Knowledge and use of folic acid among college women: a pilot health promotion program led by pharmacy students and faculty

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ABSTRACT
As pharmacists and pharmacy students are increasingly called upon to assume roles in public health activities, it is important to recognize unique opportunities to educate community members on health, wellness, and disease prevention.

Objective: To evaluate the impact of a pilot health promotion program on college women’s knowledge regarding folic acid and prevention of neural tube defects (NTD) and frequency of multivitamin use.

Methods: A health promotion program was developed by a pharmacy student and two pharmacy faculty members that included an oral presentation and reminder messages. A multiple-choice test assessing knowledge of folic acid and NTD and frequency of multivitamin use was given to participants before and immediately after the presentation. Participants then received a reminder message regarding folic acid once a week for three weeks. Knowledge and multivitamin use were re-assessed four weeks post-intervention.

Results: Thirty-two college women voluntarily attended the oral presentation. Twenty-five women (78.2%) completed the four-week post-test. Compared to the pre-test, there were statistically significant increases in average test score (p<0.0001) and correct responses to questions regarding folic acid and NTD (p<0.05 for each question). Participants reported a statistically significant increase in regular (≥4 times/week) multivitamin use (p=0.023).

Conclusion: Participants in the pilot health promotion program demonstrated a statistically significant increase in knowledge about folic acid and frequency of multivitamin use. A similarly-modeled health promotion program may be an effective way of increasing folic acid and NTD knowledge and changing behaviors of multivitamin use in college women.

Keywords: Health Knowledge, Attitudes, Practice. Folic Acid. Health Promotion. United States.
las actitudes sobre el uso de complejos vitamínicos entre universitarias.

Palabras clave: Conocimiento, actitudes y practica de la salud. Acido fólico. Promoción de la salud. Estados Unidos.

INTRODUCTION

Pharmacists and pharmacy students can make important contributions to protecting and improving public health, and various groups are advocating that they assume greater responsibilities in a range of activities including health education and health promotion.1-6 Public health is also recognized as a key component of pharmacy education, and there is much interest in increasing pharmacy students’ exposure to aspects of public health.7-11 Educating women about folic acid for the prevention of neural tube defects (NTD) is one example of the role a pharmacist or pharmacy student can fulfill in encouraging primary prevention.

Neural tube defects are birth defects of the spine (e.g., spina bifida) and brain (e.g., anencephaly) and are among the most common severe birth defects in the United States (U.S.).12,13 NTD result when the neural tube does not form correctly during the first month of pregnancy. Anencephaly, a fatal defect, affects approximately 1 in every 4000 babies in the U.S.14 Spina bifida, which often causes full or partial paralysis, affects approximately 1 in 2500 babies in the U.S.14,15

Data have shown that sufficient folic acid intake before conception and during the first trimester of pregnancy can prevent 50%-70% of NTD.16 Because NTD occur early in pregnancy (often before many women know they are pregnant) and the rate of unintended pregnancy in the U.S. is high17, both the U.S. Public Health Service and the Institute of Medicine have recommended that all women of childbearing potential consume 400 micrograms (mcg) of folic acid daily.16,18 Folic acid is a B vitamin found in certain foods, such as oranges, peanuts, and dark green leafy vegetables. In the late 1990s, the U.S. Food and Drug Administration mandated fortification of cereal grain products including pasta, bread, and breakfast cereals with folic acid.19 However, it is difficult for most women to obtain sufficient amounts of folic acid through food sources alone, therefore, vitamin supplementation is recommended.15,21-24 As most multivitamins sold in the U.S. contain 400 mcg of folic acid, increasing multivitamin use among women of childbearing potential is an essential element of NTD prevention and a priority for U.S. government and advocacy groups.23,25-27

Survey results from the March of Dimes indicate many women in the U.S., especially college-age women, are still unaware of the need for daily folic acid intake to prevent neural tube defects.28 U.S. women aged 18-24 years knew the least about folic acid compared to women aged 25-34 years or 34-45 years. Only 8% of women aged 18-24 years knew that folic acid may prevent birth defects, and only 6% of women in this age group knew that folic acid should be taken before pregnancy. Of those women who were familiar with folic acid, 12% of women aged 18-24 years indicated that physician or other healthcare professional had been the source of that information, compared to 41% of women aged 25-34 years and 35% of women aged 35-45 years. Only 27% of women aged 18-24 years reported daily vitamin use; this reported use was the lowest of all the age groups. Additionally, studies have shown that college students tend to have poor nutrition and usually do not comply with dietary guidelines regarding fruit and vegetable intake, making folic acid supplementation essential in this age group.29,30

Since there is a documented need for education on this topic for this age group, a pilot study was performed to evaluate the impact of a health promotion program. The program, led by a pharmacy student and two pharmacy faculty members, assessed college women’s knowledge regarding folic acid and prevention of NTD and frequency of multivitamin use before and after the intervention.

