

## Original Article

# Folate knowledge and consumer behaviour among pregnant New Zealand women prior to the potential introduction of mandatory fortification

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To reduce the risk of neural tube defects, the New Zealand Ministry of Health recommends women take supplemental folic acid from at least one month pre-conception until the end of the twelfth week of pregnancy, as well as consume folate-rich foods. A postpartum survey was conducted to describe folate knowledge and consumer behaviour among pregnant New Zealand women prior to the potential implementation of mandatory folic acid fortification of bread in May 2012. Increasing knowledge of folic acid recommendations was associated with higher supplement uptake among women who planned their pregnancies ( $p=0.001$  for linear trend). Folic acid information failed to adequately reach some socio-demographic subgroups before conception, even when pregnancy was planned, including: indigenous Māori, Pacific and Asian women, younger women, women with large families, and women with lower educational attainment and income. Only half of all women surveyed knew some bread contained added folic acid, and among these women, less than 2% consistently chose voluntarily fortified bread during the periconceptual period by inspecting labels. Sixty-one percent of women indicated they were either in favour of mandatory fortification, or held no opinion on the matter, while 4% were opposed to the addition of folic acid to bread. Approximately one-third (35%) of women agreed with voluntary fortification. Future health promotion initiatives should be tailored toward women who are younger, less educated, with lower income, multiparous or of minority ethnicity status. Nonetheless, mandatory folic acid fortification may be required to attain the desired degree of equity.

**Key Words:** folic acid, neural tube defects, fortification, health behaviour, nutrition policy

## INTRODUCTION

Neural tube defects (NTD) are congenital malformations of the brain and spinal cord caused by an incomplete fusion of the embryonic neural tube.<sup>1</sup> Although the number of pregnancies terminated due to NTD in New Zealand is unknown, the burden of NTD-related perinatal mortality is considerable, and among survivors morbidity is lifelong.<sup>2</sup> It is well established that the sufficient intake of supplemental folic acid before and during the first trimester of pregnancy significantly reduces the risk of NTD, and accordingly, international guidelines are in place to recommend this practice.<sup>3,4</sup> In conjunction, many governments, including the New Zealand government, also recommend women consume folate-rich or folic acid-fortified foods in the periconceptual period.<sup>5</sup>

Approximately half of all pregnancies in developed countries are unplanned and therefore are not amenable to the timely uptake of folic acid supplementation.<sup>6,7</sup> Moreover, only half of women who plan their pregnancies adhere to supplement guidelines.<sup>8</sup> In acknowledgement of these factors, fortification of foods with folic acid has been employed as a measure to increase folate intakes among reproductive-age women.<sup>9</sup> In 1995, the Australia New Zealand Food Authority (now Food Standards Australia New Zealand) permitted folic acid fortification of specified foods on a voluntary basis.<sup>10</sup> Due to poor uptake

by manufacturers and an unsatisfactory increase in levels of folic acid in the food supply, the voluntary programme was deemed unsuccessful.<sup>10,11</sup> To remedy the situation, mandatory folic acid fortification of bread was scheduled in both Australia and New Zealand for September 2009.<sup>12</sup> While Australia proceeded with the mandate, political and manufacturer objection led to its deferral until May 2012 in New Zealand, with no guarantee of implementation.<sup>13</sup>

In the absence of mandatory fortification in New Zealand, options to improve the folate intakes of reproductive-age women are limited. Effective promotion of folic acid supplementation is foremost reliant upon high rates of planned conception.<sup>8</sup> Even when conception is intentional, sufficient folate intake prior to conception is dependent upon women's exposure to information regarding folate guidelines. To date, there have been no nation-wide folate promotional campaigns in New Zealand, thus little

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is known about the sources of folate information utilised by women. Awareness and consumption of folic acid-fortified and folate-rich foods during the periconceptional period are also yet to be investigated in a New Zealand setting. With the upcoming decision on mandatory fortification, such information would be of particular relevance for policy makers. Thus, the aim of this study was to investigate knowledge of current folate recommendations and consumer behaviour among pregnant New Zealand women prior to the potential implementation of a mandatory fortification programme.

