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Original Research

Impact of a pharmacist-directed educational program on the long-term knowledge and use of folic acid among college women: a 12-month follow-up study

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ABSTRACT[*]

Few studies have examined the impact of educational interventions on participants' long-term knowledge and use of folic acid for prevention of neural tube defects (NTD).

Objective: The objective of this pilot study was to evaluate changes in knowledge and behaviors in a sample of college women one year after such a program.

Methods: Female students of a residential college campus voluntarily attended the event, which was advertised to the campus community as a women's health seminar. Participants completed a multiple-choice test assessing knowledge of folic acid and NTD and frequency of multivitamin use before and immediately after a 30-minute oral presentation. Following 3 reminder messages sent via email or mail, knowledge and multivitamin use were re-assessed 1-month and 12-months post-intervention.

Results: Thirty-two college women participated in the educational intervention; 27 (84%) completed the 12-month post-test. At 12 months, statistically significant increases in knowledge from baseline remained for questions pertaining to food high in folic acid (p=0.023); completion of spinal column (p=0.011); and 2 questions on NTD prevention (p=0.044). Increases in knowledge regarding recommended daily allowance of folic acid (p=0.817) and difficulty in receiving adequate folic acid from diet alone (p=0.617) were not statistically significant from baseline. Regular multivitamin use (≥4 times per week) was not statistically significantly increased from baseline (p=0.592).

Conclusion: Although it was encouraging that the women retained much of the information learned during the program, it appears that the changes in multivitamin use seen at 1-month were not sustained at 12-months. Further study with larger groups of college women is recommended.

Keywords: Health Knowledge, Attitudes, Practice. Health promotion. Folic Acid. Neural Tube Defects. United States.

IMPACTO DE UN PROGRAMA EDUCATIVO DIRIGIDO POR FARMACÉUTICO SOBRE EL CONOCIMIENTO A LARGO PLAZO Y USO DEL ACIDO FÓLICO ENTRE UNIVERSITARIAS: ESTUDIO DE SEGUIMIENTO DE 12 MESES

RESUMEN

Pocos estudios han examinado el impacto de las intervenciones educativas sobre el conocimiento a largo plazo de los participantes y el uso de acido fólico para prevenir los defectos del tubo neural (DTN).

Objetivo: El objetivo de este estudio piloto fue evaluar los cambios en conocimientos y comportamiento en una muestra de universitarias un año después de tal programa.

Métodos: Mujeres estudiantes de una residencia universitaria del campus atendieron voluntariamente al evento, que se promocionó en la comunidad universitaria como un seminario de salud de la mujer. Los participantes completaron un examen de preguntas de elección múltiple que evaluaba el conocimiento del ácido fólico y de los DTN y el uso de multivitamínicos antes e inmediatamente después de una presentación oral de 30 minutos. Después, se utilizaron 3 mensajes de recuerdo, enviados por email o correo, para re-evaluar 1 mes y 12 meses post-intervención.

Resultados: 32 universitarias participaron en la intervención educativa; 27 (84%) completaron el post-test de 12 meses. A los 12 meses, persisten aumentos significativos del conocimiento inicial para las preguntas relativas a los alimentos ricos en ácido fólico (p=,023), compleción de la columna vertebral (p=0,011); y las 2 preguntas sobre prevención de los DTN (p=0,044). Los aumentos en conocimiento relativos a la ingesta diaria recomendada de ácido fólico (p=0,817) y la dificultades en recibir la cantidad adecuada de ácido fólico solo en la dieta (p=0,617) no fueron estadísticamente significativas respecto al inicio. El uso de multivitamínicos ((≥4 veces a la semana) no se aumentó significativamente desde el inicio (p=0,592).

Conclusión: Aunque es esperanzador que las mujeres retenían mucha de la información aprendida durante el programa, parece que los cambios en el uso de multivitamínicos que se veían tras 1 mes, no se mantuvieron a los 12 meses. Se recomiendan estudios con grupos mayores de universitarias.

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Palabras clave: Conocimientos, Actitudes y Práctica en Salud. Promoción de la Salud. Ácido Fólico. Defectos del Tubo Neural. Estados Unidos.