METHODS

The study was conducted on the campus of a private university in northwestern Ohio (United States) during January and February 2009. The University offers both liberal arts and professional programs on a residential campus with approximately 3,500 students. The University’s Institutional Review Board deemed the study as exempt.

Participation in the health promotion program was voluntary. The health promotion program consisted of an oral presentation and three reminder messages (sent via mail or email) in the weeks following the presentation. Data were collected from participants before the oral presentation (pre-test), immediately following the oral presentation (post-test), and four weeks after the oral presentation (four-week post-test).

Women were invited to attend the oral presentation, which was held one evening on the university’s campus. As advertisements, posters were placed around campus, and emails were sent to the student body. The presentation was advertised as a women’s health seminar with no mention of folic acid or NTD to minimize bias of pre-test results.

Before the oral presentation began, participants were informed that they had the option to anonymously complete pre- and post-tests. Responses to test questions would be analyzed; however, the responses would be anonymous and reported at an aggregate level. Women were informed that they could choose to not complete the pre- or post-tests and still listen to the oral presentation. Women who chose to have their responses analyzed voluntarily provided their contact information to the investigators on data collection forms that were not linked to any test.
Participants completed the pre-test before the oral presentation began. A 30-minute PowerPoint® presentation, written and delivered by a pharmacy student and faculty member, contained recommendations from the U.S. Centers for Disease Control and Prevention (CDC) regarding preconception care. Approximately half of the presentation focused on folic acid and NTD and emphasized the importance of a proper diet as well as the rationale for multivitamin supplementation even in those not planning for pregnancy. Common barriers to multivitamin use were addressed, such as forgetfulness, difficulty in swallowing pills, and cost. Women were encouraged to increase multivitamin use now as a possible health benefit for themselves, regardless of future pregnancy intent. The remainder of the presentation covered other preconception care topics including vaccines to receive before pregnancy, tobacco and alcohol abstinence, and healthy weight and nutrition. Items to avoid during pregnancy, such as certain types of fish and high doses of vitamin A, were presented.

Immediately after the presentation, participants completed the post-test. Pamphlets, fact sheets, and a chart to track multivitamin use were then provided. Nail files, pencils, and magnets with messages about folic acid such as “Take five seconds, Take folic acid” were distributed, along with green ribbons to promote folic acid awareness. In addition, snacks containing folic acid were available.

One week after the oral presentation, an email reminder was sent. The email included a link to a ringtone created specifically for the program that participants could download onto a mobile phone as an alarm to prompt them to take their daily multivitamin. The link to the March of Dimes Facebook page (copyright, 2009) was also included, and participants were encouraged to visit for more information and free resources.

Two weeks following the presentation, a CDC pamphlet about folic acid and a friendly note to “Take five seconds, Take folic acid” were mailed to each participant. Three weeks post-intervention, a final reminder was mailed containing a similar note and a card created by the CDC about healthy pregnancy and folic acid. Four weeks after the intervention, participants completed the final post-test, which was web-based.

The pre-test, post-test, and four-week post-test were brief instruments developed by the pharmacy student and faculty members. Several college women who were unable to attend the oral presentation were asked to review the tests for face validity. The pre-test and post-test were identical and distributed on paper to participants immediately before and after the oral presentation. The web-based four-week post-test was distributed via email (QualtricsTM) and contained additional questions to assess the reminder messages and to elucidate reasons for compliance or non-compliance with multivitamin use. Participants completed each test anonymously.

Data were entered into SPSS version 15.0 (Chicago, SPSS, Inc.). To evaluate the impact of the entire health promotion program (oral presentation and reminder messages) on the changes in knowledge and multivitamin use, differences between pre-test and four-week post-test results were analyzed. The Mann-Whitney U test was utilized for between-group analysis due to the small sample size of the pilot as well as the fact that women anonymously completed the tests, which did not allow for a paired test of responses. Statistical significance was set a priori at p<0.05.

RESULTS

Thirty-two female college students attended the oral presentation; each agreed to participate in the study. Ten women identified as underclassman (sophomore status or below), and 22 women identified as upperclassman (junior status or above). The areas of study included arts & sciences (n=10), business (n=1), and pharmacy (n=21). Seven arts & sciences majors and 18 pharmacy majors (5 underclassman, 20 upperclassman) completed the four-week post-test resulting in a response rate of 78.2% (n=25).

