European Journal of Clinical Nutrition (2016) 00, 1–6
© 2016 Macmillan Publishers Limited All rights reserved 0954-3007/16
www.nature.com/ejcn

ORIGINAL ARTICLE

Knowledge about folic acid supplementation in women presenting for antenatal care

S Cawley[1], L Mullaney[1], A McKeating[2], M Farren[2], D McCartney[1] and MJ Turner[2]

BACKGROUND/OBJECTIVES: The incidence of neural tube defects (NTDs) in Ireland has increased in recent years. This study examines knowledge about folic acid (FA) supplementation for the prevention of NTDs among women presenting for antenatal care.
SUBJECTS/METHODS: Women were recruited at their convenience in the first trimester after sonographic confirmation of an ongoing singleton pregnancy. A detailed questionnaire was completed under the supervision of a research dietitian. Clinical and socio-demographic details were collected.
RESULTS: Of the 587 women studied, 96% took FA during early pregnancy. Of these, 56.4% cited brain/spinal development or the prevention of brain/spinal defects, spina bifida or NTDs as the reason for taking FA. Multivariate analysis showed that women who were experiencing material deprivation or who were living in Ireland < 5 years were least likely to be knowledgeable about the benefits of FA supplementation ($P < 0.05$ for both). Over half (57.1%) of the women did not take FA preconceptionally. The main reason reported for not supplementing preconceptionally was that the woman did not expect to get pregnant (76.4%). Over one-third of women (35%), however, reported that they did not know they needed to take FA before becoming pregnant.
CONCLUSIONS: These results highlight the need for a renewed public health campaign in Ireland about the importance of FA. As well as focusing on women who have recently come to live in Ireland, this campaign needs focus on women living in deprivation, as these are the women most at risk of having inadequate knowledge about the importance of FA in improving pregnancy outcomes.

European Journal of Clinical Nutrition (2016) **00,** 1–6. doi:10.1038/ejcn.2016.104

Uncorrected

INTRODUCTION

Neural tube defects (NTDs) are major congenital anomalies that are potentially preventable by periconceptional supplementation with folic acid (FA).[1,2] The most recent sustained public health campaign in Ireland to increase awareness about the importance of FA for NTD prevention was held in 2005.[3] A recent comprehensive national audit of NTDs in Ireland has shown that the incidence of NTDs increased between 2009 and 2011.[4] We recently reported that uptake of periconceptional FA supplementation among pregnant women in Ireland remains low, with only 24.7% taking FA for >12 weeks preconceptionally as required to minimise NTD risk.[5–9] In a separate study, we examined trends in FA supplementation practices from 2009 to 2013 and showed that the rate of periconceptional FA supplementation decreased over this 5-year period, particularly among women who were multiparous, aged 30–39 years, Irish born or obese.[10]

Perhaps this is not surprising given the wide national and international variability in guidelines for FA supplementation in pregnancy.[11,12] The lack of standardised guidelines may contribute to a lack of clarity in communications with women about FA supplementation. There is a need for contemporary data on women's knowledge about FA supplementation given the recent upward trend in NTD incidence in Ireland, the variability in national and international FA guidelines and the poor supplementation practices observed among Irish women, particularly preconceptionally.[4,5,11]

The aim of this study was therefore to examine knowledge about the importance of FA supplementation for pregnancy outcomes among women presenting for antenatal care.

MATERIALS AND METHODS

The Coombe Women and Infants University Hospital (CWIUH) in Dublin is one of the largest maternity hospitals in the European Union and cares for women from all socio-economic groups and across the urban–rural divide. Data were collected from pregnant women attending CWIUH between January and September 2014. Women's socio-demographic and clinical details were computerised routinely at their first antenatal visit. The inclusion criteria for this study were presentation for antenatal care after an ultrasound examination confirmed an ongoing singleton pregnancy in the first trimester. The exclusion criteria were multiple pregnancies and a woman's inability to understand English.

Women were recruited by convenience sampling at their first antenatal visit, before 18-week gestation. If the woman agreed to participate in the study, she was given the relevant questionnaire. This questionnaire was completed under the supervision of a research dietitian, taking approximately 15 min.

