

original paper

Folic acid knowledge and use among relatives in Irish families with neural tube defects: an intervention study

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Abstract

Background Relatives in families where a child has a neural tube defect (NTD) may be at higher risk of having an affected child. Little is known of their level of knowledge and use of folic acid.

Aim To carry out an intervention study intended to increase knowledge and use of folic acid among relatives.

Methods One hundred aunts and female first cousins (relatives of the proband) were interviewed by telephone before and after receiving an information pack.

Results At baseline, although knowledge of the benefits of folic acid was high (73%), use of folic acid was low (8.8%). After the intervention, knowledge increased and use went up to 19% ($p < 0.05$).

Conclusions This study suggests that relatives in Irish NTD families have a high level of information about folic acid benefits. This awareness may not translate into action since the intervention produced only a modest increase in folic acid use overall. Future studies focussing on women who are planning a pregnancy may show larger benefits from intervention.

Introduction

Relatives in families where a child has been born with a neural tube defect (NTD) are at excess risk of themselves having an affected child. The risk to mothers of having another affected child is approximately 3%, and has been well-studied.¹ However, the risk in more distant relatives, while thought to be greater than that in the general population, is still not clearly understood. Some reports suggest that uncles and aunts related through the mother are more likely than the general population to have an affected child.^{2,4}

We speculated that relatives in NTD families would be more aware of public health campaigns to encourage folic acid use,⁵ because some, at least, have seen the effects of spina bifida on a child and, as family, and also because of some will have a perception of being at increased risk. From among Irish families enrolled in the Boyne Research Institute's study of Genetic Factors in NTDs, aunts and wives of uncles were queried about their use of folic acid before and during early pregnancy. The overall goal of this project is to assess evidence for transmission of factors related to the occurrence of NTDs using a family history approach.

Previous analyses of data from these families indicated that folic acid use by relatives increased throughout the 1990s, so that by the years 1998-2000, 58% of pregnancies were supplemented beforehand and 90% of pregnancies were supplemented during the first three months.⁶ A nutritional survey of Irish women (conducted in 1998-1999) indicated that only 2% were getting the recommended levels of folic acid, and each of these women was taking a folic acid tablet daily.⁷

We surveyed aunts and female first cousins in Irish NTD families to determine their baseline level of knowledge and use of folic acid and then carried out an intervention designed to increase both knowledge and use. This report describes the results of our study.

Methods

Between 1995 and 1999, 77 Irish families where a child had been born with a NTD were interviewed and asked about their relatives and their health (Phase I). In Phase II, staff of the Boyne Research Institute (BRI) went back to the original families seeking contact information for the uncles and aunts in each family. From the original families (called here the 'nuclear families') 48 agreed to provide the contact information for the uncles and aunts. For this paper, the subjects are all described according to their relationship with the proband, the person with a NTD. Thus, the uncles and aunts are the sisters and brothers of the mothers and fathers of the proband.

From March 2000 to February 2001, 355 uncles and aunts were interviewed. These relatives were full siblings of mothers and fathers from the nuclear families. To be eligible for this Phase II study, uncles and aunts had to be 18 years of age or older by January 3, 2000. If relatives were deceased or incompetent a proxy respondent was sought from among spouses or children. Ineligible subjects were uncles and aunts who were adopted, who were half-sibs, who were younger than 18 years of age, or were mentally retarded or mentally ill, or confined to an institution. Proxy interviews were done only for deceased or otherwise eligible subjects. The proxy was the next-of-kin.

Details of their folic acid intakes before and during early pregnancy for past pregnancies to aunts and wives of uncles were published earlier.⁸

Eligibility criteria

To be eligible for this study of folic acid knowledge and use, women had to be either aunts or first cousins, aged from 18 to 40, and living on the island of Ireland. If more than one woman in any one sibship was eligible, we included only the youngest, reasoning that the youngest was less likely to be