INTRODUCTION

Neural tube defects (NTD) result when the neural tube does not form correctly during the first month of pregnancy, leading to birth defects of the spine (e.g., spina bifida) and brain (e.g., anencephaly). NTD are among the most common severe birth defects in the United States (U.S.), affecting approximately 3,000 babies each year.[1] Data have shown that 50%-70% of NTD can be prevented by sufficient folic acid intake before conception and during the first trimester of pregnancy.[2] Since NTD occur early in pregnancy and the rate of unintended pregnancy in the U.S. is high, it is recommended that all women of childbearing potential consume at least 400 microgram (mcg) of folic acid daily; women with certain risk factors for a NTD-affected pregnancy, such as those receiving certain antiseizure therapy or those with a family history of an NTD-affected pregnancy, are advised to consume higher doses.[3]

Folic acid is a B vitamin found in certain foods, including dark green leafy vegetables, peanuts, and oranges.[2] Although fortification of cereal grain products with folic acid has been mandatory in the U.S. since the late 1990s[4], many women still do not obtain the recommended amount of folic acid through diet alone.[3] Therefore, supplementation is advised, either with a folic acid supplement or a multivitamin containing 400 mcg of folic acid.[3] Ensuring that women of childbearing potential consume sufficient amounts of folic acid continues to be a public health priority in the U.S.; for example, there are three objectives in the recently-published Healthy People 2020 that address this issue.[5]

Data indicate that there are still many women in the U.S. unaware of the need for daily folic acid intake to prevent NTD[6], and college women represent an important group to educate on this topic. Published studies indicate that college students tend to have poor nutrition with low fruit and vegetable intake.[7,8] According to survey data from the March of Dimes women aged 18-24 years, compared to all other age groups, know the least about folic acid, including the fact that it may prevent birth defects and that it should be taken before pregnancy. Additionally, only 12% of women in this age group reported receiving information regarding folic acid from a healthcare professional and only 27% of women aged 18-24 reported current daily supplementation of folic acid.[6]

Health promotion programs and educational campaigns have been conducted in the U.S. to raise awareness about folic acid for prevention of NTD. However, few studies have assessed retention of knowledge and/or changes in multivitamin use among individuals in those programs more than several weeks or several months post-intervention. Therefore, a follow-up was performed to a pilot study with college women to evaluate the long-term impact of a pharmacist-directed educational intervention on knowledge and use of folic acid.

METHODS

This study was conducted on the campus of a private university with approximately 3,500 students located in northwestern Ohio that offers liberal arts and professional programs. Posters visible around campus and emails to the student body were used to advertise the date, time, and location of the oral presentation, which was held on the university campus. All advertisements presented the program as a woman's health seminar, with no mention of specific topics in order to minimize bias of pre-test results. Participation in the program was voluntary. The study was deemed as exempt by the university's Institutional Review Board.

The program consisted of an oral presentation conducted one evening in January 2009 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), 1 month after the educational program in February 2009 (1-month post-test), and 12 months after the educational program in January 2010 (12-month post-test).

Prior to the oral presentation, participants' willingness to anonymously complete pre- and post-tests was ascertained; they were informed that all responses would be reported at an aggregate level. Women had the option to opt out of the pre- and post-tests and still listen to the oral presentation. Women choosing to participate in the pre- and post-tests voluntarily provided their contact information to the investigators on separate data collection forms.

Participants completed the pre-test immediately prior to the oral presentation. A 30-minute PowerPoint® presentation, developed by a student pharmacist and two pharmacy faculty, was then delivered by the student pharmacist, providing recommendations from the U.S. Centers for Disease Control and Prevention (CDC) regarding preconception care topics. Half of the presentation discussed folic acid and NTD. The importance of proper diet and the rationale for multivitamin supplementation was heavily emphasized, with messages designed for those not currently planning for pregnancy. Women were informed to select a multivitamin containing the recommended 400 mcg folic acid for daily use. Forgetfulness, difficulty in swallowing pills, cost, and other common barriers to multivitamin use were addressed and methods for overcoming these barriers were provided. The use of multivitamins as a possible health benefit for themselves was stressed to participants, regardless of intent to become pregnant. The remainder of the presentation focused on a variety of other preconception care topics such as vaccines to receive prior to pregnancy, healthy weight and nutrition, and substances to avoid during

pregnancy, such as alcohol, tobacco, and large quantities of certain types of fish.