FA questionnaire

The FA questionnaire captured data about the use of FA both preconceptionally and periconceptionally. Maternal characteristics such as socio-economic status, highest level of education attained, smoking status and the number of years spent living in Ireland were also collected.

Knowledge about the importance of FA supplementation was assessed using a number of questions. Participants were asked by open-ended question, 'Why do you take folic acid?' If participants said, for example, '…. for my baby's health…', the investigator probed further about the aspects of their baby's health, which the participant felt FA was important for. The data from this question were subsequently categorised thematically into 21 reasons why women reported taking FA, as well as another category entitled 'I don't know why I am taking folic acid'.

[1]School of Biological Sciences, Dublin Institute of Technology, Dublin, Ireland and [2]UCD Centre for Human Reproduction, Coombe Women and Infants University Hospital, Dublin, Ireland. Correspondence: S Cawley, School of Biological Science, Dublin Institute of Technology, Kevin Street, Dublin 8, Ireland.
E-mail: cawleyshona88@gmail.com
Received 5 February 2016; revised 14 March 2016; accepted 16 April 2016

Women were asked three further questions about FA. These questions were closed-ended and categorical in nature with pre-defined answer options selected by the woman.

Anthropometric data

Height was measured to the nearest centimetre using a Seca wall-mounted digital stadiometer (Seca, Birmingham, UK) with the woman standing in her bare feet. Weight and body composition were measured digitally using a Tanita Body Composition Analyser Model MC-180MA III (Tanita Corp, Tokyo, Japan) and a body mass index (BMI) was calculated.

Information on socio-economic status was derived using questions from the EU Survey on Income and Living Conditions.[13] Material indices of disadvantage including relative income poverty and relative deprivation status were derived, while consistent poverty status was also calculated. Relative deprivation was assessed by determining whether respondents had experienced the enforced absence (owing to financial constraint) of $\geqslant 2$ basic necessities from a list of 11 over the past year. Relative income poverty status was determined by comparing equivalised household income against the 60% national median income threshold. Consistent poverty was identified if a respondent was categorised as being in relative income poverty in addition to experiencing the enforced absence of $\geqslant 2$ of the 11 basic markers of deprivation. The detailed methodological algorithms used to calculate these indicators of poverty are described in a document produced by the European Commission[14] and have now been adopted by the Irish Central Statistics Office.[13] Written informed consent was obtained from all participants. The study was approved by the Hospital's Research Ethics Committee (Study Reference No: 27–2013).[15]

Data from the participants' questionnaires were anonymised and coded on a Microsoft Excel spreadsheet. Where appropriate, continuous variables were collapsed into categorical variables. The distribution of continuous data was assessed for normality by determining the kurtosis and skewness of the distribution and assessing the associated Kolmogorov–Smirnov statistics and by a visual inspection of the distribution histogram and boxplot.

Descriptive statistics were first used to describe the characteristics of the study cohort. Inferential chi-square tests for independence were then used to analyse differences in categorical variables (for example, the use of FA supplements preconceptionally, FA supplementation for >12 weeks preconceptionally, appropriate knowledge about the importance of FA supplementation) between different population groups.

Binary logistic regression analyses were finally performed to assess the independent associations between a number of putative predictor variables and the likelihood of having appropriate FA knowledge. Factors were included in the multivariate model based on a statistically significant finding from the preceding univariate analyses ($P < 0.05$), their previous association with FA supplementation practices[5] and on the achievement of sufficient numbers in each category of the variable to ensure that the assumptions for binary logistic regression analysis were met.

The dependent FA knowledge variable in this model was defined according to participant responses about why they used FA. Women who cited protection against NTDs, spina bifida, anencephaly, brain defects or spinal defects or who cited spinal or brain development as their reason for FA use were adjudged to have appropriate FA knowledge. Five independent variables (years spent living in Ireland, BMI, relative deprivation status, whether the pregnancy was planned or not and parity) were included in the model, with a *P*-value < 0.05 considered to be statistically significant.