When comparing the pre-test to the four-week post-test, there was a statistically significant increase in average test score (p<0.0001). Each participant’s average test score was calculated by dividing the number of correctly answered knowledge-based questions by the total number of knowledge-based questions (12 questions). Only 1 woman (3.1%) scored a 90% or above on the pre-test while 13 women (52.0%) scored a 90% or above on the four-week post-test.

As the focus of the health promotion program was to impact knowledge of folic acid and NTD and to encourage increased multivitamin use over time, comparisons in data obtained from 7 questions specific to folic acid, NTD, and multivitamin use on the pre-test and four-week post-test were performed. Data obtained from the immediate post-test and from the other preconception care questions are not presented here. The increase in the number of correct responses to each of the 6 test questions regarding folic acid and NTD were statistically significant (Table 1).

A statistically significant increase in women reporting regular (24 times per week) multivitamin use was seen from the pre-test to the four-week post-test. On the pre-test, 37.5% of women reported regular multivitamin use. On the four-week post-test, 68% of respondents indicated regular multivitamin use (p=0.023). Responses to open-ended questions to assess reasons for compliance or non-compliance with multivitamin use are presented in Table 2.
Table 1: Correct responses to questions assessing knowledge about folic acid and NTD between pre-test and four-week post-test

| Question pertaining to:                      | Percent of participants selecting correct response on pre-test | Percent of participants selecting correct response on four-week post-test | Percent increase in correct response | p-value |
|---------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------|---------|
| folic acid can prevent NTD                  | 78.1                                                        | 100                                                                    | 21.9                                | 0.013   |
| recommended daily dose of folic acid         | 56.3                                                        | 84                                                                    | 27.7                                | 0.027   |
| food sources high in folic acid             | 53.1                                                        | 88                                                                    | 34.9                                | 0.005   |
| dietary folic acid insufficient for most women | 84.4                                                        | 100                                                                   | 15.6                                | 0.04    |
| timing of fetal spinal cord completion      | 40.6                                                        | 88                                                                    | 47.4                                | <0.0001 |
| 50%-70% of NTD may be preventable           | 78.1                                                        | 100                                                                   | 21.9                                | 0.013   |

Of the 25 women completing the four-week post-test, 100% reported receiving reminder messages via mail. Twenty-two women (88%) responded that they received a reminder message via email. One woman indicated that she visited the March of Dimes Facebook page, and 3 participants indicated that they downloaded the ringtone. Six women (24%) thought that they received “too many” reminder messages, with the remaining 19 women (76%) answering that the number of reminder messages was “just right”. No one indicated that the number of reminder messages was “too few”.

**DISCUSSION**

These results indicate that a health promotion program consisting of an oral presentation and reminder messages is effective in increasing knowledge about folic acid and NTD and increasing regular multivitamin use (≥4 times/week, as defined by previous studies) among college women four weeks post-intervention. While there have been numerous educational initiatives and studies examining folic acid knowledge and use in women of childbearing potential, few have focused exclusively on college women in the U.S.

Quillin et al. evaluated the effectiveness of a five-minute educational intervention on awareness of folic acid as assessed by a pre-test and immediate post-test. Results from the post-test indicated that the five-minute intervention was effective in increasing knowledge of folic acid (p=0.0001) and knowledge of NTD (p=0.0002); though pre-test measurements found that 32% of study subjects took a multivitamin, there was no follow-up to assess changes post-intervention. Another study evaluated the effectiveness of a 45-minute educational intervention via a pre-test, immediate post-test and one-month post-test, with no further contact with investigators in the post-intervention period. Knowledge of folic acid and NTD statistically significantly increased from pre-test to post-test and was retained during the one-month period; however, the 7.9% increase in daily multivitamin use that was reported was not statistically significant. As far as we are aware, this is the first study to examine the effects of reminder messages during the post-intervention period and to show a statistically significant increase in regular multivitamin use post-intervention in a sample of U.S. college women. Open-ended responses by women reporting ways that they remember to take their multivitamin or barriers to regular multivitamin use were consistent with previously published literature.

As this was a pilot study, an assessment of participant views on the study design was performed to inform future programs. Since the majority of participants (76%) indicated that the right number of reminders was provided during the post-intervention period, retaining this feature may be beneficial. Given the popularity of mobile phones and Facebook among college students, it was surprising that few participants reported using these resources. Perhaps more interest would have been generated if the mobile phone ringtone had been easier to download or if a Facebook page had been created specifically for this health promotion program (rather than linking to the March of Dimes Facebook page); future studies should examine these features. Continued health promotion and education on this issue is necessary and important for this population.

