

# Awareness and consumption of folate-fortified foods by women of childbearing age in Western Australia

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## Abstract

**Objectives:** The introduction of voluntary fortification of some foods with folic acid in Australia has been implemented since evidence of the prevention of neural tube defects with periconceptional folic acid was published. Our objectives were to determine how many women were aware of folate and when they became aware, what was the awareness of labels on foods that mentioned folate, and how much folate-fortified food women ate.

**Methods:** To address these objectives we collected data by self-administered questionnaire from a random sample of 578 recently pregnant women in Western Australia between September 1997 and March 2000.

**Results:** Overall, 89% of women had heard, seen or read anything about the link between folate and birth defects such as spina bifida, 62% first became aware of the folate message before their recent pregnancy and 42% of women noticed any labels on foods that mention folate before or during their recent pregnancy. Overall, 53% of women were aware of foods that have folate added to them and 33% usually or always read the labels on food packaging. The folate-fortified foods most often consumed by women were cereals (69%), breads (34%) and milk (15%). Of the women who consumed folate-fortified foods (78%), the earlier they became aware of the folate message and noticed labels on food, the more fortified foods they consumed.

**Conclusions:** These results indicate that staple foods fortified with folate are consumed by almost 80% of women in the population. Therefore, mandatory fortification of staple foods may reach most women, providing improved opportunity for the prevention of neural tube defects in Australia.

**Keywords**  
Fortification  
Folate  
Folic acid  
Neural tube defects

Evidence from randomised controlled trials has shown that periconceptional folic acid supplementation reduces the incidence of neural tube defects (NTDs) by 72%<sup>1</sup> and observational studies have shown that dietary folate is also protective<sup>2–6</sup>. In Australia, there have been two approaches to health promotion aimed at reducing the incidence of NTDs by increasing folate intake. The first involves population health-promotion programmes encouraging women to take folic acid supplements periconceptionally and to increase their dietary intake of folate-rich foods. The second has been legislative change to allow voluntary fortification of foods with folic acid.

In Western Australia (WA), from 1992 to 1995, we ran a health-promotion programme promoting folate to prevent NTDs based on the recommendations of the National Health and Medical Research Council of Australia<sup>7</sup>. The programme encouraged women of childbearing age to increase their dietary intake of folate and to

take supplements of 500 µg folic acid daily for at least one month before pregnancy and the first three months of pregnancy. Women with a close family history of NTDs were advised to take 5 mg of folic acid daily. Information was distributed widely to health professionals and women, and increases in the knowledge and practice of women and health professionals have occurred as a result of the programme<sup>8–11</sup>. Women's knowledge of the association between folate and spina bifida increased from 8% before the programme began to 67% two-and-a-half years later. The proportion of women taking periconceptional folic acid supplements increased from 13% to 30% over the same period<sup>10,12</sup>. Since 1995, some promotion of periconceptional use of folic acid supplements has continued in WA and other states and some national promotion has been undertaken<sup>13</sup>.

In 1995 voluntary folate fortification of specified foods was approved for the first time in Australia and since then

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there has been a gradual increase in the number of foods fortified. In 1999, over 100 foods were reported to be fortified with folate and available to consumers (mainly breakfast cereals, fruit juice, milk and special diet foods)<sup>13</sup>.

Since the introduction of these measures in WA, there has been a fall in NTDs. The prevalence of NTDs (births plus terminations) in WA was about two per 1000 births from 1980 until 1995, and fell by 30% from 1996<sup>14</sup>.

The objective of the present paper is to report, using data collected from a random sample of recently pregnant women in WA, how many women were aware of folate fortification and labelling on foods that mentioned folate, and their consumption of fortified foods.

## Methods

The data presented here relate to 578 women who had a live-born baby without birth defects in WA in 1997–2000. These women formed the control group of a larger case–control study, the methods of which have been reported elsewhere<sup>15,16</sup> and are summarised briefly here.

A random sample of all live-born infants in WA was selected using the Midwives' Notification System as a sampling frame. This system is a statutory collection of data on all births  $\geq$  20 weeks' gestation in WA<sup>17</sup>. Sampling was conducted from this sampling frame every month and was based on births in the previous month, using a sampling fraction such that we would have a final sample size of approximately 700 eligible controls. Mothers who did not speak English or were Aboriginal were ineligible for inclusion, as interpreters were not available, and the study methods were not culturally appropriate for Aboriginal people.