RESULTS

Of the women approached to take part in the study, 24 declined to participate usually because of time constraints, for example, they had to return to work. The characteristics of the women who agreed to be interviewed ($n = 587$) are shown in Table 1. This number was chosen based on the number of participants recruited in studies with similar outcomes.[16–19] The characteristics of the study population were similar to those of the broader hospital population and the national obstetric population in terms of their major socio-demographic and other indicators (for example, age, socio-economic status, weight and so on)[15,20] Overall, 18.1% of these women ($n = 106$) were obese based on a BMI $\geqslant 30$ kg/m^2. Of the 564 women (96.1%) who reported taking

Table 1. Characteristics of the study population

	(n = *587*)
Age (years; mean (s.d.))	30.5 (5.5)
Weight (kg; mean (s.d.))[a]	69.3 (15.4)
Body mass index (kg/m^2; mean (s.d.))[a]	25.8 (5.3)
Underweight (%; *n*)	1.9 ($n = 11$)
Ideal weight (%; *n*)	50.7 ($n = 296$)
Overweight (%; *n*)	29.3 ($n = 171$)
Obese (%; *n*)	18.1 ($n = 106$)
Nulliparous (%; *n*)[b]	40.2 ($n = 235$)
Marital status[b]	
Single (%; *n*)	48.0 ($n = 280$)
Smoking[c]	
Current smoker (%; *n*)	12.7 ($n = 73$)
Former smoker (%; *n*)	35.2 ($n = 203$)
Never smoked (%; *n*)	52.0 ($n = 300$)
Taking FA postconceptionally (%; *n*)	96.1 ($n = 564$)
Taking FA preconceptionally and postconceptionally (%; *n*)	42. 9 ($n = 252$)
Taking FA >12 weeks preconceptionally (%; *n*)	24.7 ($n = 145$)

Abbreviation: FA, folic acid. [a]Data for $n = 584$. [b]Data for $n = 583$. [c]Data for $n = 576$.

FA at any point during their pregnancy, 92% ($n = 516$) said that they were taking FA 'for a healthy baby' when asked to select reasons from a range of possible answers (see Methods section for categories; Table 2).

However, when questioned in an open-ended manner, 'Why do you take folic acid?', only 56.4% ($n = 318$) of the women who took FA during their pregnancy mentioned the importance of FA in 'spinal or brain development' or in the prevention of 'spinal or brain defects', 'spina bifida' or 'neural tube defects'. Numerous other reasons were reported by women for taking FA, including 'for baby's health and development', 'because my doctor told me to', 'for prevention of miscarriage', 'for nutrients' and 'for baby's bones' (Table 3).

Among those who did not supplement with FA preconceptionally ($n = 331$), the main reason reported for not doing so was that the woman did not expect to get pregnant (76.4%). Over one-third of women (35%) who did not supplement preconceptionally, however, reported that they did not know that they needed to take FA before becoming pregnant (Table 2). For those who took FA both preconceptionally and postconceptionally and for those who took FA only after becoming pregnant, the main sources of this advice were the family doctor, family and friends.

There was no significant difference in knowledge about the reasons for taking FA between those who took FA for 12 weeks preconceptionally (58.6% with appropriate knowledge; $n = 85/145$) compared with those who did not take FA for 12 weeks preconceptionally (55.6% with appropriate knowledge; $n = 233/419$) ($P = 0.594$).

There was also no difference in FA knowledge between those who took FA for any duration preconceptionally (56%; $n = 141/252$) compared with those who only took FA once they found out that they were pregnant (56.7%; $n = 177/312$) ($P = 0.920$).

