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## Knowledge Levels Of College Students Concerning Folic Acid

Lesa Faye Ferguson

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KNOWLEDGE LEVELS OF COLLEGE STUDENTS  
CONCERNING FOLIC ACID

by

LESA FAYE FERGUSON

A Thesis  
Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science in Nursing  
in the Division of Nursing  
Mississippi University for Women

COLUMBUS, MISSISSIPPI

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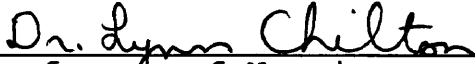
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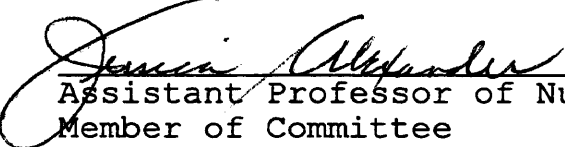
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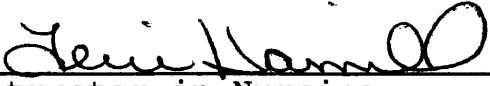
Knowledge Levels of College Students  
Concerning Folic Acid

by

Lesya Faye Ferguson

  
\_\_\_\_\_  
Professor of Nursing  
Director of Thesis

  
\_\_\_\_\_  
Assistant Professor of Nursing  
Member of Committee

  
\_\_\_\_\_  
Instructor in Nursing  
Member of Committee

  
\_\_\_\_\_  
Director of the Graduate School

## Abstract

Neural tube defects (NTDs) are among the most serious birth defects affecting approximately 4,000 pregnancies in the United States each year. More than one third of these pregnancies are spontaneously aborted. Thus, about 2,500 infants per year are born with an NTD. Research spanning two decades has shown that women who consume folic acid-containing supplements have 50% to 75% fewer infants with NTDs than women who do not consume folic acid supplements. Despite the empirical evidence in the literature, the message about folic acid is not getting across to the general public. This quasi-experimental pretest-posttest study examined the impact of a multifaceted educational intervention on the knowledge levels of college students concerning folic acid. The study was guided by one null hypothesis: There will be no significant difference in knowledge levels among college students before and after exposure to a folic acid educational intervention. The theoretical framework for this research was the Neuman Systems Model. The setting was a community college in a rural southeastern state. The sample was one of

convenience, utilizing five randomly selected 8:00 a.m. classes ( $N = 114$ ), consisting of male and female students between the ages of 18 and 45 years. Data were compiled from a pretest questionnaire, establishing a baseline knowledge level. A fourfold educational intervention that extended over 3 weeks was initiated: E-mail messages were sent daily, posters were placed in strategic places on campus, television public service announcements rotated hourly, and displays with folic acid brochures were placed throughout the campus. At the completion of the intervention, a posttest was given. Data were analyzed using the dependent  $t$  test. A significant increase in knowledge levels ( $p = .15$ ) of folic acid emerged. Therefore, knowledge levels were impacted by the educational intervention, and the null hypothesis was rejected. It was noted that the facet of the intervention most frequently received was the television public service announcements, and the least frequently received method was the E-mail messages. The implication for nurse practitioners involves the role of educator. As primary care providers, it is the responsibility of the nurse practitioner to promote general and reproductive health during every health encounter. This includes increasing

awareness of patients concerning folic acid and its role in the prevention of NTDs. A recommendation for future research includes replication of this study with a sample group comprised of childbearing age women who are in the workforce and have not had formal education beyond high school. Additionally, a similar study excluding students with a health-related academic major would yield a more accurate assessment of the average college student. A further recommendation is to investigate the lack of behavioral change regarding intake of folic acid among college students despite their increase in knowledge.

Dedication

I dedicate this research to my mother,  
Edna Faye Sherrill Ross  
1938-1997.

So many times it only took a mother's touch to heal  
A broken heart, a bruised knee.  
You'd say, "It's no big deal."  
Well, now I'm grown and wiser too  
because of seeds you've sown.  
Mama, look and see and know your dreams  
for me are now my own.

Thank you, Mama, for teaching me that  
"I can do all things through Christ which  
strengtheneth me."

Philippians 4:13



## Acknowledgments

I wish to thank the many people who have encouraged and supported me throughout this endeavor. Without each of you, this research would not have been possible.

First, I thank my husband, Ronnie, for believing in me and loving me when I was unlovable. Because of your patience, I was able to focus endless hours on this research. You never made me feel guilty for the time this took from our family. You are my dearest friend, and I will always love you.

To Joshua and Laura Leigh, you have been my inspiration and driving force to continue my education. You will never know how much you contributed to this research by your love, patience, and understanding during a time when I was either away from home or busy at the computer. Although this year has been an intensive focus on education, I hope you know that the two of you are my most cherished accomplishment, and you will always be the center of my world. I love you with all of my heart. My prayer is that each of you will allow God to use you in

His service so that you will realize life abundantly and your dreams will be fulfilled.

To Jessica Alexander and Terri Hamill, my committee members, I want to thank you for sharing your expertise to broaden my knowledge and hone my writing skills.

Finally, to Dr. Lynn Chilton, I wish to thank you for your guidance and support throughout this research endeavor. Your kindness and wisdom are unsurpassed, and your faith in God is apparent in all that you do. It has been an honor to be in your counsel. God bless you.

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## Chapter I

### The Research Problem

Neural tube defects (NTDs) are among the most serious birth defects. Approximately 4,000 pregnancies in the United States each year are affected by NTDs, with more than one third of these pregnancies spontaneously aborted. Thus, about 2,500 infants per year are born with an NTD (Tinkle & Sterling, 1997). Randomized controlled studies have shown that women who consume folic acid-containing supplements have 50 to 75% fewer infants with NTDs than women who do not consume folic acid supplements (Crandall, Corson, Knight, & Salafsky, 1995; Czeizel & Dudas, 1992; Medical Research Council Vitamin Study Group, 1991).

Despite the empirical evidence in the literature, the message about folic acid is reaching the general public. The Centers for Disease Control and Prevention (CDC) (1995) recounts a stratified random-digit-dialed telephone survey of a national sample of women aged 18 to 45 years that revealed 48% of the respondents had not heard about folic acid.

## Establishment of the Problem

NTDs are a group of brain and spinal cord malformations that develop at various points during early gestation. The open NTDs (neural tissues are exposed to the surface) occur when the neural tube which forms the future brain, spinal cord, and spinal column, fails to close during neurulation (Tinkle & Sterling, 1997). The neural tube is temporarily open at both ends, with the cranial end closing on approximately the 25<sup>th</sup> day after fertilization and the caudal end closing nearly 2 days later.

The two most common types of open NTDs are anencephaly and spina bifida. About half of infants affected by NTDs have anencephaly, in which the neural tube fails to close at the cranial end, resulting in a rudimentary or absent brain. This is a fatal birth defect. When the neural tube fails to close along the axis of the spine, the infant is born with spina bifida. Spina bifida is a collective term for the malformations involving the spinal cord and the vertebral arches caused by a defective closure of the caudal neuropore (Tinkle & Sterling, 1997).

It had been hypothesized during the 1960s that nutritional deficiency, such as vitamin deficiency, may have a role in neural tube closure, hence the development of defects (Rose & Mennuti, 1994). Early research focused

on prevention of recurrence of an NTD-affected pregnancy, with studies demonstrating a significant reduction in the risk of NTD recurrences when multivitamin supplementation during the periconceptional period occurred. In 1991 the United Kingdom Medical Research Council reported the results of a double-blind, randomized trial among women at high risk for recurrence of an NTD-affected pregnancy. The women who received folic acid as the only supplementation experienced a 72% reduction in their risk of having an NTD-affected pregnancy. The remaining problem was in knowing how this information translated to lower-risk women in the general population, as about 95% of women who deliver an infant with an NTD had no prior history of an offspring with the defect (Tinkle & Sterling, 1997).

Controversies regarding the lack of control in a number of observational studies conducted among women with no prior history of an NTD-affected pregnancy led Czeizel and Dudas (1992) to conduct a prospective, randomized controlled trial. Women who took a multivitamin containing 0.8 mg of folic acid at least one month before conception and until the second missed menstrual period were significantly less likely to have an infant with an NTD than women who took only a placebo-like trace element supplement.



A synthesis of the data from the observational studies and randomized trials led the United States Public Health Service to recommend in 1992 that all women of childbearing age who were capable of becoming pregnant should consume 0.4 mg of folic acid daily (CDC, 1992). The CDC (1992) predicted that an estimated 50% of NTDs could be prevented if all women consumed adequate folic acid during the periconceptional period. Achieving the CDC recommendation became the logical next step.

Impeding progress toward achieving the CDC recommendation was a knowledge deficit among the general public related to folic acid. The CDC (1995) reported on a statewide study of women with pregnancies affected by NTDs in South Carolina. Overall, 6 (8%) of the 71 women reported using a folic acid-containing multivitamin supplement during the periconceptional period.

The Gallup Organization conducted two surveys related to folic acid awareness for the March of Dimes Birth Defects Foundation, one in 1995 and another in 1997. The first was a proportionate, stratified random-digit-dialed telephone survey of a national sample of 2,010 women aged 18 to 45 years. Overall, 52% of women reported never hearing of or reading about folic acid. Fifteen percent of respondents reported having knowledge of the CDC

recommendation regarding the use of folic acid (CDC, 1995).

In an effort to increase daily consumption of the B vitamin, folic acid, and to reduce the number of birth defects, leading health care organizations in the United States, including the March of Dimes and the CDC, have committed to educating women and their families about the importance of daily folic acid intake (CDC, 1997). The March of Dimes conducted a campaign from June 1995 to January 1997 to encourage women to take 0.4 mg of folic acid daily. The campaign included print and television public service advertising and in-store displays in collaboration with the vitamin supplement and citrus industries.

A second Gallup survey conducted in 1997 also investigated women's knowledge concerning folic acid. Sixty-six percent of the respondents claimed they had read about or heard of folic acid, compared with 52% in 1995. In addition, 22% of the sample had heard of the Public Health Service recommendation that women should increase their folic acid intake, as compared with 15% in 1995. Although results of the Gallup survey showed a modest increase in awareness and use of folic acid, the CDC (1997) concluded that more educational programs were needed, stressing the benefits of folic acid and

describing the options for achieving adequate daily intakes.

Health professional education has emerged as a critical overall component of increasing folic acid awareness in the general public. Indeed, studies have reported that many pregnant women are not advised by their health care provider to take folic acid. According to the findings of a study by Great Britain's Department of Health Expert Advisory, 679 women were questioned at their first antenatal visit regarding their exposure to folic acid advice by their health care provider. Only 189 of the women had been prescribed or advised to take folate supplements before conception (Wild & Sutcliffe, 1997). Similarly, in the United States, a Gallup Survey, commissioned by the March of Dimes in 1995, revealed a significant number of pregnant women who reported having never been told about the importance of folic acid in the prevention of birth defects. Surveys of patients emphasized their belief that, unless the health care provider initiates a discussion about an item, it is not important or relevant to them (March of Dimes Birth Defects Foundation, 1999). This makes the inclusion of folic acid education even more consequential to the thrust for an overall reduction in the number of births affected by neural tube defects.