Table 1. Knowledge of folic acid before and after intervention

Knowledge of folic acid	Pre-interview (n=100)	Post-interview (n=86)
Ever heard of folic acid?		
Yes	98%	100%
Heard of the benefits of folic acid		
Yes	92%	98%
No	7%	2%
Not sure	1%	0
What are the benefits of folic acid?		
Helps prevent birth defects	49%	32%
Helps prevent spina bifida	73%	73%
Helps prevent Down syndrome	9%	4%
Not sure, don't know	8%	0
When is the best time to take folic acid?		
Before you become pregnant	19%	14%
During pregnancy	1%	0
Before and during early pregnancy	78%	86%
Not sure, don't know	2%	0
Besides tablets, what are ways to take more folic acid?		
Eat foods, such as broccoli, cereals and orange juice	48%	50%
Take a daily multivitamin with folic acid	9%	2%
Take both folate-rich foods and multivitamins/tablets	29%	3%
Don't know, not sure	14%	5%
Where did you hear about folic acid?		
TV or radio	31%	24%
Doctor or nurse	19%	16%
Magazine or newspaper	12%	11%
Friend/relative or word of mouth	30%	32%
Work	4%	2%
School	3%	11%
BRI Intervention Package	NA	4%
Other	NA	1%
Usage of folic acid		
Are you currently taking folic acid daily? Yes	9%	19%*

*p<0.05

knowledgeable and thus would benefit more from the intervention. Furthermore, the youngest was more likely to have her pregnancies ahead of her, while the oldest may have finished her family. Also, we were concerned by what we called 'contamination' within families. That is, sisters would talk to each other and pass on the information that they had participated in a folic acid survey and thus within families, their level of information might not be independent. However, since withholding the intervention from their sisters could be unethical, each older sister also received the intervention pack, without evaluating their level of knowledge or behaviour. Relatives living overseas were ineligible, since the objective was to measure change in knowledge and behaviour among women living in a similar environment, i.e., the island of Ireland.

Contact procedures

From interviews with uncles and aunts, it was determined that there were 30 aunts and 266 female first cousins aged from 18 to 40. Each uncle or aunt, or the contact person in that family, was called back and asked for the contact information for each of their children aged over 18 years at that time. Four aunts living overseas and 135 older sisters were eliminated. Thus, 26

aunts and 131 first cousins were eligible. A further elimination of first cousins who lived overseas and those with no phone and one woman who was sterilised yielded 106 women who were contacted and asked to participate. Six declined giving a refusal rate of 5.7%. The final group included in this study consisted of 100 women.

Folic acid pre-interview

The interview incorporated questions used in surveys reported by the Centers of Disease Control and Prevention (CDC) in the US. Some demographic questions were added to help describe the participants. The project was approved by the Ethics Board of the BRI. The questions covered overall knowledge of folic acid ("Have you ever heard of folic acid?") and usage ("Are you currently taking folic acid tablets daily?"), then specific benefits of folic acid and the source of their information. Demographic questions included level of education, marital status, occupation of respondent and partner/husband, parity and smoking status. The interview took 5-10 minutes to complete over the telephone. Interviews started on 2 April 2001 and were completed on 9 July 2001. Within 14 days an intervention pack was posted to each participant and to each older sister in her family.

Folic acid intervention pack

The pack contained two vouchers for 50p off cereals from two cereal manufacturers, a pack of folic acid pills provided by an Irish pharmaceutical company, two different leaflets from the Irish Department of Health encouraging folic acid use and a letter from the BRI carrying the same information as the government brochures. The pack was sent in an attractively coloured large size envelope with a hand-written address and a postage stamp, to encourage participants to open and read the contents.

Folic acid post-interview

The intention was to carry out the post-interview between 14 and 30 days after the pre-interview. Of the 100 participants contacted for the pre-interview, 86 were located and agreed to the second interview. The interval between the pre- and the post-interview ranged from 4 to 74 days, with an average length of 23 days. Fifty per cent, or 43 women, were re-interviewed from 14 to 30 days; 32 were interviewed more than 30 days after the pre-interview. Reasons for not completing the post-interview were as follows: four students were overseas for the summer, nine women could not be contacted by the closing date despite multiple efforts, one woman had moved and had no telephone.

Statistical analysis

McNemar's test for correlated proportions in a 2x2 table with a correction for continuity was used to test differences in the proportions of women taking folic acid between pre- and post-interviews.⁸

Results

Of the 100 women who participated in the pre-interview, 33% were current smokers, 25% had children and 31% were married. Their ages ranged from 18 to 39, with an average age of 25.7 years. Formal education ceased at Leaving Certificate (equivalent to high school) for 39%, 53% had some college and 8% said that they had a post-graduate level education. Students comprised a large proportion (23%) reflecting the young age of the group; another 22% were professionals (teachers, nurses, accountants) and the remaining 55% included clerical workers, skilled craft workers and unemployed women.