For those who took FA at any point during their pregnancy, the factors associated with appropriate FA knowledge upon univariate analyses are shown in Table 4. These data show that women who had a healthy BMI were more likely to know the reasons for taking FA in pregnancy ($P < 0.05$), with FA knowledge declining consistently as BMI increased above the ideal weight range. Women experiencing relative deprivation were less likely to have

Uncorrected Proof

© 2016 Macmillan Publishers Limited

Table 2. Knowledge and attitudes related to folic acid and neural tube defects (NTDs)

	% (n)
Advice source to take folic acid for those who took FA during pregnancy[a]	
Midwife	9.4 (53/563)
Nurse	5.3 (30/563)
Family doctor	**63.1 (355/563)**
Obstetrician	3.6 (20/563)
Family/friends	**25.6 (144/563)**
Internet	11.7 (66/563)
Magazine	6.2 (35/563)
Radio or television	3.9 (22/563)
Other	5.0 (28/563)
Advice source to take folic acid for those who took FA before pregnancy[a]	
Midwife	7.6 (19/251)
Nurse	6.8 (17/251)
Obstetrician	4.8 (12/251)
Family doctor	**55 (138/251)**
Family/friends	**33.5 (84/251)**
Magazines	7.6 (19/251)
Internet	17.5 (44/251)
Radio	5.2 (13/251)
Other	6 (15/251)
Why do you take folic acid?[b]	
I don't usually eat the right foods	20.4 (114/560)
Prevents heart disease	4.3 (24/560)
Good for health	41.4 (232/560)
For a healthy baby	**92.0 (516/560)**
Family and friends say it is good	37.0 (207/560)
Doctor and nurse say it is good	**53.6 (300/560)**
Why did you not take folic acid before becoming pregnant?	
Did not expect to get pregnant	**76.4 (253/331)**
Did not think I needed to take it	**35 (116/331)**
Vitamins are too expensive	0.0 (0/331)
Vitamins gave me side effects	0.6 (2/331)

Abbreviation: FA, folic acid. [a]Data missing for $n=1$. [b]Data missing for $n=4$.

Table 3. Knowledge about the reasons for taking FA among those supplemented with FA during pregnancy ($n=564$)

Reason stated for taking FA supplements	% (n)
To prevent spina bifida	34.2 (193)
It is important for baby's health	14.4 (81)
To prevent neural tube defects	8.9 (50)
It is important for baby's development	6.9 (39)
It is important for pregnancy	6.7 (38)
To support spine development	6.0 (34)
Don't know	5.5 (31)
Because the doctor told me to	3.4 (19)
To prevent spine defects	3.2 (18)
To support brain development	2.7 (15)
To prevent brain defects	1.4 (8)
To enhance nutrient intake	1.2 (7)
Because I was planning the pregnancy	1.2 (7)
To support bone development/bones	1.1 (6)
Because I have epilepsy	0.9 (5)
To prevent miscarriage	0.7 (4)
To prevent cleft palate	0.5 (3)
To prevent osteoporosis	0.2 (1)
To prevent cystic fibrosis	0.4 (2)
To prevent Down's syndrome	0.4 (2)
To improve energy levels	0.2 (1)

Abbreviation: FA, folic acid.

Table 4. Univariate analysis of factors associated with appropriate FA knowledge among those taking FA during pregnancy ($n=564$)

	n	*Mentioned NTD/spina bifida/anencephaly/ spinal or brain development/ prevention of spinal or brain defects* % (n)	P
Body mass index (kg/m^2)[a]			**0.022**
<18.5	8	50.0 (4)	
18.5–24.9	285	63.5 (181)	
25–29.9	164	50.6 (83)	
30–34.9	66	48.5 (32)	
35–39.9	25	44.0 (11)	
$\geqslant 40$	15	38.5 (5)	
Age (years)			0.766
<22	39	61.5 (24)	
22–30	235	55.3 (130)	
>30	290	56.6 (164)	
Years living in Ireland			
<5	25	36.0 (9)	0.068
5–10	92	62.0 (57)	
>10 years	447	56.4 (252)	
Years required for full-time education[b]			
$\leqslant 15$	102	54.9 (56)	0.239
16–18	95	66.3 (63)	
>19	69	63.3 (38)	
Age completed for full-time education[b]			0.563
$\leqslant 21$	142	59.2 (84)	
>22	115	63.5 (73)	
Parity[a]			
Nulliparous	229	58.5 (134)	0.477
Multiparous	332	55.1 (183)	
Planned pregnancy[c]			
Yes	347	59.7 (207)	0.061
No	213	51.2 (109)	
Married[c]			
Yes	286	57.3 (164)	0.719
No	274	55.5 (152)	
Current smoker[d]			
No	488	57.8 (282)	0.078
Yes	66	45.5 (30)	
Place of birth[e]			
Irish	421	56.8 (239)	0.748
Non-Irish	38	52.6 (20)	
Relative income poverty[f]			
Yes	72	48.6 (35)	0.116
No	300	59.7 (179)	
Relative deprivation[g]			
Yes	45	40.0 (18)	**0.023**
No	496	58.7 (291)	
Consistent poverty[h]			
Yes	19	36.8 (7)	0.097
No	346	59.0 (204)	
Assisted reproduction[i]			0.676
Yes	12	66.7 (8)	
No	550	56.4 (310)	