### Data collection

A letter of invitation, with an information sheet about the study, a pregnancy questionnaire and a quantified food-frequency questionnaire, were sent to all eligible mothers 3–4 months after the birth of their child. Participating mothers returned completed questionnaires in the reply-paid envelope provided. Follow-up of non-responders was by telephone or by post. A short questionnaire covering knowledge of folate, and intake of vitamin supplements and fortified foods, but excluding the food-frequency questionnaire, was offered to mothers who felt that they did not have time or were not able to complete the full questionnaires.

Information collected from the long and short questionnaires included: awareness of the main health message about folate and spina bifida and timing of awareness of this message<sup>15</sup>; and awareness of folate fortification measured as (1) awareness of folate added to foods, (2) knowledge of folate labelling of foods and (3) how often labels were read. We measured the proportion of women who noticed any labels on foods that mentioned folate, whether they were aware that folate

was added to foods, how often they read the labels on foods and packaging, what foods they were aware of that had folate added to them, if they ate folate-fortified food, and if so, how much of the fortified food was eaten in the six months before their recent pregnancy. An increasing number of folic-acid-fortified foods came onto the market over the study period<sup>13,18</sup>, and so the list of specific branded foods included in the questionnaire was updated at intervals.

We estimated the average weekly dietary intake of folate-fortified foods in the six months before pregnancy in servings of fortified foods. Serving sizes were defined according to the *Australian Guide to Healthy Eating*<sup>19</sup>. For example, 2 slices of bread equals a bread serving,  $1\frac{1}{3}$  cup of breakfast cereal equals a cereal serving and 1 cup of milk (250 ml) equals a milk serving. The mean average weekly number of servings of folate-fortified foods that were eaten in the six months before pregnancy was determined by multiplying the number of months prior to the recent pregnancy that the food was eaten by how often the food was eaten per week multiplied by four and the number of servings per eating occasion. This total was then divided by 26 to determine the mean number of servings consumed per week over the previous six months. In addition we estimated, in servings per week, the intake of breads, cereals and milk (fortified and unfortified) consumed in the six months prior to the recent pregnancy from a modified 135-item food-frequency questionnaire.

### Statistical analysis

Statistical comparisons were made using basic frequencies, the  $\chi^2$  test for trend, Student's *t*-test and analysis of variance in SPSS Release 11.0.0 (SPSS Inc., 1998–2001). A mean, standard error and *F*-test were calculated and significance is given. Not all women answered all questions, so each analysis was based on all available data for the variables involved.

## Results

Of the control mothers in the study 724 were eligible and invited to participate, and 578 agreed (79.8%). Non-responders were significantly more likely to be younger, unmarried, a public patient, to smoke during pregnancy, and have either no previous births or more than two previous births, when compared with responders. There was no difference between responders and non-responders with respect to infant sex or plurality, or maternal place of residence<sup>15</sup>. Of women surveyed 88.9% were aware of the main folate message (the link between folate intake and prevention of birth defects such as spina bifida). Overall 62.3% of women were aware of the correct message of the association between folate and spina bifida before they became pregnant, 11.1% became

aware during pregnancy and 26.7% were unaware of the association before or during pregnancy.

Of the women surveyed, 47% were not aware or were unsure that folate was added to foods available in Australia. However, 74% had noticed folate labelling, most commonly on breakfast cereals, breads and milk (Table 1). Forty-two per cent of women noticed folate labelling before their recent pregnancy, while 16% noticed it only during their pregnancy. In the six months before pregnancy, folate-fortified foods (cereals, breads or milk) were consumed by 78% of women ( $n = 451/578$ ), with 69% consuming fortified cereals, 34% consuming fortified breads and 15% consuming fortified milk. Of those who ate fortified foods the mean number of servings per week of cereals consumed was 4.5, of bread was 8.2 and of milk was 9.2 (Table 2).