## MATERIALS AND METHODS

### Study design and population

The Vitamins and Minerals in Pregnancy Survey was a study of postpartum women resident in maternity wards located across New Zealand between March 7 and April 15, 2011. Survey sites included: Tauranga Hospital, Tauranga; Whakatane Hospital, Whakatane; River Ridge East Birth Centre, Waterford Birth Centre and Waikato Hospital, Hamilton; Hutt Hospital, Lower Hutt; Kenepuru Community Hospital and Wellington Hospital, Wellington; Christchurch Women's Hospital, Christchurch; Queen Mary Maternity Hospital, Dunedin; and Southland Hospital, Invercargill. Women were eligible for participation if they were aged 18 years or over, had delivered a healthy term ( $\geq 37$  wk gestation) infant, and could communicate in English. Eligible women were identified with the assistance of the postpartum ward staff. Research staff then approached eligible women individually, and provided an information sheet explaining the nature of the study. If they agreed to participate, the study questionnaire was provided. Ethical approval for this study was obtained from the Multi-Region Ethics Committee of the New Zealand Ministry of Health.

### Questionnaire

An anonymous, self-administered questionnaire was developed with reference to similar postpartum questionnaires used elsewhere.<sup>14-16</sup> Question areas included: knowledge of current folate recommendations; awareness, consumption and opinion of folate-rich and folic acid-fortified foods; dietary supplement use; and maternal socio-demographic and obstetric characteristics. Pre-testing and refinement of the questionnaire was undertaken in January 2011 with eight pregnant volunteers.

### Statistical analysis

Analyses were conducted using Stata 11.1 (Stata Corporation 2010, College Station, Texas, United States), and a two-sided 0.05 level of significance was used in all cases. Women were assigned to one of five mutually exclusive ethnic groups according to the New Zealand Ministry of Health's prioritised system.<sup>17</sup> In an effort to make the sample more nationally representative in terms of age and ethnicity, women in under-represented age-ethnicity subgroups were weighted up and those in over-represented subgroups were weighted down corresponding to recent New Zealand maternity data.<sup>18</sup> All analyses incorporated post-stratification weights and included sites as clusters to estimate robust standard errors. Estimates of folate knowledge, sources of information, consumer behaviour and opinion are reported as weighted proportions with 95% confidence intervals (CI). Logistic regression was used to determine the association between recommended folic acid supplement use (dependent variable) and knowledge of folic acid supplement recommendations (unaware of correct time or reason to take folic acid supplements; aware of either correct time or reason; and aware of both correct time and reason) among women reporting planned pregnancies. Logistic regression analyses were performed to estimate univariate odds ratios (OR) and 95% CI for folic acid supplement use as recommended among women with planned pregnancies, with sources of folic acid information as independent variables. Receipt of folic acid information before pregnancy was analysed with logistic regression to estimate univariate OR and 95% CI for the independent variables: maternal age (three categories), parity (four categories), ethnicity (five categories), education (five categories), and household income (five categories).

## RESULTS

Of the 968 women invited to participate, 758 agreed (78%). Thirty-five women did not meet inclusion criteria for maternal age or gestational duration, resulting in a total sample of 723. Maternal age (median, interquartile range: 31 years, 27-35 years) was similar to that recorded nationally in the year ended March 2011 (median: 30 years).<sup>19</sup> Almost half (45%) of women delivered their first child, 56% of all pregnancies were planned and the majority of women (91%) were married or cohabitating. Fifteen percent of women did not hold a high school or post-