Abbreviations: FA, folic acid; NTD, neural tube defect. Statistical test used is cross-tabulation. [a]Data for $n=561$. [b]Data for $n=257$. [c]Data for $n=560$. [d]Data for $n=554$. [e]Data for $n=459$. [f]Data for $n=372$. [g]Data for $n=541$. [h]Data for $n=365$. [i]Data for $n=562$.

Uncorrected Proof

© 2016 Macmillan Publishers Limited

appropriate knowledge about the reasons for taking FA however ($P < 0.05$). Also, despite a low number of participants in this category, those who were living in Ireland < 5 years showed a tendency to have poorer knowledge than those who were living in Ireland for 5–10 years or for > 10 years ($P = 0.07$). When women living in Ireland for < 5 years were compared against those living in Ireland for > 10 years, the women living in Ireland > 10 years had superior knowledge ($P = 0.04$).

Further multivariate binary logistic analyses were also undertaken to adjust for the potential confounding effect of other factors in determining the correlates of appropriate FA knowledge (Table 5). The full regression model from which these data were derived explained 5% (Cox and Snell R Square) to 6% (Nagelkerke R Square) of the variance in FA use for $\geqslant 12$ weeks preconceptionally. These analyses showed that, among women who took FA during their pregnancy, those who were experiencing relative deprivation continued to have a poorer knowledge than their more affluent peers ($P = 0.034$). Those who were living in Ireland < 5 years were also less likely to have appropriate knowledge about the benefits of FA supplementation than either those living in Ireland for 5–10 years ($P = 0.039$) or those living in Ireland for > 10 years ($P = 0.038$).

DISCUSSION

This observational study of 587 women presenting for antenatal care found that, of those women who reported taking FA during their pregnancy, only half took FA to prevent NTDs or anencephaly or spina bifida or spinal or brain defects or because they believed it to be important for spinal and brain development.

Table 5. Multivariate analysis of factors associated with appropriate knowledge about FA[a]

	Likelihood of mentioning NTD/anencephaly/ spina bifida/brain or spinal development/ prevention of brain or spinal defects		
	n	*Odds ratio (95% CI)*	P-*value*
Years living in Ireland			
$\leqslant 5$	23	1.0[b]	
5–10	89	2.83 (1.04–7.63)	**0.039**
> 10	447	2.63 (1.05–6.59)	**0.038**
BMI (kg/m^2)			
Class 1 (< 18.5)	10	3.14 (0.77–12.80)	0.109
Class 2 (18.5–24.9)	286	1.87 (0.45–7.70)	0.388
Class 3 (25–29.9)	163	1.88 (0.42–8.01)	0.421
Class 4 (30–34.9)	63	1.50 (0.30–7.51)	0.613
Class 5 (35–39.9)	25	0.52 (0.25–9.28)	0.647
Class 6 ($\geqslant 40$)	12	1.0[b]	
Experiencing relative deprivation			
Yes	31	0.51 (0.271–0.95)	**0.034**
No	141	1.0[b]	
Planned pregnancy			
Yes	343	1.40 (0.975–1.99)	0.068
No	216	1.0[b]	
Parity			
Nulliparous	224	1.12 (0.784–1.61)	0.524
Multiparous	335	1.0[b]	

Abbreviations: BMI, body mass index; CI, confidence interval; FA, folic acid; NTD, neural tube defect. [a]Data for $n = 559$ for which all variables are available. [b]1.0 denotes the reference category.