**Table 1** Knowledge and behaviour of the total number of women surveyed

Knowledge and behaviour	% (n/N)
Heard, seen or read anything about the link between folate and birth defects such as spina bifida	
Yes	88.9 (514/578)
No or not sure	11.1 (64/578)
When first became aware of the message about folate and prevention of spina bifida	
Before pregnancy	62.3 (360/578)
During pregnancy	10.2 (59/578)
After pregnancy	0.9 (5/578)
Not sure or not aware	26.6 (154/578)
Awareness of foods* that have extra folate added to them	
Aware	52.8 (305/578)
Not aware	25.6 (148/578)
Unsure	21.6 (125/578)
The foods* that women are aware of that have extra folate added to them	
Cereals	43.9 (254/578)
Breads	8.8 (51/578)
Milk	17.0 (98/578)
When women noticed any labels on foods* that mention folate	
Before pregnancy	1.9 (11/578)
Before and during pregnancy	40.5 (234/578)
During	16.3 (94/578)
After pregnancy	5.9 (34/578)
Not sure when noticed	9.7 (56/578)
Not noticed	25.8 (149/578)
How often do women read the labels on food and packaging†	
Always	8.7 (50/578)
Usually	24.2 (140/578)
Sometimes	54.5 (315/578)
Never	12.6 (67/578)
Women who consumed the following folate-fortified foods at any time in the six months before their recent pregnancy	
Cereals	68.9 (398/578)
Breads	33.6 (194/578)
Milk	15.4 (89/578)
Women who consumed the following foods (fortified or unfortified) at any time in the six months before their recent pregnancy‡	
Cereals	87.3 (393/450)
Breads	98.0 (441/450)
Milk	95.3 (429/450)

\* Available in Australia; not aware or unsure = 47.2%.

† To see what nutrients or additives the food contains.

‡ The balance of subject responses are missing as food-frequency questionnaires were completed for  $n = 450$ .

Based on all women surveyed who completed the dietary questionnaire ( $n = 450$ ), cereals, bread or milk (fortified or not fortified) were consumed by 99% (444) of women. Of these women, 87% ate any cereal, 98% ate any bread and 95% drank milk.

Women who were aware that folate was added to foods were more likely to have heard, seen or read anything about the link between folate and birth defects, were more likely to have first become aware before pregnancy of foods that mention folate than women who were not aware of foods that mention folate (Table 3), were more likely to have noticed (at any time) labels on foods that mentioned folate, and were more likely to usually or always read labels on food and packaging. They were also more likely to have eaten fortified cereals, fortified bread and fortified milk in the six months before becoming pregnant.

Of the 78% of women who ate folate-fortified foods, those who had heard, seen or read anything about the link between folate and birth defects such as spina bifida ate more servings of folate-fortified cereals, breads and milk per week in the six months prior to their recent pregnancy (significant only for cereals,  $P = 0.015$ ) than those who had not heard, seen or read anything about the link. The earlier women became aware of the folate message, the more fortified cereals, breads and milk they consumed (significant only for cereals,  $P = 0.004$ ) (Table 4). The intake of servings of folate-fortified cereals, breads and milk was greater with greater awareness of foods that have extra folate added (significant only for cereals,  $P < 0.0005$ ). Furthermore, the earlier women noticed folate labelling, the more fortified cereal servings ( $P = 0.002$ ), bread servings ( $P = 0.184$ ) and milk servings ( $P = 0.006$ ) were consumed prior to or during their recent pregnancy. The mean number of servings of fortified cereals, breads and milk was greater, but not significantly so, the more often women read the labels on food and packaging (Table 4).

## Discussion

We showed that between 1997 and 2000, 62.3% of women in this study were aware before becoming pregnant of the protection against spina bifida of extra folate intake before pregnancy, 53% were aware that foods available in Australia have extra folate added to them, and 42% noticed folate labelling on foods before or during their recent pregnancy. Folate-fortified cereals, breads or milk were consumed by 78% of women. Those women who were aware that folate was added to foods were more likely to have been aware of folate and to have noticed that foods were fortified with folate before their recent pregnancy. The earlier women became aware of the folate message or noticed any labels on foods that mentioned folate, the more servings of folate-fortified cereals were consumed.

**Table 2** Of those women who consumed fortified foods, the mean number of servings consumed per week in the six months prior to recent pregnancy

	No. of women who consumed these foods ( <i>N</i> = 451*)	% of all women who consumed these foods	Mean servings consumed per week	Standard deviation
Fortified cereals	398	68.9	4.5	3.4
Fortified bread	194	33.6	8.2	8.0
Fortified milk	89	15.4	9.2	5.5

\* 78% ate one or more fortified food types (*n* = 451/578).