### Purpose of the Study

This researcher sought to assess a baseline level of knowledge related to folic acid and its significance to the prevention of birth defects among college-aged students, and then to evaluate changes in the knowledge level following an educational intervention. The objective of the study was to increase student awareness of folic acid and its role in the prevention of birth defects, specifically NTDs, with the ultimate goal to reduce the number of NTD-affected pregnancies.

### Significance to Nursing

Nurse practitioners (NPs) are the primary care providers for a large portion of the population, especially in rural areas. NPs working with women of childbearing age and their families have a responsibility to promote general and reproductive health during every health encounter. An ongoing responsibility of the advanced practice nurse is to remain aware of the issues regarding folic acid and to be prepared to provide accurate and appropriate education and counseling. According to Tinkle and Sterling (1997), the public has been exposed to an array of potentially confusing messages about folic acid. Therefore, the responsibility for empowerment of the client, through information

disbursement, to take an active role in their health management rests with the nurse practitioner. Results of this study may provide information related to effective strategies to teach college students about the benefits of folic acid in the prevention of NTDs.

Education of the nurse practitioner is a primary responsibility of the profession. Research studies, such as the current investigation, add to the body of knowledge related to knowledge levels of college students concerning folic acid. Schools of nursing in which NPs are educated could teach NP students effective and creative methods of relaying information about NTDs and folic acid to women of childbearing age. Results of this study will provide NP educators statistical data related to the number of women who need to be taught about this preventative therapy.

In addition to this study's significance to practice and education, folic acid awareness is a prime issue for nursing research. Although there are several documented studies related to knowledge levels concerning folic acid, this study's focus was college-aged students. Findings from this study may further validate the existing body of knowledge with specific reference to a unique population, college-aged women and men.

## Theoretical Framework

The Neuman Systems Model provided the framework for this research study. Neuman defines the client/person in terms of a system of variables interacting with the environment while focusing on stressors as they relate to client health (Reed, 1993). For the purpose of this study, the client/person represents currently enrolled community college students from a rural southeastern state. The environment in Neuman's terminology is categorized into three types: internal, external, and created. The internal environment includes variables within the person, such as the physiological deficit of folic acid and the knowledge deficit related to folic acid and birth defects. The external environment includes well-established data related to folic acid and neural tube defects established in the literature.

Neuman views the client with a central core of five variables: physiological, psychological, sociocultural, developmental, and spiritual (Reed, 1993). The global problem of increased incidence of neural tube defects in infants born to mothers with a folic acid deficit was the driving force for this study. Although the specific variables were not tested, the assumption was that many of these variables contribute to the problem. For example, physiological components such as overall health,

nutritional status, and exercise habits directly impact pregnancy outcomes. Psychological factors, such as anxiety, fear, or uncertainty and security of relationships, also impact the general welfare of the childbearing woman. Sociocultural variables affect how the client meets nutritional needs, balanced meals, and vitamin supplements. Developmental components include the age and maturation of the childbearing woman and cannot be ignored when evaluating knowledge and understanding of folic acid and its role in the prevention of birth defects. Lastly, spiritual factors incorporate the client's beliefs related to health and childbearing, which include her personal role in prevention health.

While the client is exposed to stressors from within and without the system, Neuman visualizes the client system protected by a series of concentric buffers that serve to minimize the impact of stressors and act as safety zones between environments and the central core (Reed, 1993). Lines of defense act like an accordion when bombarded by stressors. This study attempted to increase the strength of the defense lines by increasing knowledge levels of students related to folic acid.

Neuman characterized stressors as intrapersonal, interpersonal, and extrapersonal (Reed, 1993). In the context of this study, intrapersonal stressors were the

person's genetic predisposition for NTDs and pregnancy. Interpersonal stressors included their prior experience with pregnancy, learned experiences related to nutrition, and learning styles. These variables were assessed in this study by utilizing the self-reporting questionnaires in an effort to determine the effectiveness of an educational intervention. Extrapersonal stressors included educational level, availability of educational programs, socioeconomic status, and comfort level during teaching sessions. This researcher responded to the stressor of educational level by offering a program to increase awareness of folic acid and the prevention of NTDs.

The Neuman Systems Model defines nursing interventions as primary, secondary, and tertiary. The concept of primary nursing care, summarized as Prevention through Intervention, was the method of intervention applied by this researcher. The ultimate goal of this research study was to reduce the number of births with NTDs by increasing knowledge levels and stimulating behavioral changes in childbearing-age women.

Lastly, in Neuman's terminology, entropy is the presence of a knowledge deficit yielding a woman at greater risk for a birth with an NTD. Having corrected the knowledge deficit, the state of a woman in relation to her likelihood for an uneventful pregnancy and optimal



wellness places in negentropy, satisfying the goal of the researcher.

### Assumptions

For the purposes of the proposed study, the following assumptions were made:

1. Knowledge levels concerning folic acid are measurable.
2. Folic acid has the potential to prevent 50% or more of the NTD-affected pregnancies in the United States if taken as recommended during the preconceptional and periconceptional period.
3. Exposure to primary nursing interventions related to folic acid education will impact knowledge levels of participants.

### Statement of the Problem

Though empirical evidence shows an increased incidence of NTDs with folic acid deficiency, childbearing-aged women remain largely unaware of the benefits of folic acid supplementation during the preconceptional and periconceptional period.

### Null Hypothesis

The following null hypothesis was generated for this study: There will be no significant difference in knowledge levels among college students before and after exposure to a folic acid educational intervention.

### Definition of Terms

#### 1. Knowledge levels

Theoretical: awareness of truths or facts.

Operational: awareness of truths or facts about folic acid; to be determined according to correct responses on Ferguson's Questionnaire I and Questionnaire II, self-reporting pretest/posttest.

#### 2. College students

Theoretical: men and women who attend a program of study at an institution of higher learning.

Operational: men and women who are currently enrolled in a program of study at a selected rural community institution in a southeastern state and who are classified as freshmen or sophomores.

#### 3. Folic acid educational intervention

Theoretical: methods used to educate and inform about vitamin B<sub>11</sub>.

Operational: methods used to educate and inform the participants concerning folic acid during a 3-week period

to include the following: five posters placed on bulletin boards in a large classroom building; five folic acid displays with brochures placed in the following sites: department of nursing secretary's office, student health office, library, cafeteria, and the gymnasium; five television public service announcements which ran one per hour throughout Monday-Friday, 8:00 a.m.- 8:00 p.m. Messages rotated each hour; five e-mail messages were sent over campus mail giving the same information as the television public service announcements.

In conclusion, the significance of folic acid to the prevention of NTDs is evident in the literature. Empirical evidence also exists to support a knowledge deficit among the general public related to folic acid. The current study validated this information and sought to determine if the baseline knowledge level of college students related to the importance of taking folic acid preconceptionally and during the early weeks of pregnancy could be impacted by a multi-faceted educational intervention.

## Chapter II

### Review of Literature

The review of literature strongly establishes the significance of folic acid in the prevention of neural tube defects (NTDs). Numerous studies document both preconceptional and periconceptional benefits of folic acid supplementation. Additionally, experts have studied public awareness of folic acid and its role in the prevention of birth defects, citing a definite knowledge deficit among the general public as well as health care professionals. Several authorities have initiated interventions to increase public awareness related to folic acid during the past 10 years, with current research evaluating the effectiveness of those activities. The following is a chronological synopsis of the research during the past two decades.

Prior to 1992, research related to folic acid and the prevention of NTDs focused on recurrence of NTD-affected pregnancies. One such study, published in 1981, was considered a landmark study. A double-blind, randomized, controlled trial of folate treatment before conceptions to

prevent recurrence of NTDs was conducted in south Wales (Laurence, James, Miller, Pennant, & Campbell, 1981).

Laurence et al. (1981) studied women residents in Glamorgan and Gwent who had a pregnancy in the past complicated by an NTD between 1954 and 1969. The sample of 905 women who had a child with a neural tube defect was interviewed during a home visit at which time a questionnaire was completed giving details of the woman's diet during the interpregnancy period and during her previous pregnancies. Diets were judged as good, fair, or inadequate based on information obtained from the questionnaires. A sample of blood was taken from all women who were planning to have further children for estimation of serum and red-cell folate concentrations by a modified lactobacillus method. Those willing to cooperate were asked to take twice daily a tablet containing either 2 mg of folic acid or placebo starting from the time contraceptive precautions were stopped. From this sample, 111 agreed to take part in the prophylactic randomized controlled trial and achieved a subsequent pregnancy. Of those, 60 were randomized to receive a folate supplement and 51 were to receive a placebo. Laurence et al. (1981) monitored compliance at the sixth to ninth weeks of estimated gestation by checking serum folate concentrations. Sixteen of the women in the

supplementation group did not comply with their vitamin supplement.

Six pregnancies resulted in a fetus with an NTD: none in the 44 compliers, 2 in the non-compliers, and 4 in the placebo group. The proportion of women with inadequate diets was similar to the two treatment groups: 10 out of 44 compliers and 17 out of the 67 non-compliers and women in the placebo group. The probability of such a distribution, using Fisher's exact test with a single tail, was  $p = .01$ . All six of the recurrences of NTDs occurred in women taking an inadequate diet (Laurence et al., 1981).

As a trial of the methodology of preventing NTDs by giving prophylactic folate, the trial was unsuccessful. Two out of 60 women allocated to receive treatment had a recurrence compared with 4 out of 51 controls. A disappointing result was due to noncompliance with the tablet regimen. As a trial of the biological effects of receiving folate during early pregnancy, however, the study was more successful.

Laurence et al. (1981) separated the specific effect of folate from the nonspecific effect of diet. There were no recurrences among the 84 women who received good or fair diets, but there were six recurrences among the 27 women receiving a poor diet ( $p < .0001$ , Fisher's exact

test). The research indicated that women who take poor diets are at an extremely high risk of a recurrence of neural tube defects. Laurence et al. (1981) concluded that folic acid supplementation might be a cheap, safe, and effective method for primary prevention of NTDs, but that this must be confirmed in a large, multicenter trial.

The implications of Laurence et al.'s (1981) study were pertinent to the current study because it showed that a diet lacking in folic acid contributed to the occurrence of NTDs. The established need for folic acid supplementation was an assumption of this researcher.

Milunsky et al. (1989) conducted another study that further validated the significance of folic acid to the prevention of NTDs. The researchers prospectively examined the relation of multivitamin intake in general and folic acid intake in particular to the risk of NTDs in a cohort study of over 22,000 women. Each of the women underwent amniocentesis or had a serum alpha-fetoprotein assay at about 16 weeks of pregnancy during the period October 1984 through June 1987. Interviewers contacted 24,559 women; 1,068 (4%) refused to participate. Of the 23,491 interviewed women, completed questionnaires and pregnancy outcome information from 22,776 were used in the study. Interviews focused on family, medical, and genetic history with special emphasis on diet, medication, and illness

during the first trimester of pregnancy. Each woman was asked to provide detailed information on her use of vitamins and other nutritional supplements. Pregnancy outcome was ascertained from a brief questionnaire mailed to the delivering physicians near the expected date of delivery or subsequently to the mothers themselves when physicians did not respond (Milunsky et al., 1989).