**Table 1.** Knowledge and periconceptional intake of folic acid supplements

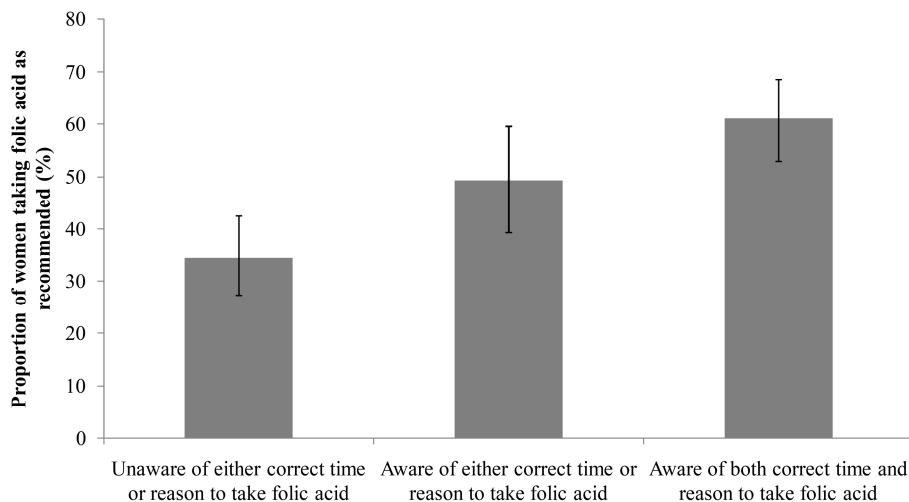
	Unplanned pregnancies (n=311)		Planned pregnancies (n=401)	
	n	% (95% CI) <sup>†</sup>	n	% (95% CI) <sup>†</sup>
Heard of folic acid/ folate	282	88.2 (78.2-93.9)	396	98.0 (93.6-99.4)
Aware folic acid supplements reduce the risk of birth defects (unprompted)	139	41.9 (33.1-51.2)	263	63.6 (58.0-68.7)
Aware folic acid supplements should be taken periconceptionally (prompted)	164	48.4 (40.2-56.7)	321	77.4 (70.5-83.1)
Folic acid supplement use as recommended <sup>‡, §</sup>	11	3.3 (1.7-6.3)	222	54.0 (48.2-59.7)

Abbreviation: CI confidence interval

<sup>†</sup>Weighted for age and ethnicity and adjusted for clustering by site

<sup>‡</sup> $\geq 400$   $\mu\text{g}$  folic acid/d from one month preconception until three months post-conception

<sup>§</sup> Due to incomplete data, unplanned pregnancy n 306, planned pregnancy n 394



**Figure 1.** Proportion of women with planned pregnancies taking folic acid supplements as recommended<sup>†</sup> by folic acid supplement knowledge<sup>‡</sup>,  $n = 392$ ;  $p=0.001$  for linear trend<sup>§</sup>. <sup>†</sup> $\geq 400$   $\mu\text{g}$  folic acid/day from one month preconception until three months post-conception. <sup>‡</sup>Defined as knowing folic acid supplements should be taken before and during the first three months of pregnancy (time) to reduce the risk of birth defects (reason). <sup>§</sup>Weighted for age and ethnicity and adjusted for clustering by site.

high school qualification, and 42% reported an annual household income below the national median for 2010 (64,272 NZ\$).<sup>20</sup> Compared to recent national maternity data, this sample had a higher proportion of New Zealand Europeans (65% versus 56%), a lower proportion of Māori (14% versus 21%) and Pacific women (5% versus 11%), and a similar proportion of Asians (9% versus 10%).<sup>18</sup> Post-stratification weighting was performed using age and ethnicity groups and analyses reported hereafter are weighted and incorporate robust standard errors with sites treated as clusters.

Nearly all (98%) women with planned pregnancies had heard of folic acid or folate, however less than two-thirds (64%) were aware that folic acid supplements reduce the risk of birth defects (Table 1). While more than three-quarters (77%) of women with planned pregnancies knew the correct period for folic acid supplementation, only 54% took folic acid supplements as recommended during the periconceptional period. Compared to women with planned pregnancies, those with unplanned pregnancies reported lower knowledge and substantially poorer uptake of recommended folic acid supplementation. Increasing knowledge of folic acid supplementation recommendations was linearly associated with folic acid supplement use as recommended among women with planned pregnancies ( $p=0.001$ ; Figure 1).