On multivariate analysis, those who were experiencing relative deprivation had poorer knowledge about FA than their more affluent peers ($P = 0.034$). Those who were living in Ireland < 5 years were also less likely to have appropriate knowledge about the benefits of FA supplementation than those living in Ireland for > 5 years ($P < 0.05$). Of those who reported taking FA during their pregnancy, 55% reported the family doctor as the primary source of advice and information concerning FA, followed by family and friends (25.6%). One-third of women who did not supplement preconceptionally reported that they did not know that they needed to take FA before becoming pregnant. Women reported that the main reason for not taking FA before their pregnancy was that they did not expect to get pregnant. This highlights the importance of pregnancy planning as a predictor of FA use among women in Ireland.

Previous international studies have shown that 16–72% of women were aware of the NTD-protective benefits of FA.[16–19,21–23] One Irish study of 313 women found that 10.6% ($n = 36$) of the total sample knew that FA could prevent spina bifida.[18] A more recent Irish study that examined knowledge about the prevention of NTDs with FA showed that knowledge rose from 21% to 66% ($P < 0.001$) between 1996 and 2002.[19] This was probably reflective of a major media-based FA promotional campaign undertaken by the Irish Department of Health and Children in 2000–2001. This finding highlights the potential positive effect that a public health campaign can have on FA knowledge and usage. Since this campaign (2000–2001), there have been no more public health campaigns to inform women regarding the importance of taking FA. The absence of a public heath campaign of this nature may be a factor contributing to the suboptimal knowledge described in this study where only 56.4% cited brain/spinal development or the prevention of brain/spinal defects, spina bifida or NTDs as the reason for taking FA. There was no difference in FA knowledge between those who took FA for any duration preconceptionally (56%; $n = 141/252$) compared with those who only took FA once they found out that they were pregnant (56.7%; $n = 177/312$) ($P = 0.920$). A key objective of future FA campaigns would therefore be to achieve similar increases in preconceptional FA supplementation, as those apparently achieved in postconceptional FA supplementation rates by previous campaigns.

When confounding factors were controlled for in the current study, women who were more affluent and those who had lived in Ireland longer had better knowledge about the reasons for taking FA. Other studies have also found that lower socio-economic status groups have poorer nutritional knowledge and practices.[24,25] Thus future public health campaigns about FA should incorporate elements that are specifically targeted at disadvantaged women.

It is possible that those living in Ireland for > 5 years have better knowledge than those living in Ireland for < 5 years, because many of those resident in Ireland for a longer time would have been exposed to the last major public health campaigns about FA supplementation in 2000–2001 and 2005. It is noteworthy that the increased maternal FA knowledge achieved between 1996 and 2002 coincided with an increase in FA supplement use during pregnancy from 14% to 83% of respondents during this time. The demonstrable efficacy of such campaigns, the significant time elapsed since the last campaign and the increased number of non-Irish nationals now resident in Ireland all suggest that the need for a further national public health campaign in this area is now prescient.

One previous study found that 34% of respondents reported the family doctor as the primary source of advice concerning FA, whereas 20% mentioned family and friends and 22% mentioned the media.[26] The literature consistently shows that the family doctor is the main source of advice regarding FA supplementation, highlighting the potential efficacy of a national FA campaign supported by primary care physicians.[17,18]

Uncorrected Proof

© 2016 Macmillan Publishers Limited

This study provides contemporary information on women's knowledge about FA supplementation. This information is both important and timely given the recent upward trend in NTD incidence in Ireland, the variability in national and international guidelines concerning FA use before and during pregnancy and the poor FA supplementation practices observed among women in Ireland, particularly preconceptionally.[4,5,11]

This study indicates that the main reason why women do not take FA before pregnancy is that they did not expect to get pregnant. This finding highlights the need for a revised public health campaign with a new message that all women who are at risk of becoming pregnant should take FA.