Forty-nine women had an NTD outcome for their pregnancies. Among the 12,297 women who took multivitamins in the first trimester only, there were 29 (2.6 per 1,000) who had NTD outcomes. Among the 7,261 women who used multivitamin supplements before and after conception, 9 had an NTD outcome, a significantly lower number (0.9 per 1,000, prevalence ratio 0.27; 95% confidence interval, 0.12 to 0.59 compared with never users). Milunsky et al. (1989) observed a substantially reduced risk of NTDs among women who took standard doses of multivitamin/folic acid supplements. Therefore, this study was relevant for the current study by emphasizing the direct effect of folate intake on pregnancy outcomes, particularly in the prevention of NTDs.

In response to the Laurence et al. (1981) recommendations, and subsequent to the Milunsky et al. study, Werler, Shapiro, and Mitchell (1993) conducted a multicenter case-control trial with mothers of 436



occurrent cases with NTDs and mothers of 2,615 controls with other major malformations. The study was done in metropolitan Boston, Massachusetts, Philadelphia, Pennsylvania, and Toronto, Ontario during the period from 1988 through 1991 as a part of an ongoing surveillance program of drugs and environmental factors in relation to the risks of major malformations (Werler et al., 1993).

Werler et al. (1993) ascertained study subjects by a systematic contact at tertiary and birth hospitals in greater metropolitan Boston, Philadelphia, and Toronto. The primary physician of each potential study subject was asked for permission to contact the mother. Women were then sent an introductory letter, followed by a telephone call to schedule an interview. Within 6 months after delivery, study nurses obtained written informed consent and interviewed mothers at home (91%), at an alternative site (8%), or by telephone (1%).

The standardized interview questioned demographic and health behavior factors, reproductive history, family history of birth defects, occupation, illnesses (chronic and during pregnancy), and use of alcohol, cigarettes, and medications. More specifically, the interview included detailed questions about use of vitamin supplements during the 6 months prior to the last menstrual period through the end of pregnancy (Werler et al., 1993).

Werler et al. (1993) administered a semiquantitative food frequency questionnaire to ascertain average consumption during the 6-month interval before the last menstrual period. Average servings per day of each food item were linked to nutrient levels to estimate an average daily dietary intake of folate.

At the end of the interview, each woman was asked, "Are there any vitamins, minerals, or anything else that may cause or reduce the risk of birth defects?" If she answered yes, she was asked, "What vitamin or mineral?" and "Is this related to any particular birth defect?"

Werler et al. (1993) studied 436 eligible subjects with anencephaly ( $n = 84$ ), spina bifida ( $n = 308$ ), or encephalocele ( $n = 44$ ). The controls were 2,615 eligible subjects with other major malformations. The defects in the control group included chromosomal anomalies, ventricular septal defects, renal defects, transposition of great vessels, hypospadias, limb reduction defects, and craniosynostosis.

Werler et al. (1993) defined the periconceptional period as the interval from 28 days before the last menstrual period through the 28 days after the last menstrual period. Four exposure categories were identified: (a) daily use of a vitamin supplement containing folic acid, (b) less than daily use of a

vitamin supplement containing folic acid, (c) use of a multivitamin with unknown folic acid status, and (d) use of a multivitamin without folic acid. To assess the independent effect of folic acid supplementation after the periconceptional period but before neural tube closure was complete, Werler et al. (1993) separately examined exposure that occurred in the second lunar month. The dose of folic acid among daily users was considered in four categories: (a) 1 or more mg, (b) 0.5 to 0.9 mg, (c) 0.4 mg, and (d) less than 0.4 mg (Werler et al., (1993).

Relative risks (RRs) were estimated by odds ratios (ORs). The following factors were considered as potential confounders: (a) maternal age, (b) education, (c) race, (d) religion, (e) ethnic group, (f) family income, (g) birth status (live born, stillborn, and therapeutic abortion), (h) gravidity, (i) parity, (j) the duration between the previous and index pregnancies, (k) whether the pregnancy was planned and, if so, whether a health care provider was consulted, (l) the frequency of routine gynecologic visits in the index pregnancy, (m) routine use of seatbelts and exercise, (n) recreational drug use 6 months before or during pregnancy, (o) prepregnancy use of cigarettes or alcohol, (p) diabetes in pregnancy, (q) use of folate antagonist medications in the periconceptional period, (r) calendar time, and (s) geographic region

(Werler et al., 1993). With the large number of factors considered, Werler et al. (1993) separately examined the effects of each by Mantel-Haenszel adjustment of the relative risk estimate; any factor that altered the crude relative risk was included in a multivariate logistic regression model. Then, to obtain the most parsimonious model, Werler et al. (1993) dropped those factors least associated with NTDs. In addition to the four categories of folic acid supplementation, the final model included the following terms: maternal age ( $\leq 20$ , 21 to 25, 26 to 30, 31 to 35, and  $\geq 36$  years), maternal education ( $< 12$ , 12 to 15, and  $\geq 16$  years), annual family income ( $< \$10,000$ ,  $\$10,000$  to  $\$14,999$ ,  $\$15,000$  to  $\$24,999$ , and  $\geq \$25,000$ ), and birth status (liveborn, stillborn, and therapeutic abortion). Trend was tested by entering ordinal terms for quintiles of folic acid intake in the multivariate model.

Dietary folate intake was examined only among women who did not use multivitamin supplements (Werler et al., 1993). These data were divided into quintiles of intake determined by the distribution of dietary folate intake among the control mothers. For dietary analysis, the model controlled for calories as a continuous variable, as well as the effects of maternal age, maternal education, family income, and birth status.

Daily use of folic acid supplements in the periconceptional period was reported by mothers of 8% of cases and mothers of 13% of controls; the crude and multivariate relative risk estimates and 95% confidence intervals (CIs) were 0.5 (0.3 to 0.7) and 0.6 (0.4 to 0.8), respectively (Werler et al., 1993). The most common dose was 0.4 mg, for which the relative risk estimate was 0.3 (95% CI, 0.1 to 0.6). Seventy-five case mothers (17%) and 65 control mothers (3%) reported that folic acid reduces the risk of NTDs. Among them, for daily use in the periconceptional period, the multivariate relative risk was 0.8 (95% CI, 0.3 to 2.4); for women who did not know the hypothesis, the corresponding estimate was 0.4 (95% CI, 0.2 to 0.6). For less than daily use in the periconceptional period, and for first use in the second lunar month, multivariate estimates for women who knew the hypothesis were 0.4 (95% CI, 0.1 to 1.3) and 0.6 (95% CI, 0.2 to 1.7), respectively; the corresponding estimates for women who did not know the hypothesis were 0.9 (95% CI, 0.6 to 1.4) and 0.8 (95% CI, 0.6 to 1.1).

Werler et al. (1993) classified the cases according to the type of NTD. There were 59 cases with anencephaly, 42 cases with encephalocele, and 260 cases with spina bifida. For anencephaly, encephalocele, and spina bifida, relative risks for daily periconceptional exposure ranged

from 0.2 to 0.5, and each was consistent with the overall findings.

For quintiles of dietary folate among women who did not use supplements, there was a statistically significant trend of decreasing risk with increasing intake (test for trend,  $p = .02$ ). For the three highest quintiles, relative risk estimates ranged from 0.6 to 0.7 (Werler et al., 1993).

The findings suggested that daily periconceptional intake of 0.4 mg of folic acid reduces the risk of NTDs by approximately 60%. These results supported and extended previous findings that use of folic acid supplements before and during early pregnancy reduces the risk of occurrent NTDs (Werler et al., 1993). The Werler et al. study lends credence to the current research as it demonstrated the significance of folic acid to the prevention of birth defects as well as a knowledge deficit among women of childbearing age. The current study expanded the population to focus on college students and their perception of folic acid and its relationship to NTDs.

There is considerable evidence that the periconceptional administration of multivitamin supplements, or a folic acid supplement alone, prevents recurrent NTDs (Czeizel & Dudas, 1992). However, about 95%

of the women who deliver infants with NTDs have not previously delivered infants with these defects. Czeizel and Dudas (1992) undertook a trial to determine whether periconceptual vitamin supplementation could reduce the incidence of a first occurrence of neural tube defects.

Czeizel and Dudas (1992) conducted a randomized, controlled trial of periconceptual multivitamin supplementation to test the efficacy of this treatment in reducing the incidence of a first occurrence of an NTD. The study was conducted in Hungary, where the overall prevalence of isolated NTDs was 2.8 per 1,000 live births.

Women planning a pregnancy who satisfied the criteria were eligible to participate in the Hungarian Family Planning Program trial begun in 1984 (Czeizel & Dudas, 1992). The study design involved three steps performed or supervised by qualified nurses: (a) a checkup of reproductive health, (b) a 3-month preparation for conception, including vitamin or trace-element supplementation and contraception, and (c) protection of very early pregnancy with immediate prenatal care. At the first visit, eligible women were informed about the purpose of the trial, including supplement use, and were asked whether they agreed to random assignment to receive either supplement. The women were then asked to give

written informed consent and to stop taking any other vitamins (Czeizel & Dudas, 1992).

Women planning a pregnancy were randomly assigned to receive a single tablet of a vitamin supplement containing 0.8 mg of folic acid or a trace-element supplement daily for at least one month before conception and until the date of the second missed menstrual period. The women were asked to note that they had taken the tablet each day on a form used to record their basal body temperature and to leave the unused tablets in the box.

At the second visit, 3 months later, the women were supplied with tablets for the next 3 months, advised to attempt to achieve conception within this period, and asked to return immediately after the first missed menstrual period. The purpose of the third visit was to confirm pregnancy with a sensitive serum pregnancy test if the woman had missed a menstrual period. Pregnancy was also confirmed by ultrasonography within 2 weeks after a positive serum pregnancy test. Tablets were supplied until the third month of gestation. If the woman had not conceived within this 3-month period, she was given an additional 3-month supply of supplement (Czeizel & Dudas, 1992).

All deliveries and terminations of pregnancy took place in obstetrical inpatient clinics. All the



informative pregnancies of the women were evaluated with particular attention to the appropriate diagnosis or description of congenital malformations. The women completed summaries of the outcome of their pregnancies, including the date of delivery, sex, weight, gestational age, and the presence or absence of congenital defects. The results were reviewed and confirmed by their physicians, who sent the summaries to the study staff (Czeizel & Dudas, 1992).

Pregnancy was confirmed in 4,753 of the 7,540 women who participated. The outcome of the pregnancy (whether the fetus or infant had an NTD or congenital malformation) was known in 2,104 women who received the vitamin supplement and in 2,052 who received the trace-element supplement. Congenital malformations were significantly more prevalent in the group receiving the trace-element supplement than in the vitamin-supplement group (22.9 per 1,000 vs. 13.3 per 1,000,  $p = .02$ ). Six pregnancies were affected by NTDs in the group who received the trace-element supplement, as compared with none in the vitamin-supplement group ( $p = .029$ ) (Czeizel & Dudas, 1992).