Immediately following the presentation, participants completed the post-test. Informational handouts and a chart to track multivitamin use were then provided. Other items with messages about folic acid such as nail files, pencils, and magnets, as well as green ribbons to promote folic acid awareness were distributed. Snacks high in folic acid were also available.

Once a week for three weeks following the presentation, participants received an email or card via mail with a reminder about folic acid. One month following the oral presentation, participants were sent a web-based post-test for completion. Twelve months following the oral presentation, participants were again sent a similar web-based post-test.

The pre-test, post-test, 1-month post-test, and 12-month post-test were short tools developed by the student pharmacist and two faculty members. The tests were reviewed for face validity by several college women unable to attend the program. The pre-test and post-test were identical and completed on paper by participants immediately before and after the oral presentation. The web-based 1-month and 12-month post-tests were distributed via email (Qualtrics^{TM}) and contained additional questions assessing the reminder messages and obtaining reasons for compliance or non-compliance with multivitamin use. Participants were also asked to identify sources, other than the current study, from which they had received information regarding folic acid. Each test was completed anonymously.

Data were analyzed using SPSS version 15.0 (Chicago, SPSS, Inc.). To evaluate the long-term impact of the educational program, differences between pre-test and 12-month post-test results are presented here. The results from the 1-month study have been previously published.[10] The Mann-Whitney U test was utilized due to the small sample size of the pilot as well as the fact that anonymous responses did not allow for a paired test of results. Statistical significance was set a priori at $p<0.05$.

RESULTS

Thirty-two women chose to attend the seminar; no woman was turned away due to space limitations. Each of the 32 female college students who attended the educational program agreed to participate in the study. Their areas of study included business (n=1), arts & sciences (n=10), and pharmacy (n=21). Ten women indicated they were underclassman (sophomore status or below); the remaining 22 women indicated they were upperclassman (junior status or above). Due to the fact that at this university pharmacy students are directly admitted in their first year of college to the a six-year professional program, first- and second-year pharmacy students were classified as underclassmen, while pharmacy students in their third through sixth years were classified as upperclassmen. Twenty-seven women (8 arts & sciences majors and 19 pharmacy majors) completed the 12-month post-test resulting in a response rate of 84%.

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). When comparing the pre-test to the 12-month post-test, there was a statistically significant increase in average test score (59.6% vs. 73.1%, $p=0.002$). Comparisons in data obtained from 6 questions specific to folic acid, NTD, and multivitamin use on the pre-test and 12-month post-test were then performed, as the focus of the educational program was to improve knowledge of folic acid and NTD and to increase multivitamin use over time. The increase in the number of correct responses to 4 of the 6 test questions regarding folic acid and NTD was statistically significant. An increase in the number of correct responses to the remaining 2 questions regarding folic acid and NTD was observed; however, the differences were not statistically significant (Table 1). When asked to indicate sources of information regarding folic acid outside of this educational program, only 3 women indicated receiving information on this topic from a healthcare provider.

Approximately 44% of participants reported regular (≥4 times per week) multivitamin use at 12 months; this value was not statistically significantly increased from the baseline value of 37.5% ($p=0.592$). Open-ended questions on the 12-month post-test assessed barriers and methods of remembering of regular multivitamin use. The most commonly reported method for remembering to take a multivitamin regularly was setting the bottle of vitamins in a specific location (n=8). The most commonly cited barrier to regular multivitamin use was forgetfulness (n=6).

DISCUSSION

Twelve months following the educational intervention, women could correctly recall information regarding folic acid and neural tube defects for 4 of 6 questions. However regular

Table 1. Difference in number of correct responses to questions assessing knowledge about folic acid and neural tube defects (NTD) from pre-test to 12-month post-test

Question pertaining to:	Percent correct response		p-value
	Pre-test	12-month post-test	
folic acid can prevent NTD	78.1%	96.3%	0.044
recommended daily dose of folic acid	56.3%	59.3%	0.817
food sources high in folic acid	53.1%	81.5%	0.023
dietary folic acid insufficient for most women	84.4%	88.9%	0.617
timing of fetal spinal cord completion	40.6%	74.1%	0.011
50%-70% of NTD may be preventable	78.1%	96.3%	0.044

multivitamin use (defined as ≥4 times per week in previous studies[9]), was not statistically significantly increased. Data obtained from the 1-month post-test (published previously) had shown a statistically significant retention in knowledge for each of the 6 questions and a statistically significant increase in regular multivitamin use from the pre-test.[10] Although it was encouraging that the women retained much of the information learned during the program for 12 months, it appears that the changes in multivitamin use reported at 1 month were not sustained for a longer period of time.