Over half (57%) of women with unplanned pregnancies did not receive folic acid information before pregnancy, compared to 15% of women with planned pregnancies (Table 2). When restricted to multiparous mothers, almost half (48%) of women with unplanned pregnancies had not received folic acid information before pregnancy. Not receiving information before pregnancy appreciably decreased the likelihood of recommended folic acid supplement uptake among women with planned pregnancies (OR: 0.13, 95% CI: 0.05-0.34;  $p=0.001$ ). Among women with planned pregnancies, sources of information associated with folic acid supplementation as recommended included: general practitioners (OR: 2.25, 95% CI: 1.33-3.80), other health professionals (excluding midwives and

general practitioners) (OR: 3.18, 95% CI: 1.56-6.46), family or friends (OR: 1.83, 95% CI: 1.24-2.70) and the Internet (OR: 1.81, 95% CI: 1.07-3.09) (all  $p\leq 0.031$ ).

Regardless of pregnancy intention, women aged 35 years or above were more likely to have received information on folic acid before conception than those under 25 years (both  $p\leq 0.023$ ) (Table 3). After adjusting for parity, this association remained significant ( $p=0.001$ , data not shown). Women delivering their fourth or subsequent child were less likely to have received folic acid information before conception when pregnancy was planned (OR: 0.20, 95% CI: 0.05-0.80;  $p=0.027$ ), and were more likely to be Māori (39%) or Pacific (11%) than women delivering their first child (10% and 5%, respectively). Among women with planned pregnancies, Māori, Pacific and Asian women were less likely to receive folic acid information before conception than New Zealand Europeans (all  $p\leq 0.038$ ). Pacific women were less likely than women of Other ethnicity to receive folic acid information before conception, whether or not pregnancy was planned, and Pacific women with unplanned pregnancies were also less likely to receive folic acid information before conception than New Zealand European women (all  $p\leq 0.048$ ). Compared to those with less than a high school qualification, women with tertiary or post-graduate qualifications were more likely to receive folic acid information before pregnancy when pregnancy was planned (both  $p\leq 0.040$ ). Increasing household income was linearly associated with the likelihood of receiving folic acid information before conception, regardless of pregnancy intention (both  $p\leq 0.004$  for linear trend).

Half (50%) of all women were aware that folic acid is added to some bread (Table 4). Among these women, less than 2% always inspected labels in order to buy folic acid-fortified bread in the periconceptional period. While only 4% of all women did not believe that folic acid should be added to bread, 15% supported mandatory fortification and almost half (47%) had no opinion on the matter. Approximately one-third (35%) of women favoured voluntary fortification.

**Table 2.** Sources of folic acid information before pregnancy and periconceptional intake of folic acid supplements

	Sources of folic acid information <sup>†</sup>				Folic acid supplement use as recommended <sup>‡</sup>		
	Unplanned pregnancies (n=311)		Planned pregnancies (n=401)		Planned pregnancies (n=392)		<i>p</i> -value
	n	% (95% CI) <sup>§</sup>	n	% (95% CI) <sup>§</sup>	% (95% CI) <sup>§</sup>	OR (95% CI) <sup>§,¶</sup>	
Midwife	21	7.5 (4.9–11.4)	31	7.2 (4.3–11.8)	47.3 (24.2–71.5)	0.75 (0.26–2.18)	0.557
General practitioner	35	10.0 (7.0–14.2)	139	34.3 (26.2–43.3)	66.8 (56.8–75.6)	2.25 (1.33–3.80)	0.006
Other health professional	15	5.1 (2.5–10.2)	60	14.2 (9.7–20.2)	76.3 (58.3–88.1)	3.18 (1.56–6.46)	0.005
Family or friends	50	13.8 (9.4–19.7)	137	33.3 (28.3–38.8)	63.8 (54.6–72.0)	1.83 (1.24–2.70)	0.006
Pamphlet, booklet or poster	35	11.3 (7.4–16.8)	93	21.9 (16.7–28.1)	56.1 (47.1–64.6)	1.11 (0.70–1.77)	0.615
Internet	19	5.9 (3.9–8.9)	50	12.8 (11.1–14.7)	66.5 (51.8–78.5)	1.81 (1.07–3.09)	0.031
Newspaper, magazine or book	17	6.1 (2.7–13.4)	58	14.6 (12.5–17.1)	49.7 (32.0–67.5)	0.82 (0.43–1.57)	0.505
Television or radio	36	11.0 (6.7–17.6)	105	25.5 (18.5–34.1)	51.2 (38.8–63.4)	0.86 (0.55–1.33)	0.456
Other source <sup>††</sup>	16	5.3 (1.8–14.3)	39	10.2 (5.6–18.0)	66.1 (45.2–82.2)	1.75 (0.67–4.59)	0.222
Not sure	6	2.2 (0.8–6.2)	8	1.9 (1.1–3.3)	52.9 (11.3–90.8)	–	–
Did not receive information	172	57.0 (47.5–65.9)	51	14.7 (11.5–18.5)	16.9 (8.0–32.2)	0.13 (0.05–0.34)	0.001