This represents an opportunity for pharmacists and pharmacy students to expand health promotion programs and fulfill a vital role in public health activities. As accessible and trusted members of the healthcare team, pharmacists and pharmacy students can play an important part in educating women about folic acid and prevention of NTD. The low number of women reporting that a healthcare provider has talked to them about the importance of
folic acid\textsuperscript{28} underscores that pharmacists and pharmacy students can fulfill a need which has previously been unmet. In addition, involving pharmacy students in such efforts provides these future pharmacists with significant exposure to health promotion concepts.

Limitations to this pilot study included a small sample size that was rather homogenous, as the majority of students were Caucasian and “traditional” college students (that is, approximately 18-23 years of age). Data regarding multivitamin use was self-reported. Finally, given that the seminar attendance was voluntary, there was a potential for self-selection bias.

CONCLUSIONS

Increasing the number of women of childbearing age who consume folic acid is a public health priority, and this message is especially important for college women to receive. Health promotion programs led by pharmacists or pharmacy students may be an effective way of increasing long-term knowledge about folic acid and NTD as well as changing behaviors of multivitamin use among college women. Since the results of this pilot program showed efficacy, further study in larger groups of more diverse college women is warranted. If consistent results are seen in additional studies, this will signify a major advance in preconception care.

CONFLICT OF INTEREST

The authors declare no conflict of interest. There was no external funding obtained for this research project.

References

1. World Health Organization (WHO) and International Pharmaceutical Federation (FIP). Developing Pharmacy Practice: a focus on patient care. Handbook. 2006.
2. American Public Health Association. The role of the pharmacist in public health. [Internet] Washington, DC: American Public Health Association; [updated 8 Nov 2006; cited 25 Nov 2008]. Available from: http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1338
3. American Society of Health-Systems Pharmacists. Statement on the role of pharmacists in public health. Am J Health-Syst Pharm. 2008;65(5):462-467.
4. American Pharmacists Association. Accreditation standards and guidelines for the professional program in pharmacy education. [Adopted: 15 Jan 2006; Effective: 1 Jul 2007; cited 25 Nov 2008] Available from: http://www.acpe-accrredit.org/pdf/ACPE_Revised_PharmD_Standards_Adopted_Jan152006.pdf
5. Calis KA, Hutchison LC, Elliott ME, Ives TJ, Zillich AJ, Poirier T, Townsend KA, Woodland B, Feldman S, Raebel MA. Healthy People 2010: challenges, opportunities, and a call to action for America's pharmacists. Pharmacotherapy. 2004;24(9):1241-1294.
6. Babb VJ, Babb J. Pharmacist involvement in Healthy People 2010. J Am Pharm Assoc. 2003; 43(1):56-60.
7. International Pharmaceutical Federation (FIP), United Nations Educational, Scientific and Cultural Organization (UNESCO), and World Health Organization (WHO). Pharmacy Education Taskforce Action Plan 2008 – 2010, 28 January 2008.
8. Joint Commission on Pharmacy Practice. Future vision of pharmacy practice 2015. [Internet] Joint Commission on Pharmacy Practice [created 10 Nov 2004; cited 15 Feb 2009] Available from: http://www.pharmacist.com/
9. Healthy People Curriculum Task Force. Clinical prevention and population health curriculum framework. [Internet] Healthy People Curriculum Task Force. [updated Jan 2008; cited 25 Nov 2008] Available from http://www.atpm.org/resources/pdfs/Official_CPHF_Framework_2008.pdf
10. Center for the Advancement of Pharmaceutical Education. Educational outcomes 2004. [Internet] Center for the Advancement of Pharmaceutical Education. [updated May 2004; cited 25 Nov 2008] Available from: http://www.aacp.org/Docs/MainNavigation/Resources/6075_CAPE2004.pdf
11. Accreditation Council for Pharmacy Education. Accreditation standards and guidelines for the professional program in pharmacy leading to the doctor of pharmacy degree. [Internet] Chicago (IL): Accreditation Council for Pharmacy Education. [Adopted: 15 Jan 2006; Effective: 1 Jul 2007; cited 25 Nov 2008]. Available from: http://www.acpe-accredit.org/pdf/ACPE_Revised_PharmD_Standards_Adopted_Jan152006.pdf
12. Spina Bifida [homepage on the Internet]. White Plains (NY): March of Dimes Foundation; c2009 [updated 2009 Aug; cited 2009 Aug 31]. Available from: http://www.marchofdimes.com/professionals/14332_1224.asp
13. Medical progress in the prevention of neural tube defects [homepage on the Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [updated 2005 Jun 17; cited 31 Aug 2009]. Available from: http://www.cdc.gov/ncbddd/bd/imp.htm
14. Vanfield MA, Honein MA, Yuskiv N, Xing J, Mai CT, Collins JS, Devine O, Pettrini JR, Ramadhani TA, Hobbs CA, Kirby RS. National estimates and race/ethnic-specific variation of selected birth defects in the United States, 1999-2001. Birth Defects Res Part A Clin Mol Teratol. 2006;76(11):747-756.
15. Spina Bifida [homepage on the Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [updated 2009 Mar 11; cited 2009 Aug 31]. Available from: http://www.cdc.gov/ncbddd/birthdefects/SpinaBifida.htm
16. Centers for Disease Control and Prevention. Recommendations for the use of folic acid to reduce the number of cases of spina bifida and other neural tube defects. MMWR. 1992;41(No. RR-14)
17. Henshaw S. Unintended pregnancy in the United States. Fam Plann Persp. 1998; 30(24):9-46.
18. Institute of Medicine. Dietary reference intake: Folate, other B vitamins, and choline. Washington, DC: National Academy Press; 1998.
19. Food and Drug Administration. Food Standards: Amendment of standards of identify for enriched grain products to require addition of folic acid. Federal Register 1996;61:8781-8797.