Knowledge of folic acid and its benefits by this group of relatives was very high. Nearly all (98%) had heard of folic acid. Of those, 92% had heard of the benefits. In answer to the question "What are the benefits of folic acid", respondents could choose one or more of the answers. Nearly 50% said that it helped prevent birth defects and 73% knew that folic acid helped prevent spina bifida. They were also very knowledgeable about the best time to take folic acid, most (78%) selecting "before and during early pregnancy" from the choices offered. Almost half knew which foods were good sources of folic acid.

The source of information was identified as TV or radio by 31% and the same proportion had heard from a relative or friend, or by word of mouth (30%). A number had heard at school and others at work. However, in spite of being so well informed, only 9%, or 8 of 91 women, said that they were currently taking folic acid tablets daily (see Table 1).

After the intervention, the level of information as well as use of folic acid increased for each major indicator. At post-interview, 100% had heard of folic acid. The proportion that had heard of its benefits went up from 92% to 98%. The

Table 2. Factors that affected knowledge about the benefits of folic acid at baseline

Factor	Percent heard of the benefits of folic acid at baseline	Percent changed their usage of folic acid after intervention*
Age, average		
Heard of benefits (used FA)	26.1 years	25.3 years
Didn't hear of benefits (used FA)	22.0 years	25.8 years
Marital status		
Married	97%	13%
Unmarried	89%	10%
Have children		
Yes	100%	5%
No	89%	13%
Smoker		
Yes	84%	4%
No	96%	14%
Education		
Completion of secondary school (Leaving Certificate)		
Or less	94%	7%
More than secondary school	90%	13%
Status		
Student	91%	21%
Professional	91%	5%
Other (working class, unemployed)	92%	9%

*Eight women who were using folic acid at baseline not included in this column.

proportion that selected Down syndrome as being prevented by folic acid (a currently incorrect answer) went down from 9% to 4% and the proportion who did not know any specific benefit of folic acid fell from 8% to zero. After the intervention, more women said that the best way to take more folic acid was to take both folate rich foods and multivitamin tablets (29% to 43%). Three women said that their source of information about folic acid came from the BRI intervention pack.

The percentage of women taking folic acid at the post-interview was 19% (16/84), an increase from 9% (9/91) at baseline. This difference is statistically significant ($p < 0.05$ by McNemar's test). All women taking folic acid at baseline (except one) were still taking it at the post-interview. We analysed the factors that might influence knowledge of the benefits at baseline and change in behaviour (started taking folic acid) at the post-interview. At baseline, women who knew of the benefits of folic acid were more likely to be non-smokers, older and married with children. Women who started to take folic acid following the intervention were more likely to be non-smokers, without children, better educated and currently students. In particular, the intervention was successful only among non-smokers ($p < 0.05$; see Table 2).

Discussion

In this small study of Irish families where a child has been born with a NTD, the level of knowledge among female relatives about the benefits of folic acid is remarkably high. Nonetheless, the proportion of women taking folic acid before the intervention was low (9%). The intervention increased each of the indicators of knowledge from an already high level, and more importantly, significantly improved the proportion of women who started to take folic acid. These results are consistent with a previous retrospective study of periconceptional use of folic acid by aunts and wives of uncles in these same families that showed a high level of folic acid use before and during early pregnancy.⁶

Studies of folic acid knowledge and usage in NTD families have been few. In limited surveys of pregnant women at risk for recurrent NTDs none had taken folic acid as recommended.⁹⁻¹⁰ The US Spina Bifida Association of America (SBAA) website carries the results of a survey (carried out from October to December 2000) of women with a history of spina bifida.¹¹ Results are consistent with the present study in describing a high level of knowledge and a lesser level of usage of folic acid. In the SBAA study, 34% of women who have a child with spina bifida and 35% of women with spina bifida took folic acid. Similar levels of folic acid supplementation were reported among women in Texas with a history of a neural tube pregnancy.¹² No survey known to the author has evaluated folic acid use in more distant relatives.