<sup>†</sup>Participants could select more than one source

<sup>‡</sup>≥400 µg folic acid/d from one month preconception until three months post-conception

<sup>§</sup>Weighted for age and ethnicity and adjusted for clustering by site

<sup>¶</sup>Not receiving information from specified source was the referent in all cases except for *Did not receive information*, in which receiving information from any source was the referent

<sup>††</sup>Other sources of information included: previous pregnancy, profession, tertiary education, health food store assistant, naturopath, general awareness, oral contraceptive packaging

**Table 3.** Maternal socio-demographic factors and the receipt of folic acid information before pregnancy

Maternal factors	n	Received folic acid information before pregnancy				p-value
		Unplanned pregnancies		Planned pregnancies		
		OR (95% CI) <sup>†</sup>	p-value	n	OR (95% CI) <sup>†</sup>	
Age at delivery			<0.001			0.086
<25	85	1.00 referent		24	1.00 referent	
25–34	164	1.67 (0.85–3.28)		238	3.21 (0.94–10.94)	
≥35	54	3.49 (2.21–5.51)		128	3.94 (1.26–12.27)	
Parity			0.347			0.070
Primiparous	127	1.00 referent		196	1.00 referent	
2 children	73	1.64 (0.71–3.76)		135	1.58 (1.15–2.17)	
3 children	68	2.25 (0.89–5.70)		55	1.64 (0.38–7.03)	
≥4 children	43	1.06 (0.31–3.67)		15	0.20 (0.05–0.80)	
Prioritised ethnicity			0.047			0.006
NZ European	159	1.00 referent		281	1.00 referent	
Māori	73	0.70 (0.33–1.52)		25	0.22 (0.05–0.90)	
Pacific	27	0.48 (0.23–0.99)		9	0.10 (0.01–0.77)	
Asian	22	0.64 (0.20–2.07)		38	0.32 (0.22–0.47)	
Other	21	1.24 (0.89–1.73)		35	0.57 (0.11–2.93)	
Highest education qualification			0.057			0.018
Less than high school	68	1.00 referent		30	1.00 referent	
High school	81	1.02 (0.50–2.07)		56	6.32 (2.09–19.06)	
Vocational training	37	0.90 (0.23–3.50)		22	2.88 (0.48–17.11)	
Tertiary qualification	104	2.00 (0.92–4.36)		220	14.69 (4.43–48.72)	
Postgraduate qualification	11	1.25 (0.15–10.23)		59	8.62 (1.12–66.21)	
Annual household income (NZ\$)			0.004 <sup>‡</sup>			0.001 <sup>‡</sup>
<40,000	125	1.00 referent		41	1.00 referent	
41,000–60,000	59	0.95 (0.47–1.93)		57	3.88 (1.34–11.21)	
61,000–80,000	47	2.25 (1.08–4.71)		62	6.86 (1.99–23.69)	
81,000–100,000	29	2.82 (1.21–6.58)		77	9.33 (3.48–25.03)	
>100,000	31	3.01 (1.49–6.07)		139	9.75 (3.29–28.96)	