20. Centers for Disease Control and Prevention. Spina bifida and anencephaly before and after folic acid mandate – United States, 1995-1996 and 1999-2000. MMWR. 2004;52:362-365.

21. Werler MM, Louik C, Mitchell AA. Achieving a public health recommendation for preventing neural tube defects with folic acid. Am J Public Health. 1999;89(11):1637-1640.

22. Oakley GP, Bell KN, Weber MB. Recommendations for accelerating global action to prevent folic acid-preventable birth defects and other folate-deficiency diseases: Meeting of experts on preventing folic acid-preventable neural tube defects. Birth Defects Res A Clin Mol Teratol. 2004;70(11):835-837.

23. Centers for Disease Control and Prevention. Use of supplements containing folic acid among women of childbearing age – United States, 2007. MMWR 2008;57:5-8.

24. Institute of Medicine. Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline. Washington, DC: National Academy Press; 2000.

25. Folic acid [homepage on the Internet]. White Plains (NY): March of Dimes Foundation; c2009 [updated 2008 Dec; cited 2009 Aug 21]. Available from: http://www.marchofdimes.com/pnhec/173_769.asp.

26. Facts about folic acid [homepage on the Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [updated 2009 Mar 31; cited 2009 Aug 21]. Available from: http://www.cdc.gov/ncbddd/folicacid/about.html.

27. U.S. Department of Health and Human Services. Healthy People 2010. 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, DC: U.S. Government Printing Office; Nov 2000.

28. Gallup Organization and March of Dimes Foundation. Improving preconception health: women’s knowledge and use of folic acid. White Plains (NY): March of Dimes; Dec 2008.

29. Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Changes in weight and health behaviors from freshman through senior year of college. J Nutr Educ Behav. 2008;40(1):39-42.

30. Nelson MC, Larson NI, Barr-Anderson D, Neumark-Sztainer D, Story M. Disparities in dietary intake, meal patterning, and home food environments among young adult nonstudents and 2- and 4-year college students. Am J Public Health. 2009;99(7):1216-1219.

31. Lawrence JM, Watkins ML, Ershoff D, Petit DB, Chiu V, Postlethwaite D, Erickson JD. Design and evaluation of interventions promoting periconceptional multivitamin use. Am J Prev Med. 2003;25(1):17-24.

32. Ahluwalia IB, Lawrence JM, Balluz L. Psychosocial factors associated with use of multivitamins by women of childbearing age. J Commun Health. 2007;32(1):57-69.

33. Quillin JM, Silberg J, Board P, Pratt L, Bodurtha J. College women’s awareness and consumption of folic acid for the prevention of neural tube defects. Genet Med. 2000;2(4):209-213.

34. DiPietro NA, Kier KL. An educational intervention about folic acid and healthy pregnancies targeted at college-age women. J Am Pharm Assoc. 2001;41(2):283-285.

35. Chivu CM, Tulchinsky TH, Soares-Weiser K, Braunstein R, Brezis M. A systematic review of interventions to increase awareness, knowledge, and folic acid consumption before and during pregnancy. Am J Health Prom. 2008;22(4):237-245.