This study has strengths. First, the information on FA supplementation was recorded using a supervised questionnaire completed at a personal consultation with a single, trained dietetic researcher at the first antenatal visit. This reduced the risks of respondent error, recall bias or interobserver variation. This supervised approach has previously been shown to result in lower levels of recall bias compared with self-administered questionnaires.[27]

Maternal socio-economic, socio-demographic and anthropometric data, including measured weight, height and BMI, were also recorded accurately in a standardised way. This enhances the integrity of these data.[28] The study sample is also representative of the broader national obstetric population from a socio-economic and socio-demographic perspective, increasing the applicability and relevance of our findings in the broader public health context.

A potential weakness of the single-centre, convenience sampling method employed in this study is that the subjects recruited may differ from the wider population. However, the hospital does accept women from all socio-economic groups and from across the urban–rural divide, with roughly one in eight of all births in the Republic of Ireland being delivered at this hospital in 2013.[15] The substantially increased time and personnel costs associated with a consecutive sampling protocol precluded the use of such quota-controlled recruitment techniques. However, by inviting all women attending the hospital to take part in the study, we aimed to recruit a study population that was largely representative of the national obstetric population; and our *post hoc* analyses confirmed that this objective had been met. A further challenge with all observational studies is the potential for confounding when evaluating the association between individual factors and the outcome variable. However, this was addressed by using multivariate statistical analyses.

CONCLUSION

In Ireland, the last sustained health promotional campaign for FA was held 10 years ago in 2005. Our results show that those women who have moved to Ireland in the past 10 years have poorer knowledge of the importance of FA for improving pregnancy outcomes. This suggests that another campaign is required to improve public knowledge, especially in relation to the need for preconceptional FA supplementation. Given that over two-thirds of women who did not supplement with FA preconceptionally did so because they did not expect to get pregnant, this public health campaign should be aimed at all women who could potentially become pregnant, as opposed to just those who are planning a pregnancy. The incidence of NTDs is too low to relate these findings to outcomes of the pregnancies.[4] Large population studies would be required in order to compare supplementation practices to pregnancy outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

We thank the pregnant women who participated in this study. We also thank our midwifery colleagues Ms Ruth Harley and Ms Muireann Ni Mhurchu who assisted in the recruitment of women for this study. This work was supported by *Safe*food.