The findings of this trial indicated that periconceptual vitamin supplementation reduced the incidence of a first occurrence of NTDs. Given the results of this study, Czeizel and Dudas (1992) recommended that

all women planning pregnancy should receive a vitamin supplement containing folic acid. The research by Czeizel and Dudas (1992) supported the current study through recognition of the need for folic acid supplementation for all childbearing-aged women to prevent first-time occurrence of NTDs. The studies differed in that the Czeizel and Dudas study focused on an intervention of vitamin supplementation in pregnant women in an effort to prevent NTDs, while the current study focused on an educational intervention to increase knowledge of folic acid in college students in an effort to impact NTDs.

Overlapping this research was a case-controlled study by Daly, Kirke, Molloy, Weir, and Scott (1995). In light of the empirical evidence of folic acid's role in the prevention of NTDs, Daly et al. (1995) expanded on the relationship between NTD risk and early pregnancy maternal red cell and plasma folate levels. Daly et al. (1995) particularly quantified the effect of various intervention strategies on NTD risk and discussed the implications for public health policy and clinical practice. The study took place in Dublin, Ireland, from March 1986 to March 1990, with a sample of 56,049.

Preventative strategies included the high-risk approach, which involved identifying individual women at high risk because of low red cell folate levels and

raising their levels to reduce their risk. The second strategy for prevention was a population approach. This approach involved increasing red cell folate levels of all women before pregnancy, irrespective of initial level, and shifting the entire distribution of red cell folate upward. Daly et al. (1995) found that if a policy of intervention in women with red cell folate levels less than 453 nmol/L and a target of increasing levels above this figure was adopted, the maximum reduction in the total number of NTDs would be 12% (95% CI, 4% to 30%), equivalent to 17% of folate-responsive NTDs. Using the population strategy of prevention, Daly et al. (1995) reported that by increasing red cell folate levels by 25% in all women would result in a 22% (95% CI, 10% to 37%) decrease in total NTD prevalence.

Daly et al. (1995) proposed the use of folic acid supplementation and food fortification as interventions to achieve the goal of NTD reduction. The conclusion emphasized a population approach with food fortification as a preferred alternative to direct folic acid supplementation. Findings estimated that a 48% (95% CI, 22% to 72%) reduction in the total NTD rate (66% of folate-responsive NTDs) was theoretically achievable with an increased population intake of 0.4 mg per day of folic acid. In terms of reducing the population prevalence of

NTD, this study showed a high-risk strategy, requiring screening for low folate status, which on its own is likely to be less effective than the population approach. Beginning with this study, the focus of folic acid research shifted to methods to achieve the public health recommendations regarding folic acid supplementation. This study was germane to the current study in that they sought to quantify the effectiveness of various intervention strategies to increase folic acid intake in childbearing aged women. This current research was based on the assumption that a knowledge deficit related to folic acid exists that has implications for clinical practice as a nurse practitioner, which utilized various educational interventions to teach college students about folic acid and NTDs.

The Georgia Women's Health Survey (GWHS) was a study by the CDC, designed in 1995, to ascertain female consumption of folic acid in women who took multivitamins. Additionally, the study attempted to determine respondents' knowledge about folic acid. The GWHS was a random-digit-dialed telephone survey of a probability sample of 4,005 Georgia women aged 15 to 44 years with 3,130 (78%) women responding. Survey respondents were asked, "During the past 30 days, how often have you taken multivitamins?" Responses were "every day," "several times

a week," "once a week," "less than once a week," and "don't know." Respondents also were asked, "What brand of multivitamins do you or did you take most often?" and "Have you heard or read that taking a vitamin called folic acid can help prevent some birth defects?" The amount of folic acid women consumed was estimated based on the amount in the multivitamin brand they reported using (CDC, 1996).

According to the CDC (1996), overall, 20% (95% CI = 19% to 21%) of the respondents reported consuming a multivitamin containing at least 0.4 mg of folic acid per day, 5% (95% CI = 4% to 6%) reported consuming a multivitamin containing at least 0.4 mg of folic acid several times a week, and 29% (95% CI = 27% to 30%) reported they had heard folic acid can help prevent some birth defects. Of those who had heard folic acid can help prevent some birth defects, 30% (95% CI = 27% to 32%) reported consuming a multivitamin containing at least 0.4 mg of folic acid per day, and 6% (95% CI = 5% to 8%) reported consuming a multivitamin containing at least 0.4 mg of folic acid several times a week. Of the 71% (95% CI = 70% to 73%) who had not heard about folic acid, 16% (95% CI = 15% to 18%) reported consuming a multivitamin containing at least 0.4 mg of folic acid daily, and 4% (95% CI = 3% to 5%) reported consuming a multivitamin

containing at least 0.4 mg of folic acid several times a week (CDC, 1996).

Prevalence of knowledge about folic acid varied directly by respondents' educational and income levels (CDC, 1996). Women with a college degree were more likely to have heard about folic acid than women with only some high school (45% [95% CI = 41% to 49%] vs. 12% [95% CI = 9% to 15%]), and women with incomes above 150% of poverty level were more likely than women with incomes below 150% of poverty level (31% [95% CI = 29% to 33%] vs. 18% [95% CI = 15% to 21%]).

The GWHS findings underscore that 75% to 88% of the 60 million women of reproductive age in the United States may not obtain the amount of folic acid recommended by the Public Health Service to reduce the risk for NTDs (CDC, 1996). The results of the GWHS substantiate the need for continuing efforts to increase consumption of and awareness about the benefits of folic acid and, therefore, lend credence to the present study of knowledge levels of college students related to folic acid (CDC, 1996).

Along with the United States Public Health Service, the Department of Health Expert Advisory Group (HEA) of the UK also recommended that "all women should take an extra 0.4 mg of folic acid before conception and during the early months of pregnancy" (Wild & Sutcliffe, 1997).

Following the HEA recommendation, Wild and Sutcliffe (1997) undertook a longitudinal study to evaluate the effectiveness of the folic acid recommendation reaching the general public in the UK. Initial data were collected through administration of self-reporting questionnaires in 1993, with comparison data collection repeated in 1994 and 1996. Surveys were carried out among pregnant and nonpregnant women, ascertaining whether the women were taking folate supplements before and after conception.

Wild and Sutcliffe (1997) surveyed 613 women in 1993, reporting that only 1.8% of these women were taking a folic acid supplement prior to conception. An additional 5.7% responded that they began taking a folic acid supplement after pregnancy was confirmed. The findings of the 1994 survey revealed a modest increase in women's knowledge of folic acid as evidenced by a response of 18.2% of the 603 women questioned reporting use of a folate supplement preconceptionally. The number of women who were taking a folic acid supplement after conception increased to 20.7% (Wild & Sutcliffe, 1997)

Wild and Sutcliffe (1997) further evaluated the HEA's Health Education Campaign as they repeated the survey in 1996, almost one year after the campaign was formally launched. At that time, 679 women who were making their first antenatal visit between May 20 and August 29,

1996, were questioned. Forty percent were primiparous and none had a pregnancy complicated by an NTD. All of the women were interviewed by the same dietitian who completed a folate-awareness questionnaire, which ascertained knowledge about folate and when and where respondents had obtained this information. One hundred eighty-nine women had been prescribed or advised to take folate supplements before conception and all had done so. Nineteen women had taken preconceptional folate on their own accord. Sixty-four women, including 2 who had not taken supplements, had increased their intake of folate-rich foods before conception. Thus, 210 (30.9%) had increased their folate intake before conception: 146 by supplements alone, 2 by diet alone, and 62 by supplements plus diet. A further 261 had been prescribed or advised to take folate in the first 12 weeks of pregnancy and 255 had done so. Nine, who had not received advice from their general practitioners, had taken folate of their own accord during early pregnancy, making a total of 264 (38.8%).

Wild and Sutcliffe (1997) found that 431 (63.4%) of the women reported that their general practitioner had talked to them about folic acid and 260 had provided written information. Sources of information other than health professionals were newspapers, magazines, friends, and relatives. One hundred forty-nine women said they had



heard about folic acid for prevention of spina bifida on television or radio, and 81 mentioned the folate campaign on television in February 1996. One hundred seventy-five women (25.5%) said that they had not heard of the vitamin folic acid before their general practitioner talked to them. Wild and Sutcliffe (1997) showed that the percentage of women in the UK who were taking folic acid supplements preconceptionally had risen from 1.8% to 30.6% during the time of the study. The percentage of women who were taking folate after conception rose from 5.7% to 38.8%. These findings provided a foundation for the present study's attempt to measure knowledge levels of college students related to folic acid before and after an educational intervention to increase awareness related to folic acid and its role in the prevention of NTDs.

Sillender and Pring (2000), also assessing the effectiveness of the HEA's campaign launched in late 1995, used a questionnaire answered by both patients not exposed to the campaign and by those who were not exposed to the campaign. The study took place at the antenatal clinic at York District Hospital. The study population was comprised of 337 women in approximately their 20<sup>th</sup> week of pregnancy attending the clinic for routine fetal anatomy ultrasound scan. Data were collected on aspects of folate awareness, intake, and sources of advice before and after the

campaign's start. The questionnaires were given to each patient by the receptionist and were collected prior to examination by the physician. Sillender and Pring (2000) set out to prove or disprove that the HEA's campaign was effective. The probability of the HEA's campaign being effective was assessed using Chi testing on data from samples of women conceiving before and after the dates where the campaign could have been accessed. Pregnancy planning, smoking rates, and entitlement to free prescriptions before pregnancy in these samples were then compared using Chi, and ages were compared using standard error of the difference between means to demonstrate the similarity of the separate samples. During the period from May to September, 811 women attended the clinic, and, from these, 337 questionnaires were completed, a response rate of 42%.

Analyzing preconceptional folic acid intake, Sillender and Pring (2000) divided the study population into two groups. The first sample group was questioned during weeks 1 to 15 of the study. As they were considered to be 20 weeks pregnant at the time of questioning, the campaign could not have influenced their folic acid consumption preconceptionally. This group consisted of 262 women. The second group was questioned during weeks 16 to 20 of the study and could have been influenced to take

preconceptional folic acid by the campaign. This group numbered 75 pregnant females.

Sillender and Pring (2000) compared these two samples using planned pregnancy rates (156/262 vs. 52/75,  $\chi = 2.37$ ,  $p = .124$ ), smoking rates (55/262 vs. 12/75,  $\chi = 0.91$ ,  $p = .34$ ), entitlement to free prescriptions prior to pregnancy (78/262 vs. 17/75,  $\chi = 1.45$ ,  $p = .23$ ), and mean age (27.1 years vs. 27.8 years, standard error of the difference,  $\chi = 1.07$ ,  $p = .28$ ). As there were no statistical differences between the two sample groups for these variables, the groups were considered to be broadly comparable. The two sample groups were then compared question by question.

Sillender and Pring (2000) found that following the campaign, a significant increase was found in the number of women who had read material recommending the use of preconceptional folic acid prior to their pregnancy (61.1% rising to 76%). The amount of advice increased from all sources following the campaign, although only advice from a nurse (3.9%) reached statistical significance.