Population-based surveys of knowledge and use of folic acid conducted in the US indicate that awareness of folic acid is gradually increasing, with 68% of women reporting ever having heard of folic acid in a 1998 US survey.¹³ In the same survey, only 13% knew that folic acid helps to prevent birth defects and only 7% knew that folic acid should be taken before pregnancy. Thirty-two per cent of women reported taking a vitamin supplement containing folic acid daily. Although pregnant women are more likely to know about and take folic acid,¹⁴ the gap between knowledge and use seen in our study seems to be widespread.

As with this intervention study, an intense intervention campaign to increase folic acid awareness in four southwestern

Virginia (USA) counties during the 12 months of 1997 significantly raised awareness of benefits from 31% beforehand to 54% afterwards.¹⁵

Surveys of Irish women suggest that knowledge and usage of folic acid may not be as widespread as elsewhere. Sayers et al¹⁶ in a survey of Dublin women reported in 1997, indicated that only 9 of 337 women surveyed were currently taking folic acid supplements. An All-Ireland survey carried out between 1997 and 1999 indicated that only 2% of women aged 18-35 years achieved the recommended folate intake and these women were supplementing their diets with folic acid tablets.⁷ A UK study of diet and serum folate showed that folic acid supplements provided a greater elevation in serum folate levels than could be achieved by dietary sources alone.¹⁷

Factors that were related to compliance with government recommendations are fairly consistent across studies and were found in our study also. Studies carried out in countries such as the UK, the Netherlands and the US as well as in Ireland, showed that women who smoked, or who were young, or of low educational attainment, were less likely to use folic acid.¹⁸⁻²² Smokers as a group particularly merit the attention of public health authorities. In addition to their low use of folic acid, smokers have poor diets with low intake of foods having anti-carcinogenic properties.²³ Public health campaigns to reduce smoking would have a large impact on many aspects of women's health.

Women of low socioeconomic status are more likely to be unaware of the benefits of folic acid. More sensitive efforts by public health authorities to reach women who may be illiterate or who live in disadvantaged circumstances, and who may have other risk factors for poor pregnancy outcomes, are needed to overcome the barriers to information experienced by such women.

This study has a number of strengths and limitations. The high participation rate and inclusion of all eligible subjects are strengths, while the relatively small number of subjects makes it difficult to generalise the results to all Irish NTD relatives. The gold standard for intervention studies is the randomised clinical trial, which was not possible with the small numbers available for this project. The absence of population-based data on knowledge and use of folic acid in Ireland make it impossible to place the high level of knowledge in these families in its proper context.

Nevertheless, available information for Irish groups suggests that these families are paying close attention to public health messages about folic acid. Interviews done over the telephone meant eliminating women without phones, who may be more likely working class. Thus, we may have overestimated knowledge and use of folic acid in this study. Women planning a pregnancy are more likely to take folic acid. This information was not determined by the interview, so the impact of pregnancy contemplators could not be assessed by the study.

Fortification of flour with folic acid is one way to increase usage without having to increase level of information. A reduction of 19% in the occurrence of NTDs in the US has been linked to the introduction of fortified flour.²⁴ However, against a background of falling rates²⁵ it is difficult to ascribe cause and effect with certainty.

To summarise, surveys by this institution have shown that aunts and female first cousins in this group of Irish families with NTDs are very knowledgeable about folic acid and its benefits and a large proportion used folic acid periconceptionally. However, among non-pregnant women, level of folic acid use is low. This intervention increased usage significantly, suggesting that a high level of information and

presumably motivation, can be translated into action with appropriate stimulation. However, even in very knowledgeable women, folic acid was taken by less than one in five women after the intervention. Simply increasing knowledge may not raise folic acid use to acceptable levels. Food supplementation may be the only way to ensure that all women get adequate levels of folic acid.

Acknowledgements

The participation of the respondents is gratefully appreciated. I wish to acknowledge also the expert support of Dorothy Collins and Clodagh Byrne who carried out the interviews, and of David Murphy, Suzanne Markey, Mark Harmon and Catrina Culligan in data management. This study was supported by grants from the Drogheda and District Charity Chest, the Joseph E and Marjorie B Jones Foundation and the Friends of the BRI. In-kind support was provided by Clonmel Healthcare Ltd, Nestle Ireland Ltd and Kellogg's Company of Ireland Ltd.