<sup>†</sup>Weighted for age and ethnicity and adjusted for clustering by site

<sup>‡</sup>P-value for linear trend

**Table 4.** Knowledge, opinion and periconceptional consumption of folic acid-fortified foods

	n	% (95% CI) <sup>†</sup>
Folic acid is added to some foods (n=708)		
Unaware	305	45.4 (38.1–53.0)
Aware – since before conception	330	44.4 (36.5–52.6)
Aware – became aware during pregnancy	73	10.2 (8.1–12.8)
Noticed labels on foods mentioning folic acid / folate (n=709)		
No	503	72.7 (68.6–76.5)
Yes – since before conception	130	17.5 (14.0–21.7)
Yes – first noticed during pregnancy	76	9.8 (8.3–11.6)
Some bread is voluntarily fortified with folic acid (n=707)		
Unaware	334	50.3 (42.2–58.4)
Aware – since before conception	316	41.9 (34.6–49.6)
Aware – became aware during pregnancy	57	7.8 (5.6–10.8)
Intentionally bought folic acid fortified bread periconceptionally by checking labels <sup>‡</sup> (n 371)		
Do not eat manufactured bread	35	9.3 (4.8–17.1)
No	304	82.6 (75.3–88.1)
Yes – sometimes	26	6.0 (3.5–10.2)
Yes – usually	2	0.5 (0.1–1.8)
Yes – always	4	1.6 (0.9–3.1)
Folic acid fortification of bread (n=706)		
Should be mandatory	112	14.6 (12.1–17.7)
Should be voluntary	257	35.3 (29.7–41.3)
Folic acid should not be added to bread	30	3.6 (2.3–5.8)
No opinion / not sure	307	46.5 (40.7–52.3)

<sup>†</sup>Weighted for age and ethnicity and adjusted for clustering by site

<sup>‡</sup>Among women who knew some bread is voluntarily fortified with folic acid

**Table 5.** Knowledge and periconceptual consumption of folate-rich foods

Food	Which foods are good sources of folic acid or folate? (n=711)	
	n	% (95% CI) <sup>†</sup>
Vegetables <sup>‡</sup>	341	46.0 (42.9–49.1)
Bread <sup>‡</sup>	194	24.5 (19.6–30.1)
Breakfast cereal <sup>‡</sup>	169	21.4 (17.1–26.4)
Beans, legumes (e.g. lentils) <sup>‡</sup>	154	20.8 (17.0–25.1)
Meat (other than liver)	109	14.9 (12.2–18.1)
Fruit and fruit juice <sup>‡</sup>	101	14.4 (10.5–19.46)
Yeast spreads (e.g. Marmite) <sup>‡</sup>	90	11.5 (8.9–14.8)
Fish	83	11.7 (8.8–15.4)
Eggs	81	10.7 (6.6–16.8)
Liver <sup>‡</sup>	75	10.6 (7.4–15.1)
Seaweed (e.g. sushi)	63	8.5 (5.9–12.2)
Dairy products (e.g. milk)	54	7.2 (5.8–8.8)
Seafood	37	4.9 (2.9–8.1)
Iodised salt	22	2.7 (1.7–4.3)
Other <sup>§</sup>	2	0.2 (0.04–0.7)
Don't know of any foods	248	37.4 (32.1–43.0)
Didn't intentionally consume any folate-rich foods in the periconceptual period	603	85.5 (81.9–88.4)

<sup>†</sup>Weighted for age and ethnicity and adjusted for clustering by site

<sup>‡</sup>New Zealand Ministry of Health recommended sources of folate / folic acid for women planning a pregnancy and pregnant women (Planning for Pregnancy or When Pregnant & Eating for Healthy Pregnant Women, New Zealand Ministry of Health, Wellington (NZ); 2010)

<sup>§</sup>Other foods included: Complan (a fortified beverage), whole grains

Over one-third of women (37%) either reported they did not know of any foods rich in folic acid or folate, and a further 2% could not correctly identify any folate-rich / folic acid-fortified foods (Table 5). Vegetables were the food most commonly identified as a rich source of folate (46%), while meat was the food incorrectly identified most frequently (15%). Few women deliberately consumed food in the periconceptual period due to its folate content (14%).