As a result of both these factors, Sillender and Pring (2000) noted the use of preconceptional folic acid increased by a very significant amount (27.1% to 48%). Findings also revealed that general practitioners were significantly more likely to prescribe folic acid

preconceptionally following the campaign (3.1% to 14.7%). Consumption of folate-rich food increased, but did not reach significance. The most common reason for not taking folic acid preconceptionally was unplanned pregnancy (86/337, 25.5%). Other important reasons were non-awareness of folate (52/337, 15.4%) and awareness without being convinced of efficacy (28/337, 8.3%). Cost was a less important factor (7/337, 2.1%).

Sillender and Pring (2000), in evaluating the folic acid intake only after confirmation of pregnancy, again divided the group into two subgroups for analysis. The first group ( $n = 169$ ) was questioned between weeks 1 and 10 of the study. The second group ( $n = 168$ ) was questioned in the remaining weeks.

These two samples were then compared using planned pregnancy rates (98/169 vs. 110/168,  $\chi = 2$ ,  $p = .16$ ), smoking rates (36/169 vs. 31/168,  $\chi = 0.43$ ,  $p = .51$ ), entitlement to free prescriptions prior to pregnancy (47/169 vs. 48/168,  $\chi = 0.02$ ,  $p = .88$ ), and mean age (27.3 years vs. 27.2 years, standard error of the difference,  $\chi = 0.18$ ,  $p = .86$ ). As there were no statistical differences between these two sample groups, the groups were considered to be broadly comparable (Sillender & Pring, 2000).

The two sample groups' responses to questions on their folate intake were then compared. It was noted that there was no statistically significant change in postconceptional-only folic acid consumption, although consumption of tablets fell from 49.1% to 38.7% ( $\chi = 3.72$ ,  $p = .05$ ). Amount of advice on postconceptional folate from various sources over the study period remained constant, as did consumption of folate-rich food and general practitioner's prescription of tablets (Sillender & Pring, 2000).

Sillender and Pring (2000) additionally reported the effectiveness of the HEA's campaign as evidenced by 48.7% of the women responding that they had heard of the campaign. Comparing study weeks 1 to 15 versus study weeks 16 to 20 for this question yielded 42.4% vs. 65.3%,  $\chi^2 = 12.33$ ,  $p < .001$ , 95% confidence intervals: 10.6% to 35.3%. Significant increases in preconceptional and total folate consumption, awareness of folate's benefits in preventing NTDs, and the number of prescriptions written was seen as the study progressed. The implication of this study to the current research is that Sillender and Pring (2000) showed that targeted health promotion is effective. The current research targeted a different study population, college students.

Bower, Blum, Watson, and Stanley (1996) conducted another study evaluating a health promotion project in Western Australia. The objectives of this study were as follows: (a) inform health professionals and women of childbearing age about the prevention of NTDs by folate, (b) recommend that all women of childbearing age increase their intake of folate, and (c) evaluate the effectiveness of the strategies used to achieve these aims. The study took place in Western Australia where the prevalence of NTDs is approximately 2 per 1,000 births (Bower et al., 1996).

Before the public launch of the project in November 1992, Bower et al. (1996) conducted surveys of general practitioners attending a continuing education seminar and a random sample of all child health nurses and pharmacists in Western Australia. Questions were asked about current practices in nutritional advice for pregnancy, prescribing patterns for folic acid, and the perceived need for educational material (Bower et al., 1996).

Using information obtained from these surveys, an information update sheet for health professionals was prepared, along with a pamphlet for women, a poster, and an order card for more materials (Bower et al., 1996). These materials were mailed out to all general practitioners, obstetricians, pediatricians, child health

nurses, and pharmacists in Western Australia. Information was also distributed to dietitians, health education officers, and health-related professional societies and colleges in the state.

The media launch was covered by all four major Perth television stations in their evening news service, a television current affairs program, the daily newspaper, several suburban and rural newspapers, most radio station news services, and by some national radio and television programs (Bower et al., 1996). A survey was conducted in four metropolitan shopping centers over a period of a week to ask women of childbearing age questions about their knowledge of folate, spina bifida, of the association between the two and their sources of health information (Bower et al., 1996). Because of the limited budget, it was decided to make maximal use of unpaid media in promoting the health message. Invitations to participate in the project were sent to all television channels, radio stations, and statewide and community newspapers. Another activity was supermarket demonstrations where price tags for folate-rich fruit and vegetables were prepared with a "high in folate" message on them. In addition to these activities, a home economist working under contract presented a "Folate Foods" demonstration to 18 interested groups in the workplace and the community.

Bower et al. (1996) evaluated the effectiveness of the interventions by repeating surveys of general practitioners and child health nurses 12 months after the initial survey. Surveys of pharmacists were also undertaken as well as two further surveys of women in metropolitan shopping centers at 6 and 12 months after the launch of the project. Data from the surveys of general practitioners, child health nurses, and women of childbearing age were entered into Epi Info databases. Comparisons were based on chi-squared tests. Unless stated otherwise, all chi-squared tests were on one degree of freedom. The 95% CI for the odds ratios were calculated using Cornfield's approximation, or the exact method if indicated (Bower et al., 1996).

The results of the general practitioner surveys showed a decrease in the number of practitioners who stated they had not heard about an association between folate and NTDs (13% to 9%). When asked about the formulation and dose of folic acid usually recommended before and in early pregnancy, 52% of doctors in the first survey stated that they recommended 5 mg per day. In the second survey, only 24% stated this dose. In the first survey, 91% of the practitioners indicated that they wanted further information about folate and the prevention of NTDs; in the second survey, 64% stated that they had



heard about the association between folate and NTDs from materials sent out in response to the participant's request during the first survey. Ninety-four percent of the doctors said that they were displaying the poster and or pamphlets in their offices (Bower et al., 1996).

A random sample ( $N = 77$ ) of all child health nurses in Western Australia was sent a self-administered questionnaire in August 1992, and the remaining nurses ( $N = 93$ ) were sent a questionnaire one year later. A total of 57 (76%) questionnaires were completed and returned from the first survey and 64 (69%) from the second survey (Bower et al., 1996). The findings indicated a decrease in the number of nurses who had not heard about the association between folate and NTDs (20 [35%] vs. 10 [16%],  $p = .02$ ). The number of nurses that stated green vegetables were a good folate source increased (36 [69%] to 57 [89%],  $p = .001$ ). Nurses who offered dietary advice to women planning a pregnancy increased from 9% to 19%. Ninety-five percent of the nurses indicated in the first survey that they wanted further information and educational materials about folate and NTDs; in the second survey, 95% stated that they had received those materials and were displaying them in the clinic waiting rooms (Bower et al., 1996).

Before the launch of the project, 452 women were surveyed at shopping centers. Six months later, 460 women were surveyed, and 12 months later a further 405 women were surveyed (Bower et al., 1996). No significant differences were found between the women in the three surveys in terms of age and number of children. Compared with the first and second surveys, proportionately more women in the third survey had tertiary education and fewer whose highest level of education was completion of high school. A significant trend was found over the three surveys of increased knowledge related to foods rich in folate. By the third survey, 41% of women stated that fruit was a source of folate, 50% stated vegetables, and 28% stated cereals as a source of folate.

A total of 395 women in the first survey had heard of spina bifida, and 372 (82.3%) chose the correct description of the defect from a list of three provided. At the third survey, 350 women (86.4%) chose the correct description (Bower et al., 1996).

Bower et al. (1996) reported that at the 18 Folate Foods demonstrations conducted at work site and community groups, 224 attendees completed evaluation sheets. Ninety-four percent stated that it provided them with new information.

Bower et al. (1996) noted that this was the first population-based project established in Australia to promote an increased intake of folate for the prevention of NTDs. Though preliminary evaluation of the project demonstrated its success in disseminating the information in Western Australia, the researchers have yet to determine whether women have acted on the information by increasing their folate intake before they become pregnant.

The Bower et al. (1996) study's significance to the current research was its success in disseminating the folic acid recommendation through intensive educational interventions. The present study imitated the media launch detailed in the work of Bower et al. (1996), utilizing a multifaceted approach.

Werler and Louik (1999) conducted another study concerned with achieving public health recommendations. Werler and Louik (1999) examined the impact on the occurrence of NTDs of each of the foregoing approaches to meeting the CDC recommendation. This study examined three approaches: (a) the promotion of daily use of folic acid supplements, (b) promotion of dietary intake of folate-rich foods, and (c) fortification of food with folic acid.

Study subjects were 1,136 mothers of infants with major malformations who were interviewed through 1996 and

were from the Boston and Philadelphia areas (Werler & Louik, 1999). This study evaluated both voluntary and passive approaches to achieving the CDC recommendation that all women of childbearing age consume 0.4 mg of folic acid daily.

Voluntary approaches 1 and 2 showed the prevalence of daily folic acid supplementation during the periconceptional period was 29% overall, changing from 25% in 1993 to 30% in 1994 and to 34% in 1995. Seventy-one percent of the 1,136 women in the study did not take folic acid-containing supplements daily before conception, but the proportion decreased over the years of the study. The average daily intake of folic acid was 2.4 servings as compared to the recommended intake of 7 servings. Patterns of consumption changed little across the three study years (Werler & Louik, 1999). Knowledge that folic acid reduces the risk of birth defects was reported by 32% of the subjects overall, with the proportion of subjects reporting such knowledge increasing from 29% in 1993 to 47% in 1995.

Approach 3, FDA-mandated fortification of folic acid in cereal grains, was evaluated by estimating the average daily intake of folic acid among women not taking supplements across all three study years (Werler & Louik, 1999). The average daily intake of folic acid was

estimated at 0.13 mg. The average increase in consumption resulting from fortification was 0.08 mg (added to the 0.05 mg from already-fortified breakfast cereals). The combined average daily intake of folate was 0.38 mg; however, the folate component of this is less bioavailable. With the assumption that folate is half as bioavailable as folic acid, Werler and Louik (1999) found that 8% of women not taking folic acid supplements would meet the CDC recommendation. Assuming that folate is 75% as bioavailable as folic acid, 21% of such women would meet the recommendation.

Werler and Louik (1999) concluded that with consumption of folic acid only through dietary intake, sizeable portions of the childbearing population would receive less than the level of folic acid recommended for preventing NTDs. Even with food fortification, women of childbearing age should be advised to take folic acid supplements (Werler & Louik, 1999). The findings of this study were relevant to the current research by acknowledging the significance of education related to food sources of folic acid. The current research sought to identify a knowledge deficit related to folic acid and to educate college students of foods rich in folate.

The effect of a mass media campaign to reduce socioeconomic differences in women's awareness and

behavior concerning the use of folic acid was reported by de Walle and van der Pal (1999). This cross-sectional comparison study took place in the Netherlands where a mass media campaign with special emphasis on reaching women in low socioeconomic categories was begun in 1995. The researchers asked pregnant women in four regions of the Netherlands attending their first or second antenatal visit to complete a questionnaire. Taking the highest fulfilled education, a recognized indicator of socioeconomic status, de Walle and van der Pal (1999) merged it into three levels: low, middle, and high. Multivariate logistic regression was used to calculate adjusted odds ratios for high versus low education.

