

## Original Research

# 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 ( $\geq 4$  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.

### CONOCIMIENTO Y USO DE ÁCIDO FÓLICO ENTRE ESTUDIANTES UNIVERSITARIAS: UN PROGRAMA PILOTO DE PROMOCIÓN DE LA SALUD CONDUCIDO POR ESTUDIANTES DE FARMACIA

#### RESUMEN

Como los farmacéuticos y estudiantes de farmacia están llamados cada día más a asumir papeles en actividades de salud pública, es importante reconocer las oportunidades para educar a los miembros de la comunidad en salud, bienestar y prevención de la enfermedad. Objetivo: Evaluar el impacto de un programa piloto de promoción de la salud en el conocimiento de las universitarias sobre ácido fólico y prevención de defectos del tubo neural (DTN) y la frecuencia del uso de multivitamínicos. Métodos: Se desarrolló un programa de promoción de la salud por un estudiante de farmacia y dos profesores de la facultad que incluía una presentación oral y mensajes recordatorios. Se dio a las participantes antes e inmediatamente después de la presentación un test de respuesta múltiple que evaluaba el conocimiento sobre ácido fólico y DTN y la frecuencia de uso de multivitamínicos. Las participantes recibieron después un mensaje recordatorio sobre el ácido fólico una vez a la semana durante tres semanas. Los conocimientos y el uso de multivitamínicos fueron re-evaluados cuatro semanas después de la intervención. Resultados: 32 universitarias asistieron voluntariamente a la presentación oral. 25 mujeres (78,2%) completaron las cuatro semanas post-intervención. Comparado con el pre-test, hubo incrementos estadísticamente significativos en la puntuación media del test ( $p < 0,0001$ ) y en las respuestas correctas a preguntas sobre ácido fólico y DTN ( $p < 0,05$  para cada pregunta). Las participantes comunicaron un aumento estadísticamente significativo en el uso regular ( $\geq 4$  veces/semana) de multivitamínicos ( $p = 0,023$ ). Conclusión: Las participantes en el programa piloto de promoción de la salud demostraron un aumento estadísticamente significativo en conocimientos sobre el ácido fólico y la frecuencia de uso de multivitamínicos. Programas diseñados de modo similar podrían ser efectivos para aumentar el conocimiento sobre ácido fólico y DTN y cambiar

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las actitudes sobre el uso de complejos vitamínicos entre universitarias.

**Palabras clave:** Conocimiento, actitudes y practica de la salud. Ácido 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.<sup>1-6</sup> 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.<sup>7-11</sup> 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.).<sup>12,13</sup> 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.<sup>14</sup> Spina bifida, which often causes full or partial paralysis, affects approximately 1 in 2500 babies in the U.S.<sup>14,15</sup>

Data have shown that sufficient folic acid intake before conception and during the first trimester of pregnancy can prevent 50%-70% of NTD.<sup>16</sup> 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 high<sup>17</sup>, 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.<sup>16,18</sup> 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.<sup>19</sup> However, it is difficult for most women to obtain sufficient amounts of folic acid through food sources alone,<sup>20,21</sup> therefore, vitamin supplementation is recommended.<sup>15,21-24</sup> 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.<sup>23,25-27</sup>

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.<sup>28</sup> 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 of 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.<sup>29,30</sup>

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 (Qualtrics™) 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 ( $\geq 4$  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

Table 2: Summary of open-ended questions from four-week post-test regarding methods of remembering regular use or barriers to regular use of multivitamins

Methods of Remembering Regular Multivitamin Use Among Women Reporting Regular (≥4 times/week) Multivitamin Use (n=17)	
Response	Number of responses*
Set the vitamins in a certain location	11
Part of daily routine	3
Set a reminder alarm	1
Leave a reminder note in an obvious spot	1
Barriers to Regular Multivitamin Use Among Women Reporting Multivitamin Use 3 Times Per Week or Less (n=8)	
Response	Number of responses*
Forget	4
Vitamins cause nausea	2
Feel like diet is sufficient	2
Don't want to spend money on vitamins	1
Don't like swallowing pills	1

\*NOTE: Participants could type more than 1 answer or could skip the free text box

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 per week, as defined by previous studies<sup>31,32</sup>) 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.<sup>33</sup> 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.<sup>34</sup> 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.<sup>28,35</sup>

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<sup>1-4</sup> 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<sup>28</sup> 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.

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