis on increasing fruit and vegetable consumption, may account for some of the unexpected outcomes. Then too, the current focus on fruit and vegetables, antioxidants and health may be further detracting from an appreciation of the link between bread and cereals and dietary fibre or folate. Certainly, more subjects reported increasing their

consumption of fruit and vegetables than of bread and cereals. The increasing use of nutrient–individual food relationships by the processed food industry when labelling and promoting certain products may also be confusing the issue. For example, whereas Brand X bread may contain and promote a high fibre content, all breads and cereals contain fibre and some have more than others. The differences observed for men and women may be linked to differences in their formal and informal education about food and related skills, as well as their level of use of such food skills (e.g. in shopping, cooking, planning, feeding). The larger differences between men and women in relation to folate may also reflect food skills/education – not only is the folate message targeted at women, but much of the specific information has been in women's magazines, in food stores and on labels of particular foods.

Second, we are seeing more of a single food–nutrient–health focus. In Australia this focus is being expressed in the trial of folate 'health claims'<sup>9</sup>. Health claims may distort the understanding of the link between nutrients and major food sources. To make a health claim, criteria for the types of food and the level of the nutrient must be defined. For folate, for example, this level has been set at 40 µg per serving of the food<sup>9</sup>. In current public health information brochures this level limits the foods promoted to those that are either fortified foods (i.e. processed foods), foods that are eaten infrequently (e.g. spinach) or foods eaten by subsets of the population (e.g. legumes)<sup>11</sup>. Foods that are major sources of folate in the diet such as potatoes (which contribute around 8% of folate in the diet of adults) or dairy products (9% of total folate intake)<sup>20</sup> are not mentioned in these education materials. While these foods have a low level of folate per serving, they are generally eaten frequently and in high quantities over the day by many people. This single nutrient–single food approach works against the importance of diversity/variety in the diet and the food-based dietary guidelines approach to frameworks for nutrition education.

In this study, people were asked about changes in their consumption of the nutrients and the food (group) sources separately as the basis for assessing the level of awareness of the food–nutrient links between nutrients and their food sources. This approach is difficult to compare with the more commonly used 'knowledge test' approach, but is more consistent with public health messages promoted at community level which tend to use groups and subgroups of foods to identify nutrients. However, individual responses may be distorted by any misconceptions and links already made of food sources and nutrients (e.g. increasing consumption of wholemeal bread increases fibre, but increasing consumption of white bread does not). This was not measured by this study. Other measures of the link between food and nutrients as well as health issues may clarify this.

## Conclusions

The results suggested that all subjects, and in particular younger women, had a poor understanding of the relationship between folate intake and its food sources. The understanding of the relationship between fibre intake and its food sources appeared substantial, but confusion about specific food sources was still evident. These results question the effectiveness of nutrition education approaches used to date, and have particular relevance to the task of increasing folate intake in women of pre-menopausal age and the potential impact of health claim approaches on the food–nutrient link.

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## References

- 1 Commonwealth Department of Health. Five food groups (poster). Canberra: Australian Government Publishing Service, c. 1970.
- 2 Cashel K, Jeffreson S. *Core Food Groups. The Scientific Basis for Developing Nutrition Education Tools*. Canberra: National Health and Medical Research Council, 1994.
- 3 Langsford WA. A food and nutrition policy. *Food Nutr. Notes Rev.* 1979; **36**: 100–3.
- 4 Commonwealth Department of Health. *Commonwealth Department of Health Dietary Guidelines for Australians*. Canberra: Australian Government Publishing Service, 1982.
- 5 Health Targets and Implementation Committee. *Health for All Australians*. Report to the Australian Health Ministers' Advisory Council and the Health Minister's Conference. Canberra: Australian Government Publishing Service, 1988.
- 6 National Health and Medical Research Council. *Dietary Guidelines for Australians*. Canberra: Australian Government Publishing Service, 1992.
- 7 National Health and Medical Research Council. *Dietary Guidelines for Children and Adolescents*. Canberra: Australian Government Publishing Service, 1994.
- 8 Truswell AS. Prospects for folic acid fortification and its monitoring. *Aus. J. Nutr. Diet.* 1996; **53**: S17–23.
- 9 Australia New Zealand Food Authority. *A Pilot for a Health Claims System using Folate/Neural Tube Defects Health Claims* [Online]. Available at <http://www.anzfa.gov.au/FolatePilot/HealthClaimsPilot.htm>. 3 June 1999.
- 10 Australia New Zealand Food Authority. *List of Foods and Food Products Approved to Carry a Folate/Neural Tube Defects Health Claim* [Online]. Available at <http://www.anzfa.gov.au/FolatePilot/Folatelist.htm>. 3 June 1999.
- 11 Australia New Zealand Food Authority. Important health message. Folate make it part of your day (pamphlet). Canberra: ANZFA, c. 1999.
- 12 Cox D, Anderson A, Lean M, Mela D. UK consumer attitudes, beliefs and barriers to increasing fruit and vegetable consumption. *Public Health Nutr.* 1998; **1**(1): 61–8.
- 13 Whichelow M. Which foods contain dietary fibre? The beliefs of a random sample of the British population. *Eur. J. Clin. Nutr.* 1988; **42**: 945–51.
- 14 Coles-Rutishauser I. *A Guide to Instruments for Monitoring*

- Food Intake, Food Habits and Dietary Change*. Food and Nutrition Monitoring Unit Working Paper 96.2. Canberra: Australian Institute of Health and Welfare, 1996.
- 15 United States Department of Agriculture (USDA). *What We Eat in America: 1994–1996. Diet and Health Knowledge Survey Questionnaire*. Washington, DC: United States Department of Agriculture, 1996.
  - 16 Guthrie JF, Derby B, Levy A. What people know and do not know about nutrition. In: Frazão E, ed. *America's Eating Habits: Changes and Consequences*. Agriculture Information Bulletin No. 750 (AIB-750). Food and Rural Economics Division, Economic Research Service, United States Department of Agriculture, 1999; 243–81. Available at <http://www.ers.usda.gov/publications/AIB750/>.
  - 17 Leidy L. Timing of menopause in relation to body size and weight change. *Hum. Biol.* 1996; **68**(6): 967–82.
  - 18 Luoto R, Kaprio J, Uutela A. Age at natural menopause and sociodemographic status in Finland. *Am. J. Epidemiol.* 1994; **139**(1): 64–76.
  - 19 Altman D. *Practical Statistics for Medical Research*. London: Chapman & Hall, 1991.
  - 20 Australian Bureau of Statistics (ABS). *National Nutrition Survey. Nutrient Intakes and Physical Measurement. Australia 1995*. Cat. No. 4805.0. Canberra: Australian Bureau of Statistics, 1998.
  - 21 Australian Bureau of Statistics (ABS). *Australian Social Trends 1997*. Cat. No. 4102.0. Canberra: Australian Bureau of Statistics, 1997.