The authors showed that in both studies, 90% of the pregnancies were planned (de Walle & van der Pal, 1999). After the campaign, 89% (1,437 of 1,612) of the respondents had heard about folic acid, and 76.9% (1,240) had heard about it before their pregnancy. In 1996, 53.5% (862) of all the respondents used folic acid (25.1% [411 of 1,636] in 1995) in some part of the advised period from 4 weeks before conception to 8 weeks after, and 21% (339) used it during the entire advised period (4.8% [78] in 1995). The adjusted odds ratios for education and use of folic acid decreased after the campaign but were not

statistically significant ( $p = .99$  for some use and  $p = .86$  for use during the entire period).

In 1996, 25.8% (146 of 565) of the women knew about folic acid before their pregnancy and were aware of the advised period, yet did not take it (49.2% [184 of 374] in 1995). The reasons for not taking folic acid did not differ significantly before and after the campaign. Cited as the main reasons for not taking folic acid were being pregnant already, disliking taking drugs during pregnancy, eating healthy food, or not thinking about the possibility of taking folic acid (de Walle & van der Pal, 1999).

Following the campaign, of the informed women who did not take folic acid, 37.8% (28 of 74) of highly educated women versus 54.5% (60 of 110) of lower educated women ( $p = .02$ ) stated they would consider taking folic acid in a next pregnancy. The de Walle and van der Pal (1999) study further established the need for continued research related to the knowledge deficit among childbearing aged women, thus adds credence to the current researcher's study of college students' knowledge levels concerning folic acid.

In conclusion to the review of literature, the author accepted the empirical evidence of the association between folic acid and neural tube defects as documented by Laurence et al. (1981), Milunsky et al. (1989), and Werler

et al. (1993). Czeizel and Dudas (1992), who looked at first-time occurrence of NTDs, undertook the next logical research related to the effect of folic acid on pregnancy outcomes. This author concluded, following this report, that the significance of folic acid to the prevention of first-time NTDs has equal relevance to the prevention of recurrences. Major organizations related to world health, noting the importance of this new knowledge, recommended that all women of childbearing age who could become pregnant increase their folic acid intake. The remainder of the literature focused on implementation and evaluation of strategies developed to meet these recommendations. Based on CDC (1996) reports, studies by Sillender and Pring (2000) and Wild and Sutcliffe (1997), the author concluded that further research is needed related to a perceived knowledge deficit among the general public related to folic acid and NTDs. Thus, recommendations lend credence to the study under investigation as the author examined the knowledge level of college students related to folic acid, provided educational interventions to correct an anticipated knowledge deficit, and evaluated the statistical significance through pretest-posttest data.

The review of the literature revealed a progression of research related to folic acid intake and pregnancy



outcomes. Landmark studies in the 1980s that linked folic acid deficiency in pregnant women to delivering infants with NTDs were documented by Laurence et al. (1981) and Milunsky et al. (1989). Various intervention studies were conducted throughout the next decade including works of the CDC (1996), Czeizel and Dudas (1992), Daly et al. (1995), and Sillender and Pring (2000). Findings consistently indicated a significant reduction of NTD-affected pregnancies in women who ingested folic acid prior to and during the early weeks of pregnancy. Several educational intervention studies related to teaching women about the benefits of folate preconceptionally and during early pregnancy were reviewed. Studies recommended the need for further research related to folic acid intake in women and suggested expansion to new populations, such as college students, which was the focus of the study under investigation.

## Chapter III

### The Method

It is well established in the literature that folic acid plays a significant role in the prevention of neural tube defects (NTDs). Supplementation of folic acid, both preconceptionally and during the first trimester of pregnancy, is the standard of care accepted worldwide by health care professionals. Despite the knowledge of its significance in prevention of these birth defects, the incidence of NTDs remains high. In response to evidence of a knowledge deficit related to folic acid among childbearing-aged individuals that is apparent in the literature, this researcher's purpose of study was to evaluate the effect of an educational intervention on the knowledge level of college students concerning folic acid.

#### Design of the Study

A quasi-experimental, one-group pretest-posttest design was utilized for comparison of knowledge levels concerning folic acid before and after an educational intervention. Polit and Hungler (1999) defined a quasi-experiment as "a study in which subjects are not randomly

assigned to treatment conditions, but the researcher does manipulate the independent variable and exercises certain controls to enhance the internal validity of the results" (p. 712). The pretest-posttest design is "an experimental design in which data are collected from research subjects both before and after the introduction of the experimental intervention" (Polit & Hungler, 1999, p. 711). This research design was deemed appropriate because the exclusive manipulation of variables was the introduction of the educational intervention, the independent variable, allowing causation to be implied.

### Limitations

Limitations of the study included the use of self-administered questionnaires. The instruments for cross-sectional data collection were highly structured and administered by the sole researcher to increase reliability. Closed-ended questions were utilized to increase efficiency; however, the potentiality exists that the researcher omitted possible alternative responses to some of the questions.

Another limitation of the study was the setting, which was a rural community college in the southeast with a population of approximately 4,000 students. The size and

homogeneity of the sample may have limited generalization to other populations in different geographical locations.

An additional limitation to the study was the use of self-administered questionnaires with no established, published validity. The original instrument, developed by the March of Dimes Birth Defects Foundation for use in its Folic Acid Campaign, was modified by the researcher to meet the purposes of this study. The modified tool was submitted to a panel of experts and then piloted on five students not involved in the study. Thus, face validity, within the confines of this study, was established.

#### Setting, Population, and Sample

The setting of this study was a community college in a rural county in a southeastern state. The college's enrollment was approximately 4,000 full-time and part-time students. The target population was male and female freshmen and sophomores who attended college. The target sample ( $N = 114$ ) included those potential subjects who met the criteria, agreed to participate, and were present on the day of data collection. Sampling design was one of convenience with subjects drawn from five randomly chosen 8:00 a.m. classes.

## Instrumentation

Data for the study were collected through administration of two researcher-adapted questionnaires (see Appendices A and B). The original questionnaires were developed, validated, and shown to be reliable by the March of Dimes Birth Defects Foundation (1999). The questionnaires were utilized in the University of Wisconsin, Oshkosh study, part of the ongoing Folic Acid Campaign. The researcher modified the tools to provide demographic information such as age, gender, and academic major. In addition, questions that related to personal history of pregnancy, plans to become pregnant, and use of folic acid were included. A group of five freshman college students who were not participants in this study piloted both the pretest and posttest instruments for wording and ease of administration. Additionally, the modified questionnaires were submitted to a panel of experts in an effort to establish face validity.

The remainder of the questions consisted of specific information regarding folic acid. Items 4 through 7 on the questionnaires were scored as follows: a correct response received 1 point; an incorrect response or "unsure" received 0 point. Item 6 was comprised of a list of foods from which the participants were asked to identify the

ones containing folic acid. Seven of the 12 foods listed contained folate. One point was awarded for correct responses, 0 point for incorrect or omitted responses. The total possible points were 10 for each questionnaire. The questionnaires were completed in approximately 10 minutes each.

#### Data Collection Procedure

Prior to implementation of this study, permission was obtained from the Mississippi University for Women Committee on Use of Human Subjects in Experimentation (see Appendix C). Permission to conduct the study at the community college was obtained from the Vice-President for Student Services (see Appendix D).

The researcher, using the fishbowl method of randomization, selected five 8:00 a.m. classes for the sample ( $N = 150$ ). Following selection, the researcher met with the classes, explained the purpose and nature of the study, instruments to be used, and invited them to participate. An individual consent form was obtained from those who agreed to participate (see Appendix E). The researcher then administered the pretest, Ferguson's Questionnaire I, providing instructions on completion. Ten minutes were allowed for completion. The completed questionnaires were collected for analysis.

Phase two of the study was the educational intervention, which was a four-part intervention that was completed over 3 weeks. Five posters provided by the March of Dimes Birth Defects Foundation with messages about folic acid from their current "Get the 'B' Attitude" campaign were placed on bulletin boards in the largest classroom building. Five Folic Acid displays with brochures containing "Get the 'B' Attitude" information were placed in the department of nursing secretary's office, the library, the gymnasium, the student health office, and the cafeteria. Five TV public service announcements ran on the college TV channel, one each hour, Monday to Friday, 8:00 a.m. to 8:00 p.m. The five messages rotated each hour. Lastly, five e-mail messages with the same information as the TV public service announcements were sent over the campus mail, rotating the five messages daily for the duration of the intervention phase.

Three weeks following the administration of Ferguson's Questionnaire I, the researcher returned to the 8:00 a.m. classes previously visited and administered the posttest, Ferguson's Questionnaire II. The educational intervention was ongoing during the immediate prior 3 weeks. Just as before, verbal instructions were given, 10

minutes were allowed for completion, and data were collected for analysis.

### Data Analysis

This study was a level four inquiry. In determining the test statistic most appropriate for this study, the dependent t test, a parametric statistical test used for analyzing the difference between two means was selected (Polit & Hungler, 1999). Descriptive statistics, such as mean, median, mode and frequency distribution, were utilized to analyze the demographic data. The variables of age, gender, and academic major were examined. Also examined were the personal pregnancy history, plans for becoming pregnant, and use of folic acid supplementation. An item-by-item analysis was performed on Ferguson's Questionnaires I and II to determine correct responses for each question. The number of possible correct answers was 10, thus 10 was the total possible score for each test. The mean scores for each group were then analyzed using the t test.

Design of the study was presented in this chapter. Limitations were identified. The setting, population, and sample were described. Instrumentation and data collection were specified and data analysis was depicted. Chapter IV will discuss the findings.



## Chapter IV

### The Findings

This chapter includes a description of the sample and analysis of data in relation to the hypothesis. A quasi-experimental, one-group, pretest-posttest study was conducted for comparison of knowledge levels concerning folic acid before and after an educational intervention. The purpose of the study was to determine if the educational intervention had an impact on knowledge of college students related to folic acid as measured by comparison scores on the pretest-posttest questionnaires.

#### Description of the Sample

The setting for the study was a community college in a rural county in a southeastern state. The target population was male and female freshmen and sophomores who attended college. The target sample ( $N = 114$ ) included those potential participants who met the criteria, who agreed to participate, and who were present on the days of data collection. A sample of convenience was utilized with participants drawn from five randomly chosen 8:00 a.m. classes. Using the fish bowl method of randomization, the

sample classes consisted of two nursing classes, one speech class, one interpersonal skills class, and one computer class ( $N = 114$ ). The sample participants ranged in age from 18 to 45 years with a mean age of 24.5 years. The majority of the sample (88.6%) was female, with 53% reporting nursing as their academic major. Refer to Table 1 for demographics by frequency and percentage.