In a previous study in the same cohort of women<sup>20</sup> we showed that efforts to increase folate intake through health-promotion strategies aimed at changing individual behaviour did not reach all women equally, whereas the structural health-promotion strategy of folate-fortified foods increased folate exposure and intake equally across the target group. Because folate fortification in Australia is voluntary, only about half the women in the cohort (57%) were getting more than 100 µg daily from fortified foods. We therefore concluded that mandatory fortification of a staple food may be likely to reach all women regardless of demographic characteristics and health-related behaviours. Based on the results presented in the current paper, 98% of women consumed bread (fortified or unfortified), suggesting that bread (or flour) would be an

appropriate vehicle for mandatory folate fortification in Australia, as it is in the USA and Canada<sup>21,22</sup>.

There was high participation in our study (79%) but non-responders were more likely to be young, unmarried, not to have private health insurance, to smoke during pregnancy, and have either had no previous births or more than two previous births<sup>15</sup>. With the exception of women with two or more previous births, all of these characteristics were associated with a greater risk of not knowing the correct message and not taking periconceptional folic acid supplements<sup>20</sup>. Thus, the proportion of the population unaware of the correct message and not taking supplements may be greater than our study indicates. Further, the retrospective assessment of awareness and intake of fortified foods as well as timing of awareness of

**Table 3** Women aware of folate added to foods in association with when they became aware of folate-fortified foods, when they noticed any labels on foods that mention folate and how often they read labels on food and packaging†

	Aware of folate added ( <i>N</i> = 578)		
	Not aware or unsure ( <i>n</i> = 273) (%)	Yes ( <i>n</i> = 305) (%)	<i>P</i> -value ( $\chi^2$ test)
Heard, seen or read anything about the link between folate and birth defects such as spina bifida			
Yes	42.6	57.4	
No	84.4	15.6	< 0.0005
When first became aware of the message about folate and prevention of spina bifida			
Before pregnancy	34.7	65.3	
During pregnancy	50.8	49.2	
After pregnancy	80.0	20.0	
Not sure or not aware	74.0	26.0	< 0.0005
When women noticed any labels on foods* that mention folate			
Before pregnancy	36.4	63.6	
Before and during pregnancy	22.2	77.8	
During	26.6	73.4	
After pregnancy	35.3	64.7	
Not sure when noticed	78.6	21.4	
Not noticed	91.3	8.7	< 0.0005
How often do women read the labels on food and packaging†			
Always	26.0	74.0	
Usually	29.3	70.7	
Sometimes	52.1	47.9	
Never	75.3	24.7	< 0.0005
Women who consumed the following folate-fortified foods at any time in the six months before their recent pregnancy			
Fortified cereals	42.7	57.3	0.001
Fortified bread	41.2	58.8	0.040
Fortified milk	38.2	61.8	0.064

\* Of foods available in Australia.

† To see what nutrients or additives the food contains.

**Table 4** The mean number of servings of folate-fortified foods consumed per week in the six months prior to recent pregnancy (of those women who consumed fortified foods) by awareness of folate fortification and labelling

	Mean number of servings*		
	Fortified cereals	Fortified breads	Fortified milk
Heard, seen or read anything about the link between folate and birth defects such as spina bifida			
Yes	3.3	2.8	1.5
No	2.1	2.2	1.1
P-value ( <i>t</i> -test)	0.015	0.438	0.489
When first became aware of the message about folate and prevention of spina bifida			
Before pregnancy	3.5	3.1	1.6
During pregnancy	2.6	2.7	1.2
After pregnancy	3.4	0.0	0.0
Not sure or not aware	2.4	2.1	0.9
F-test	4.5	1.3	0.2
P-value	0.004	0.289	0.886
Awareness of foods* that have extra folate added to them			
Yes	3.7	3.1	1.6
Not aware or unsure	2.5	2.4	1.2
F-test	17.7	1.9	1.4
P-value	<0.0005	0.174	0.230
When women noticed any labels on foods* that mention folate			
Before pregnancy	4.2	3.3	2.1
Before and during pregnancy	3.7	3.5	1.8
During	3.2	2.7	1.5
After pregnancy	3.2	2.4	0.2
Not sure when noticed	2.9	1.8	2.5
Not noticed	2.2	2.0	0.6
F-test	3.9	1.5	3.3
P-value	0.002	0.184	0.006
How often do women read the labels on food and packaging†			
Always	3.2	3.4	1.8
Usually	3.4	2.9	1.8
Sometimes	3.1	2.8	1.3
Never	2.5	1.7	0.9
F-test	1.1	0.9	0.9
P-value	0.370	0.435	0.436