Open-ended responses by women reporting ways that they remember to take their multivitamin or barriers to regular multivitamin use were consistent with the literature.[6,11] Although these barriers were discussed in the educational intervention and potential solutions to overcome these barriers were suggested, it seems that some women still perceive these barriers as relevant to them and reasons to avoid multivitamin use.

Reminders only occurred within 1 month following the oral presentation; the participants had no contact with investigators in the following eleven months. The reminders were generally well-received.[10] As retention in knowledge and significant changes in regular multivitamin use were seen in the 1 month following the educational intervention (immediately after the time period in which reminders were provided), future studies should examine whether reminders over an extended period of time impact sustained changes in knowledge and/or behavior.

Pharmacy students accounted for a majority of the women participating in the educational intervention. This is likely due to the fact that pharmacy students make up approximately one-third of the student population of the university. In spite of the number of women with background education in a healthcare-related field, significant increases in knowledge of folic acid and NTD were still shown, indicating that college women pursuing such degrees may still be appropriate targets for education.

National organizations, such as the March of Dimes, have been tracking trends in knowledge and use of folic acid among women in the U.S. for a number of years.[6] However, educational interventions or other studies performed in targeted groups of women in the U.S. have typically captured changes in knowledge or supplementation use only for a short period of time after the intervention. To our knowledge, there is only one published study in the U.S. that assessed long-term changes in knowledge. This study compared women, ages 18-45, who were randomly assigned to receive a 15-minute computerized educational session and free folate tablets to women in a control group. At 6-7 months post intervention, women in the intervention group reported greater knowledge of folic acid and more recent folic acid use compared to women in the control group; these differences were statistically significant.[12]

No published studies of educational interventions on this topic delivered to college women have examined retention of knowledge or changes in multivitamin use beyond one month.[13-16] Knowing whether such educational interventions are effective in improving knowledge and behaviors in the long-term for this population is valuable as the majority are generally not currently planning a pregnancy and are considered as “non-contemplators”. College campuses afford an environment to discuss preconception care and healthy behaviors with young adults who may likely become parents at some future time.[13]

Pharmacists and student pharmacists are increasingly encouraged to become more involved in public health activities that fit within their professional knowledge and expertise. The provision of educational programs such as the one utilized in this pilot study represents an example of the opportunities that exist for pharmacists and student pharmacists to inform the public about health, wellness, and primary prevention. Since current data suggest that many women in the U.S. aged 18-24 years are not receiving information regarding folic acid and NTD from healthcare providers[6], the involvement of pharmacists and student pharmacists in this study highlights ways to improve engagement of our profession in health promotion and public health activities.

Limitations to this pilot study included potential self-selection bias, as seminar attendance was voluntary. Additionally, the pilot study utilized a small sample size that was rather homogenous, as the majority of the students were Caucasian and “traditional” college students (that is, approximately 18-23 years of age). Data regarding multivitamin use was self-reported. Participants were not asked their motivation for taking multivitamins regularly, and therefore changes in use could have been due to factors other than the knowledge gained from the educational intervention. Finally, the study lacks a control group, making it difficult to ascertain the difference in changes in knowledge and folic acid use attributable to the intervention rather than to outside factors.

CONCLUSIONS

A 30-minute educational intervention regarding folic acid, NTD, and preconception care was effective in statistically significantly increasing participants’ knowledge of folic acid and NTD for 4 of 6 questions tested 12 months after the presentation. Increase in regular multivitamin use at 12 months was not statistically significantly increased from baseline, however. Further study with college women is warranted and should yield information on the most appropriate methods to improve knowledge and use of folic acid in this population.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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