REFERENCES

1 Czeizel A, Dudas I. Prevention of the first occurrences of neural tube defects by periconceptional vitamin supplementation. *N Engl J Med* 1992; **327**: 1832–1835.
2 Medical Research Council Vitamin Study Research Group. Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. *Lancet* 1991; **338**: 131–137.
3 Food Safety Authority of Ireland. *Report of the National Committee on Folic Acid Food Fortification*. FSAI: Dublin, Ireland, 2006.
4 Mc Donnell R, Delaney V, O'Mahony MT, Mullaney C, Lee B, Turner MJ. Neural tube defects in the Republic of Ireland in 2009-11. *J Public Health* 2014; **37**: 57–63.
5 Cawley S, Mullaney L, McKeating A, Farren M, McCartney D, Turner MJ. An analysis of FA supplementation in women presenting for antenatal care. *J Public Health* 2016; **38**: 122–129.
6 Crider KS, Devine O, Hao L, Dowling NF, Li S, Molloy AM *et al.* Population of red blood cell folate concentration for prevention of neural tube defects: Bayesian model. *BMJ* 2014; **349**: g4554.
7 Lamers Y, Prinz-Langenohl R, Bramswig S, Pietrzik K. Red blood cell folate concentrations increase more after supplementation with [6S]-5methyl tetrahydrafolae than with folic acid in women of childbearing age. *Am J Clin Nutr* 2006; **84**: 156–161.
8 Norsworthy B, Skeaff CM, Adank C, Green TJ. Effects of once-a-week or daily folic acid supplementation on red blood cell folate concentrations in women. *Eur J Clin Nutr* 2004; **58**: 548–554.
9 Hurthouse NA, Gray AR, Miller JC, Rose MC, Houghton LA. Folate status of reproductive age women and neural tube defect risk- the effect of long term folic acid supplementation at doses of 140 μg and 400 μg per day. *Nutrients* 2011; **3**: 49–62.
10 McKeating A, Crosby DA, Collins M, O'Higgins A, McMahon L, Turner MJ. A longitudinal study of unplanned pregnancy in a maternity hospital setting. *Int J Gynecol Obstet* 2015; **128**: 106–109.
11 Cawley S, Mullaney L, McKeating A, Farren M, McCartney D, Turner MJ. A review of European guidelines on periconceptional folic acid supplementation. *Eur J Clin Nutr* 2015; **70**: 143–154.
12 Stamm RA, Houghton LA. Nutrient intake values for folate during pregnancy and lactation vary widely around the world. *Nutrients* 2013; **5**: 3920–3947.
13 Central Statistics Office. *EU Survey on Income and Living Conditions (EU-SILC) 2011 and Revised 2010 Results*. Central Statistics Office: Dublin, Ireland, 2013.
14 European Commission Working Group - Statistics on Income Poverty and Social Exclusion Laekenindictaors Detailed Calculation Methodology. Luxembourg: Quetelet Room, Bech Building, 2003. Available at http://www.cso.ie/en/media/csoie/eusilc/documents/Laeken,Indicators,-calculation algorithm.pdf (last accessed 8 January 2014).
15 *Coombe Women and Infants University Hospital. Annual Clinical Report*. HSE Print and Design, 2013. Q2
16 Paudel P, Wing K, Silpakear SK. Awareness of periconceptional folic acid supplementation among Nepal women of child bearing age: a cross sectional study. *Prev Med* 2012; **55**: 511–513.
17 Al Hakeem MMK. Impact of education on knowledge and se of FA among Sausi women. *Pak J Med Sci* 2012; **28**: 686–690.
18 Sayers GM, Hughes N, Scallan E, Johnson Z. A survey for knowledge and use of FA among women of child bearing age in Dublin. *J Public Health Med* 1997; **19**: 328–22.
19 Ward M, Hutton J, Mc Donnell R, Bachir N, Scallan E, O'Leary M *et al.* Folic acid supplements to prevent neural tube defects: trends in east of Ireland 1996-2002. *Ir J Med Sci* 2005; **97**: 274–276.
20 Health Pricing Office & Health Service Executive. *Perinatal Statistics Report 2013*, 2014. Q3
21 Liang H, Duan M, Zhou SF, Li X. Knowledge and use of FA for birth defect prevention among women of childbearing age in Shanghai, China. A prospective cross-sectional study. *Med Sci Monit* 2011; **17**: 87–92.
22 Gjergia R, Stipolier F, Hafiner T, Tezak N, Luzar-Stiffler V. Knowledge and use of folic acid in croatioan pregnant women – a need for health care initiative. *Reprod Toxicol* 2006; **21**: 16–20.
23 de Jong-van den Berg LTW, Hernandez-Diaz S, Werler MM, Louik C, Mitchell AA. Trends and predictors of folic acid awareness and periconceptional use in pregnant women. *Am J Obstet Gynecol* 2005; **192**: 121–128.
24 Variyam JN, Baylock J, Smallwood JM. Modelling nutrition knowledge attitudes, and diet-disease awareness: the case of dietary fibre. *Stat Med* 1996; **15**: 23–35.

Uncorrected Proof

© 2016 Macmillan Publishers Limited

25 McCartney DM, Younger KM, Walsh J, O'Neill M, Sheridan C, Kearney JM. Socio-economic differences in food group and nutrient intakes among young women in Ireland. *Br J Nutr* 2013; **110**: 2084–2097.
26 Dalveit AK, Vollset SE, Lande B, Øien H. Changes in knowledge and attitudes of folate and use of dietary supplements among women of reproductive age in Norway 1998-2000. *Scand J Public Heath* 2004; **32**: 264–271.
27 Bowling A. The mode of questionnaire administration can have serious effects on data quality. *J Public Health* 2005; **27**: 281–291.
28 Fattah C, Farah N, O'Toole F, Barry S, Stuart B, Turner MJ. Body Mass Index (BMI) in women booking for antenatal care: comparison between selfreported and digital measurements. *Eur J Obstet Gynecol Reprod Biol* 2009; **144**: 32–34.

Uncorrected Proof

© 2016 Macmillan Publishers Limited