## DISCUSSION

Prior to the upcoming policy decision on mandatory folic acid fortification, our study provides an important impact evaluation of New Zealand's current voluntary fortification programme among the target group of consumers—childbearing women. Only half of all women surveyed knew some bread contained added folic acid, and among these women, less than 2% consistently chose voluntarily fortified bread during the periconceptual period by inspecting labels. Sixty-one percent of this target group indicated they were either in favour of mandatory fortification, or held no opinion on the matter, while 4% were opposed to the addition of folic acid to bread. Slightly over one-third (35%) of women supported voluntary fortification. Whether or not fortification becomes mandatory, periconceptual folic acid supplementation will continue to be advised, and our study has shown that receiving folic acid information before conception and knowledge of folic acid recommendations are associated with higher supplement uptake among women who planned their pregnancies. Furthermore, some sources of information, such as general practitioners, other health professionals, family or friends and the Internet, were better than others in effecting supplement uptake. Folic acid information failed to adequately reach some socio-demographic sub-

groups before conception, even when pregnancy was planned, including: indigenous Māori, Pacific and Asian women, younger women, women with large families, and women with lower educational attainment and income.

A lower proportion of Māori and Pacific women participated than would be expected given national data.<sup>18</sup> This was not the result of a poor response rate among these groups, but was instead due to the non-inclusion of hospitals in the Northland region, where a large proportion of people identifying themselves as Māori and Pacific reside.<sup>23,24</sup> Weighting by age and ethnicity resolved these differences in ethnic representation, thus there are no reasons to expect this to have affected any estimations presented here. We also did not attempt to assess actual periconceptual intakes of folic acid from voluntarily fortified bread, indeed no food composition database is currently able to quantify this in New Zealand.<sup>21</sup> As voluntary folic acid fortification is confined to a limited range of breads,<sup>22</sup> measuring consumer behaviour in the periconceptual period provides valuable insight into levels of consumption.

Fifty-five percent of women surveyed knew that some foods contain added folic acid, similar to an Australian survey (53%) conducted prior to the implementation of mandatory fortification.<sup>25</sup> In contrast, while 42% of Australian women had noticed folic acid / folate labelling on foods before or during pregnancy,<sup>25</sup> only 27% of women surveyed in the current study had noticed such labelling. Despite 61% of women being able to identify at least one folate-rich or folic acid-fortified food, the proportion of women who made a conscious change in their diet to increase their intake of such foods in the periconceptual period was low (14%). Overall, less than 5% of all women surveyed ever chose voluntarily fortified bread during the periconceptual period by inspecting labels.

When restricted to women who knew that some bread was fortified and were aware of the relationship between folic acid and NTD, this proportion only increased to 8%, indicating that a higher level of knowledge does not necessarily result in behaviour change among targeted consumers. When a folic acid fortification programme is mandatory, the need for consumers to make conscious changes in diet to achieve a greater periconceptional folate intake is lessened. In addition, the requirement for costly, and potentially ineffective, consumer education campaigns is reduced. Incidental consumption of voluntarily fortified foods does provide some folic acid to childbearing-age women in New Zealand, however, voluntary fortification of foods is not sufficiently widespread to ensure adequate intakes.<sup>12</sup> Moreover, there are known socio-demographic differences in the intake of foods most likely to be fortified (wholegrain bread and breakfast cereal), with younger women, Māori and Pacific women and those living in areas of greatest socioeconomic deprivation being the least likely to regularly consume these foods.<sup>26,27</sup> With cost as a probable barrier to consumption of voluntarily fortified foods in these groups, mandatory fortification of bread would increase the availability of folic acid to all women in the target population, regardless of socio-economic status.