Table 1

Demographic Characteristics of Participants by Frequency and Percentage

Demographic characteristic	$f^a$	$\%^b$
Gender		
Female	101	88.6
Male	13	11.4
Major		
Nursing	60	53.0
Undeclared	12	10.5
Accounting	6	5.2
Business/computer	14	12.0
Education	7	6.1
Engineering	2	1.8
Psychology	2	1.8
Radiology	3	2.6
Social work	8	7.0
Pregnancy history		
Gravida 0	66	57.9
Gravida > 1	48	42.1
Pregnancies planned	28	58.3
Plan future pregnancies	76	66.7
Currently taking folic acid	33	28.9

<sup>a</sup> $N = 114$ .

<sup>b</sup>Percentages were rounded to the nearest tenth place.

### Results of Data Analysis

The null hypothesis for this study was as follows: There will be no significant difference in knowledge levels among college students before and after exposure to a folic acid educational intervention. For the 114 participants, pretest scores ranged from 0 to 10, with a mean of 5.15. The posttest score range remained constant, but the mean was 6.67, an increase of 1.52 (29.5%). Mean scores were subjected to dependent  $t$  test analysis. Since  $t(114) = -1.60$ ,  $p = .15$ , the null hypothesis was rejected. Exposure to the education intervention had a significant impact on the participants' knowledge levels related to folic acid (see Table 2).

Table 2

#### Comparison of Pretest and Posttest Scores Using a Dependent $t$ Test

Group	<u>df</u>	<u>M</u>	<u>SD</u>	<u>p*</u>
Pretest	7	5.15	1.52	-1.60*
Posttest	7	6.67	1.50	

Note.  $N = 114$ .  $CI = 95\%$ .

\* $p = .15$ .

### Additional Findings

Participants were asked on the posttest if folic acid has a harmful or beneficial effect on women of childbearing age. The posttest scores revealed that 94% of the participants correctly identified folic acid as beneficial to the woman of childbearing age. When asked, "What effect does folic acid have on birth defects?" 93% correctly responded that folic acid prevents them.

The educational intervention was fourfold and included campus television public service announcements, placement of posters throughout the campus, displays with informational brochures distributed in key areas of the college, and E-mail messages. Fifty-nine participants (52%) reported that they saw the television public service announcements, 36 (32%) reported seeing the posters, 70 (61%) responded that they saw the information displays, and 5 (4%) responded that they received the E-mail messages. Therefore, the most commonly received facet of the intervention was the television public service announcements, and the least frequently received method was the E-mail messages.

Participants were asked on the posttest about foods that contained folic acid. Analysis of the food items containing folic acid revealed that the majority of the

participants were aware that folic acid was in broccoli (81.5%) and spinach (80.5%). The respondents were less aware that beans contain folic acid (30.5%) and oatmeal (44.5%) is fortified with the B vitamin (see Table 3).

Table 3

Participants Who Recognized Foods as Containing Folic Acid by Frequency and Percentage

Food	$f^a$	$\%^b$
Beans	35	30.5
Oatmeal	51	44.5
Raisin Bran	67	59.0
Lettuce	68	59.8
Orange juice	78	68.0
Spinach	92	80.5
Broccoli	93	81.5

<sup>a</sup> $N = 114$ .

<sup>b</sup>Percentages were rounded to the nearest tenth place.

The participants who knew that the CDC-recommended dose of folic acid for childbearing age women is 0.4 mg daily numbered 84 (73.6%). This was an increase of 29.0% from the pretest scores.

Lastly, the findings of the study revealed that 31.0% of the participants who planned future pregnancies were currently taking folic acid at the time of the posttest. The percentage of participants taking folic acid at the time of the pretest was 46. Therefore, no behavioral impact was realized from the educational intervention despite an increase in knowledge.

### Summary

This chapter discussed the characteristics of the sample of participants and explained the statistical methods utilized to test the null hypothesis: There will be no significant difference in knowledge levels among college students before and after exposure to a folic acid educational intervention. Since  $t(114) = -1.60$ ,  $p = .15$ , the null hypothesis was rejected. Therefore, exposure to the folic acid educational intervention significantly impacted the knowledge level of the participants.

## Chapter V

### The Outcomes

Neural tube defects (NTDs) are a group of brain and spinal cord malformations that affect approximately 4,000 pregnancies in the United States annually. The most common types of open NTDs are anencephaly and spina bifida. It was hypothesized during the 1960s that nutritional deficiencies, such as a vitamin deficiency, played a role in neural tube closure and hence the development of defects (Rose & Mennuti, 1994). Subsequent research has supported this hypothesis, specifically identifying the crucial role of folic acid in the prevention of NTDs. Strong empirical evidence led to the recommendation by large health organizations, such as the Centers for Disease Control and Prevention and the Health Education Authority, that all women of childbearing age should take 0.4 mg of folic acid daily before conception and during the early months of pregnancy. Throughout the 1990s several targeted health promotion campaigns were directed toward educating the public regarding folic acid and its significance to the prevention of birth defects. Pretest-

posttest studies evaluating the effectiveness of the campaigns have consistently shown a modest increase in the public's awareness of folic acid's benefits, thus more education is needed.

The Neuman Systems Model provided the theoretical framework for this research study. Neuman defines the client-person in terms of a system of variables interacting with the environment while focusing on stressors as they relate to client health (Reed, 1993). This chapter includes a discussion of the findings derived from these data. Conclusions, implications for nursing, and recommendations also are presented.

### Summary and Discussion of Findings

The convenience sample consisted of 114 college freshmen and sophomores from five randomly selected 8:00 a.m. classes at a rural community college in a southeastern state. The mean age of participants was 24.5 years with the range from 18 to 45 years. The majority of the sample was female (88.6%), with 53% of the participants reporting nursing as their academic major.

The null hypothesis tested in this study was as follows: There will be no significant difference in knowledge levels among college students before and after exposure to a folic acid educational intervention. Pretest



scores ranged from 0 to 10, with the mean score of 5.15. Posttest scores were constant, but the mean score increased to 6.67 (29.5% increase). Mean scores were subjected to dependent  $t$  test analysis. Since  $t(114) = -1.60$ ,  $p = .15$ , the hypothesis was rejected. Exposure to the educational intervention significantly impacted the participants' knowledge levels related to folic acid.

Sixty-six (57.9%) of the participants had no prior history of pregnancy. It is likely that these participants had not had prior exposure to information concerning folic acid from their health care provider. Although 66.7% of the respondents planned future pregnancies, only 28.9% of the participants were currently taking folic acid. Determination of pretest knowledge levels revealed 94% of the participants reported knowledge of the benefits of folic acid. In addition, 93% of the subjects correctly responded that folic acid prevents some birth defects. These results were congruent with the Georgia Women's Health Survey findings reported by the CDC (1995) that showed prevalence of knowledge about folic acid varied directly by educational levels. College students, particularly those in health-related academic programs, are more likely to read information related to preventative health and seek advice from health care

providers related to health promotion. Since two of the five classes selected randomly were in health-related majors, this may have contributed to the knowledge levels of this sample concerning folic acid.

The educational intervention was multifaceted and consisted of posters, display brochures, E-mail messages, and television public service announcements. Like Sillender and Pring (2000), in assessing the efficacy of the Health Education Authority's folic acid campaign, the study showed that targeted health promotion was effective. Sillender and Pring (2000) reported a significant increase in the number of women who had read material recommending preconceptional folic acid supplementation following the campaign (61.1% rising to 76%). The researcher determined that the multifaceted intervention was an effective approach to reach college students. A surprising finding was that the E-mail messages were the least frequently received method. With few homes devoid of personal computers in this decade, the anticipation was for a high response to the E-mail component. Since E-mail is not a routine communication tool within the nursing program and there was a high number of nursing majors in the sample, this may have contributed to the infrequent reception of folic acid messages by E-mail. The most frequently

received facet of the intervention was the television public service announcements. An anticipated finding, this may have been due to the popularity of television among this population. In addition, televisions were abundant throughout the campus. The second most frequently received facet was the brochures displayed at strategic sites on campus. A large volume of students had access to the displays, as they were located in the cafeteria and the library, both areas assessable to students from 7:00 a.m. until 10:00 p.m. during weekdays. In addition, the displays were placed in obvious areas of student gathering. The display at the cashier's counter in the cafeteria required restock of brochures the most often, as students removed the brochures while they waited for short-order foods. In the library, long lines of students waiting to check out books provided a captive audience for the educational material.

Foods that were recognized as containing folic acid most frequently were green-leafy vegetables and orange juice. The researcher attributed this to media promotion of these items in major magazines and on television. There has been little media attention directed toward other natural sources of folic acid, such as beans. Although fortification of cereal, such as oatmeal with folic acid,

such as mandatory in the United States, most of the printed information regarding this approach is available in professional journals and has not received widespread promotion in popular journals.

The participants who reported knowledge of the CDC-recommended dose of folic acid on the posttest numbered 84 (73.6%), an increase of 29% from the pretest scores. This study parallels the CDC (1997) research that reported an increase from 15% to 22% of the subjects who were aware of the CDC dose recommendation. Although a modest increase in knowledge levels concerning folic acid was achieved, the researcher concluded that there is still work to be done. Much of the educational material related to folic acid is published in professional journals. The average college student does not access this type of journal; therefore, this researcher believes benefit would be realized from the inclusion of this type of information in popular magazines that would be readily available to the general public.

Lastly, the findings of this study revealed that despite an increase in knowledge levels concerning folic acid, only 31% of the participants who planned future pregnancies were currently taking a folic acid supplement. Similarly, de Walle and van der Pal (1999) found that

25.8% of the women studied who knew about folic acid before pregnancy chose not to take a folic acid supplement. Thus, the behavioral change expected was not realized. This unexpected finding may have been due to the hectic schedules of students who did not take the extra time to purchase a folic acid supplement. Many of the college students also have jobs in addition to their studies. Time management skills may be lacking that would permit a behavioral change such as taking a vitamin supplement.

### Conclusion

The researcher determined that exposure to a folic acid educational intervention improved participants' knowledge level concerning folic acid. The multifaceted approach was particularly effective because the sample was accustomed to television as a media format. The posters and displays were well received relative to the strategic placement in high-traffic areas of the college. The E-mail messages were the least frequently received, likely because this method is newer to the college and the nursing faculty does not rely on this mode of communication with the nursing students. Due to time constraints, these students were less likely to check their E-mail on a daily basis.

The majority of the participants was nulliparous and therefore had no prior exposure to folic acid education from health care providers. As such, these participants had not been directly affected by an NTD.

The ultimate goal of educating the students concerning folic acid and its relationship to NTDs was to provide the information necessary for the childbearing aged woman to make a decision to take folic acid, therefore, reducing the number of pregnancies affected by NTDs. The findings of this study demonstrate that this goal is not realized. There was no demonstrated behavioral change reported, despite the participants' increase in knowledge.

Neuman details primary nursing interventions as those that are implemented in order to prevent illness or insult to the client's structure. Termed "Prevention as Intervention," the health education provided in this study strengthened the participants' lines of defense, guarding the core structure (Reed, 1993).

#### Implications for Nursing

Numerous implications for advanced practice nursing were identified. Implications of this study are suggested for the areas of practice, education, and research.