References

1. Elwood JM, Little J, Elwood JH. Epidemiology and control of neural tube defects. New York: Oxford University Press, 1992.
2. Chatkupt S, Lucek PR, Koenigsberger MR et al. Parental sex effect in spina bifida: a role for genomic imprinting? *Amer J Med Genet* 1992; 44: 508-12.
3. Chatkupt S, Skurnick JH, Jaggi M et al. Study of genetics, epidemiology, and vitamin usage in familial spina bifida in the United States in the 1990s. *Neurology* 1994; 44: 65-70.
4. Byrne J, Cama A, Reilly M et al. Multigenerational maternal transmission in Italian families with neural tube defects. *Amer J Med Genet* 1996; 66: 303-10.
5. Food Safety Advisory Board. The value of folic acid in the prevention of neural tube defects: Report to the Minister for Health and Children. Undated.
6. Byrne J, Byrne C, Collins D. Trends in periconceptual folic acid use by relatives in Irish families with neural tube defects. *Ir Med J* 2001; 94: 302-5.
7. Food Safety Consumption Board. North/South Ireland Food Consumption Survey, Dublin, 2001.
8. Everitt BS. The Analysis of Contingency Tables. Chapman and Hall, London, 1977.
9. Pepe F, Pepe P, Grillo S et al. Periconceptual folic acid intake by Sicilian couples at risk of recurrence of NTD. *Minerva Ginecol* 1999; 51: 399-401 [MEDLINE].
10. Callender ES, Rickard R, Miller L et al. Knowledge and use of folic acid supplementation: a study of Colorado women whose pregnancies were affected by a neural tube defect. *Clin Invest Med* 2001; 24: 124-8 [MEDLINE].
11. Spina Bifida Association of America. Folic acid awareness and consumption survey. Key Findings. <http://www.sbaa.org/>
12. Canfield MA, Andreson JL, Waller DK et al. Folic acid awareness and use among women with a history of a neural tube defect pregnancy — Texas, 2000-2001. *MMWR* September 13, 2002/51 (RR13); 16-19, 2002.
13. Knowledge and use of folic acid by women of childbearing age — United States, 1995 and 1998. *MMWR* 48: 325-7, 1999. <http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/mm4840a2.htm>
14. O'Leary M, Donnell RM, Johnson H. Folic acid and prevention of neural tube defects in 2000 improved awareness-low periconceptual uptake. *Ir Med J* 2001; 94: 180-1.
15. Centers for Disease Control and Prevention. Folic acid campaign and evaluation — Southwestern Virginia, 1997-1999. <http://www.cdc.gov/mmwr/preview/mmwrhtml/00056982.htm>
16. Sayers GM, Hughes N, Scallan E et al. A survey of knowledge and use of folic acid among women of child-bearing age in Dublin. *J Pub Health Med* 1997; 19: 328-32.
17. Elkin AC, Higham J. Folic acid supplements are more effective than increased dietary folate intake in elevating serum folate levels. *Br J Ob Gynaecol* 2000; 107: 285-9.
18. Milner M, Slevin J, Morrow A et al. Suboptimal compliance with periconceptual folic acid in an Irish hospital population. *Ir Med J* 1996; 89: 28-9.
19. Mathews F, Yudkin P, Neil A. Foliates in the periconceptual period: are women getting enough? *Br J Ob Gynaecol* 1998; 105: 954-9.
20. De Walle HEK, van der Pal KM, de Jong-van den Berg LTW et al. Periconceptual folic acid in the Netherlands in 1995: socioeconomic differences. *J Epidemiol Comm Health* 1998; 52: 826-7.
21. Itikala PR, Ruuska SE, Oakley GP et al. Periconceptual intake of folic acid among low-income women. *JAMA* 2000; 283: 3074.
22. Van der Pal-de Bruin KM, de Walle HEK, Jeeninga W et al. The Dutch 'Folic Acid Campaign'— have the goals been achieved? *Paed Perinatal Epidemiol* 2000; 14: 111-7.
23. Subar AF, Harlan LC, Mattson ME. Food and nutrient intake differences between smokers and non-smokers in the US. *AJPH* 1990; 80: 1323-9.
24. Honein MA, Paulozzi LJ, Mathews TJ et al. Impact of folic acid fortification of the US food supply on the occurrence of neural tube defects *JAMA* 2001; 285: 3022-3.
25. Stevenson RE, Allen WP, Pai GS et al. Decline in prevalence of neural tube defects in a high-risk region of the United States. *Pediatr* 2000; 106: 825-7.

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