Receipt of folic acid supplement information before pregnancy was also lower in the least advantaged socio-demographic subgroups, whether or not a pregnancy was planned. In a recent Canadian study on the sources of information for the use of periconceptional folic acid, 65% of women had received information prior to pregnancy, similar to the 69% found in the present study.<sup>28</sup> Sixty-four percent of Canadian women had received information from a general practitioner prior to conception, compared to only 24% in the present study, likely reflecting differences in the accessibility of primary healthcare.<sup>28</sup> In New Zealand, most antenatal services are free for pregnant women, however primary healthcare before conception comes at a cost to the consumer.<sup>29</sup> In the highest income bracket, 42% of women with planned pregnancies received folic acid information from a general practitioner before pregnancy compared to 25% in the lowest income bracket. Among all women surveyed, midwives and general practitioners were the preferred sources of vitamin and mineral information for pregnancy (94% and 86%, respectively, women could select more than one source). However, receiving information from a midwife before pregnancy was not associated with recommended folic acid supplement use, possibly due to a long interval between the receipt of information during a previous pregnancy and the current pregnancy. Aside from midwives, information received from people (general practitioners, other health professionals, friends or family) was associated with recommended folic acid supplement use. This suggests that with the exception of the Internet, person-to-person counselling on folic acid may be more effective than other sources of information, such as printed material or broadcast media. Qualitative research conducted by the United Kingdom's Food Standard Agency also found that women valued verbal information on folic acid above printed sources, and formal printed sources such as leaflets from general practitio-

ners' clinics were considered too lengthy and complex by some respondents.<sup>30</sup> Despite these findings, person-to-person counselling services may be unable to reach those most at risk of suboptimal folic acid intake, similar to public education campaigns.<sup>31-33</sup>

The Internet emerged in the present study as another important source of folic acid information among women who planned their pregnancies. However, we found that women who reported the use of online health information differed in terms of socio-demographic characteristics, suggesting potential inequities in Internet access. For example, the proportion of women with planned pregnancies in the highest income bracket who accessed folic acid information via the Internet (18%) was more than double that in the lowest income bracket (8%). Access to and acceptability of the Internet as an information source may also differ by ethnicity, with almost one-quarter of Asian women (24%) obtaining folic acid information this way compared with only 6% of Pacific and 4% of Māori women. We did not assess the quality of the information women sourced in the present study, and it should be noted that online health information ranges from that communicated via social networking through to evidence-based guidelines. With rapidly expanding accessibility, the Internet will continue to be a profuse source of health information, which has the potential to both improve and complicate health promotion education.

### Conclusion

Given the socio-demographic inequities in periconceptional folic acid supplement uptake noted repeatedly elsewhere,<sup>31, 34-36</sup> socio-demographic inequities in the receipt of folic acid information before pregnancy mirrored here are not surprising. This finding suggests that future health promotion initiatives should be tailored toward women who are younger, less educated, with lower income, multiparous or of minority ethnicity status. Alongside education, it is clear that mandatory folic acid fortification, a structural intervention that does not rely upon behaviour change and is not restricted to those with access to healthcare or health information, is required to achieve the desired degree of equity.

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### AUTHOR DISCLOSURES

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## Original Article

## Folate knowledge and consumer behaviour among pregnant New Zealand women prior to the potential introduction of mandatory fortification

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### 可能施行強制葉酸強化之前紐西蘭懷孕婦女的葉酸知識及消費行為

為了降低胎兒神經管缺陷的風險，紐西蘭衛生部建議婦女補充葉酸，至少從懷孕前的一個月直到懷孕 12 週，並多攝取富含葉酸的食物。可能在 2012 年 5 月執行強制麵包葉酸強化之前，從一個產後的調查來瞭解紐西蘭懷孕婦女的葉酸知識及消費行為。計畫懷孕的婦女對葉酸建議的知識越高，則葉酸的補充攝取也越多(直線趨勢  $p=0.001$ )。一些社會的次族群，甚至計畫懷孕者，未能在受孕前接收到充分的葉酸資訊；這些族群包括：毛利族婦女、太平洋裔及亞裔的婦女、年輕女性、大家庭的女性以及低教育程度或收入的婦女。被調查的全部婦女中，只有一半的人知道一些麵包中有添加葉酸，而這些女性中僅有少於 2% 的人在懷孕前會經由查看標籤，一貫地選擇自主葉酸強化麵包。61% 的婦女指出他們或是支持強制強化或者對這件事情沒有意見，只有 4% 的人反對添加葉酸至麵包中。接近三分之一的女性(35%)贊成自主性強化。未來健康推廣活動應針對年輕、低教育程度、低收入、多產或少數民族的婦女。但是可能仍需要強制葉酸強化，以達到期望的公平性。

**關鍵字：**葉酸、神經管缺陷、強化、健康行為、營養政策