\*Of folate-fortified foods consumed per week in the six months prior to recent pregnancy using a list of specific branded foods fortified with folic acid.

†Of foods available in Australia.

these may be a limitation of our study due to poor memory or inaccurate recall.

It is possible that the association between awareness of existence of folate-fortified foods, labelling and consumption is causal, but it is not possible to determine the direction of causation. Although knowledge of the health link, followed by awareness of fortified foods and increased consumption is consistent with the knowledge-behaviour theory of behaviour change<sup>23</sup>, the direction of causation may well have been in the opposite direction. Those purchasing and eating fortified foods may not have purchased or eaten the food because it was fortified but may have become aware of folate fortification and the health message due to package labelling. We did not ask women if they had purposely chosen fortified foods in order to increase their folate intake.

Despite sociodemographic differences in knowledge of the link between folate and prevention of spina bifida,

which we have previously reported<sup>20</sup>, there were no such differences between women who did and did not consume fortified products. In the current analysis only half the women knew that folate was added to foods and yet 78% ate at least one fortified food.

A study from Victoria, Australia found that, in 2000, 50% of women were aware that some foods had folate added to them and 34% nominated ready-to-eat cereals as being fortified<sup>24</sup>. These percentages are similar to those found in our study of 53% and 44%, respectively. Further, in other studies in Australia that took place around the time of our study there was an increase in women's knowledge of folate but no increase in sales of ready-to-eat breakfast cereals carrying a health claim about folate<sup>25</sup>.

In order to achieve an increase in intake of folate for the prevention of NTDs, it is generally agreed that strategies other than periconceptional folic acid supplementation are required, because even with active health promotion of supplement use, it is difficult to achieve greater than 50% of women taking supplements at the relevant time. Furthermore, there are significant socio-economic differences in use of supplements<sup>20,26</sup> and, in Australia, neither health promotion of folate nor voluntary fortification has affected the high rates of NTDs in Indigenous infants<sup>27</sup>.

Mandatory fortification of flour with folate has been introduced in many countries for the primary prevention of NTDs. The evidence for a benefit in preventing NTDs is clear, and other benefits have been suggested, but these need to be balanced against possible risks, particularly as the whole population is exposed to fortified foods, not just the target group of women of childbearing age. The risks include possible masking of vitamin B<sub>12</sub> deficiency (especially in the elderly), an increased risk of twinning<sup>1</sup> and potentiation of cancers<sup>28</sup>. While there is reassurance from countries that have instituted fortification with regard to the first two concerns<sup>29,30</sup>, it is too soon yet to have sufficient data to address the theoretical concern about cancer promotion.

Fortification of staple foods has the potential to deliver increased folate to all women of childbearing age, regardless of socio-economic status or whether they planned their pregnancy, but the evidence from the present study shows that voluntary fortification, although reaching women more equitably and leading to a population increase in serum folate<sup>31</sup>, is not sufficiently widespread to be able to increase folate intake for all women. Furthermore, only about half the women knew about foods that were voluntarily fortified – most of these were breakfast cereals, corresponding to the fact that most voluntarily fortified foods in Australia are breakfast cereals<sup>13</sup>. Thus, many women do not appear to actively choose fortified foods for the purpose of increasing their folate intake.

Mandatory fortification of flour or bread (or even milk) would passively increase intake above that achieved by voluntary fortification, as these are foods that are consumed

by most women; indeed, in countries where mandatory fortification of flour with folate has been introduced, there have been significant falls in NTD rates<sup>21,22,32</sup>. Mandatory fortification with 200–300 µg of folic acid per 100 g of wheat flour was approved in Australia and New Zealand in June 2007 and an extensive monitoring system is being finalised to determine the effects of mandatory folic acid fortification.

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