Practice. The family nurse practitioner (FNP) could utilize the educational component of this study as a model for primary prevention in the care of childbearing-aged women. Findings of the study suggested that education regarding folic acid's role in the prevention of birth defects actually increased knowledge levels. As counselor and educator, the FNP is in a position to influence women to become proactive in their general and reproductive health management. The FNP should incorporate into practice the CDC recommendation that all women of childbearing age receive 0.4 mg of folic acid daily by prescribing vitamin supplementation with folic acid for clients in this age group. Nutritional counseling should also be a part of preconception health encounters, to include education of foods rich in folic acid as well as those that are fortified with the vitamin.

It is the responsibility of the FNP to be a reliable source of accurate information that the client may use to make informed health care decisions. The advanced practice nurse must remain abreast of the most current directives related to illness and disease prevention. This study provided additional information for the FNP to consider when managing the childbearing-aged woman. First, the study suggested that there was a knowledge deficit among

college students concerning folic acid. Secondly, a large majority of childbearing-aged women were planning pregnancies in the future and did not take folic acid. Thirdly, the population was not aware of natural food sources of folic acid or those foods that are fortified with the vitamin. These findings support earlier studies in different populations. The results of the research may be incorporated into the advanced practice nurse's regimen for women's health management.

Education. Results of this study could be beneficial to nursing programs in preparing students for women's health needs. Knowledge related to folic acid and educational methods to reach this population should be incorporated into the curriculum for the entry-level nurse as well as the advanced practice nurse. A clinical experience requiring a multimedia educational intervention may provide a meaningful experience for the nursing student whose focus is community health as well as those focusing on women's health.

Research. There is limited research concerning folic acid available that is directed toward college students. The findings from this study are congruent with earlier research that evaluated the effectiveness of targeted health campaigns, suggesting that targeted health



promotion is practical. The current research adds to the existing body of knowledge about folic acid education for the childbearing-aged population. This study's sample expanded the focus to include males and females in this age group. Utilization of a multifaceted educational intervention suggested that this population was especially amenable to television advertisements and were less likely to read educational materials. Findings of the study suggest a knowledge deficit related to folic acid in this population. Further research also is warranted to investigate the lack of behavioral change related to consumption of folate supplements despite the modest increase in knowledge levels as evidenced by posttest scores.

### Recommendations

Based on the findings of this study, the following recommendations are made for future nursing research:

1. Replication of the study with a different sample, such as college students with academic majors, excluding health-related studies.

2. Replication of the study with the addition of a face-to-face lecture and informal discussion of folic acid.

3. Expansion of the questionnaire to explore reasons that folate supplements are not taken despite increase in knowledge level.

4. Expansion of the study to include childbearing aged individuals who have no formal education beyond high school.

5. Comparison of data from nulliparous women versus multiparous women to assess at what point primary care providers are educating women about folic acid.

6. Comparison of knowledge levels of clients whose primary care provider is a nurse practitioner versus a physician.

7. Expansion of the study to include participation of the community in the intervention, such as grocery stores, local radio stations, local television stations, and restaurants.

## REFERENCES

## References

Bower, C., Blum, L., Watson, C., & Stanley, F. (1996). Folate and the prevention of neural tube defects: Evaluation of a health promotion project in Western Australia. Health Promotion International, 11(3), 177-187.

Centers for Disease Control and Prevention. (1992). Recommendations for the use of folic acid to reduce the number of cases of spina bifida and other neural tube defects. Morbidity & Mortality Weekly Report, 48, RR-14.

Centers for Disease Control and Prevention. (1995). Knowledge and use of folic acid by women of childbearing age-United States. Morbidity & Mortality Weekly Report, 44(38), 716-719.

Centers for Disease Control and Prevention. (1996). Knowledge about folic acid and use of multivitamins containing folic acid among reproductive aged women. Morbidity & Mortality Weekly Report, 45(37), 793-795.

Centers for Disease Control and Prevention. (1997). Knowledge and use of folic acid by US women. Morbidity & Mortality Weekly Report, 46(31), 721-723.

Crandall, B., Corson, J., Knight, G., & Salafsky, I. (1995). Folic acid and pregnancy. Am. J. Med. Genet., 55, 134-135.

Czeizel, A., & Dudas, I. (1992). Prevention of the first occurrence of neural tube defects by periconceptional vitamin supplementation. New England Journal of Medicine, 327, 1832-1835.

Daly, L, Kirke, P., Molloy, A., Weir, D., & Scott, J. (1995). Folate levels and neural tube defects: Implications for prevention. JAMA, 274(21), 1698-1702.

de Walle, H., & van der Pal, K. (1999). Effect of mass media campaign to reduce socioeconomic differences in women's awareness and behavior concerning use of folic

acid: Cross-sectional study. British Medical Journal, 319(7205), 291-293.

Laurence, K., James, N., miller, M., Pennant, G., & Campbell, H. (1981). Double-blind randomized controlled trial of folate treatment before conception to prevent recurrence of neural tube defects. British Medical Journal, 282, 1509-1511.

March of Dimes Birth Defects Foundation. (1999). Folic acid campaign [On-line]. Available: <http://www.modimes.org/Programs2/Folic>.

Medical Research Council Vitamin Study Group (1991). Prevention of neural tube defects: Results of the MRC vitamin study. Lancet, 338, 132-137.

Milunsky, A., Jick, H., Jick, S., Bruell, C., MacLaughlin, D., Rothman, K., & Willett, W. (1989). Multivitamin/folic acid supplementation in early pregnancy reduces the prevalence of neural tube defects. JAMA, 262(20), 2847-2852.

Polit, D., & Hungler, B. (1999). Nursing research: Principles and methods (6<sup>th</sup> ed.). Philadelphia: Lippincott, Williams, & Wilkins.

Reed, K. (1993). Betty Neuman: The Neuman Systems Model: Notes on Nursing Theories 11. Newbury Park, CA: Sage.

Rose, N., & Mennuti, M. (1994). Periconceptual folate supplementation and neural tube defects. Clinical Obstetrics and Gynecology, 37, 605-620.

Sillender, M., & Pring, D. (2000). How effective was the Health Education Authority's folic acid campaign? Journal of Obstetrics & Gynecology, 20(3), 271-277.

Tinkle, M., & Sterling, B. (1997). Neural tube defects: A primary prevention role for nurses. JOGNN, 26, 503-512.

Werler, M., & Louik, C. (1999). Achieving a public health recommendation for preventing neural tube defects with folic acid. American Journal of Public Health, 89(11), 1637-1641.

Werler, M., Shapiro, S., & Mitchell, A. (1993). Periconceptual folic acid exposure and risk of occurrent neural tube defects. JAMA, 269(10), 1257-1261.

Wild, J., & Sutcliffe, M. (1997). Prevention of neural tube defects. Lancet, 350, 30-32.

APPENDIX A  
FERGUSON'S QUESTIONNAIRE I

## Ferguson's Questionnaire I

1. Age: \_\_\_\_\_  
Gender:            a. Female        b. Male  
Major: \_\_\_\_\_
2. Have you heard of folic acid?  
 a. Yes            b. No
3. If yes, where did you hear about it?  
\_\_\_\_\_
4. To women of childbearing age, folic acid is  
 a. Harmful        b. Beneficial      c. Unsure
5. Does folic acid help PREVENT or CONTRIBUTE TO birth defects such as spina bifida (exposed spinal cord) or anencephaly (exposed brain)?  
 a. Prevent            c. No effect  
 b. Contribute to      d. Unsure
6. Folic acid is found in which of the following foods? Check (✓) all that apply:  
 a. Lettuce            e. Beans            i. Caffeine  
 b. Raisin Bran        f. Oatmeal          j. Milk  
 c. Spinach            g. Vitamin C        k. Broccoli  
 d. Orange juice      h. Chicken          l. Tuna
7. What is the recommended amount of folic acid per day for the childbearing-aged woman?  
 a. None            c. .4 mg  
 b. .1 mg            d. 1.0 mg
8. Have you ever been pregnant?  
 a. Yes            b. No
9. Were your pregnancies planned?  
 a. Yes            b. No
10. Do you plan to have children?  
 a. Yes            b. No
11. Do you currently take folic acid?  
 a. Yes            b. No



APPENDIX B  
FERGUSON'S QUESTIONNAIRE II

## Ferguson's Questionnaire II

1. Age: \_\_\_\_\_  
 Gender:  a. Female  b. Male  
 Major: \_\_\_\_\_
2. Have you heard of folic acid?  
 a. Yes  b. No
3. If yes, have you seen or heard the folic acid information on campus?  
 a. TV spots  d. Information displays  
 b. Posters  e. Other. (Please specify, e.g. "word of mouth").  
 c. E-mail
4. To women of childbearing age, folic acid is  
 a. Harmful  b. Beneficial  c. Unsure
5. What effect does folic acid have on birth defects?  
 a. No effect  c. Causes them  
 b. Prevents them  d. Unsure
6. Folic acid is found in which of the following foods? Check (✓) all that apply:  
 a. Lettuce  e. Beans  i. Caffeine  
 b. Milk  f. Oatmeal  j. Raisin bran  
 c. Spinach  g. Vitamin C  k. Broccoli  
 d. Chicken  h. Orange juice  l. Tuna
7. How much folic acid is recommended per day for the childbearing-aged woman?  
 a. None  c. .4 mg  
 b. .1 mg  d. 2.0 mg
8. Have you ever been pregnant?  
 a. Yes  b. No
9. Were your pregnancies planned?  
 a. Yes  b. No
10. Do you plan to have children?  
 a. Yes  b. No
11. Do you currently take folic acid?  
 a. Yes  b. No

APPENDIX C

APPROVAL OF MISSISSIPPI UNIVERSITY FOR  
WOMEN'S COMMITTEE ON USE OF HUMAN  
SUBJECTS IN EXPERIMENTATION



MISSISSIPPI  
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FOR WOMEN

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February 23, 2001

Ms. Lesa Faye Ferguson  
c/o Division of Nursing  
P. O. Box W-910  
Campus

Dear Ms. Ferguson:

I am pleased to inform you that the members of the Committee on Human Subjects in Experimentation have approved your proposed research as submitted with the recommendation that the word "infomercial" be changed to "public service announcements."

I wish you much success in your research.

Sincerely,

A handwritten signature in black ink, appearing to read "Vagn K. Hansen".

Vagn K. Hansen, Ph.D.  
Vice President  
for Academic Affairs

VH:wr

cc: Mr. Jim Davidson  
Dr. Lynn Chilton

APPENDIX D  
AGENCY CONSENT FORM

## AGENCY CONSENT FORM

I agree to allow Lesa Faye Ferguson to recruit participants for a research study on the knowledge levels of college students concerning folic acid from the student population of Jackson State Community College. She also may administer a personal profile survey, and a pre/post questionnaire, Ferguson's Questionnaires I and II, to students agreeing to participate in her study. I understand that participants will be asked to sign an informed consent form and that there will be no risk to the individual student or to the college. I understand that the participants will be informed that their participation in this research study will not affect their grades. All data will be reported as group totals and no names of students or institutions will be used. I also understand that this study will be conducted during the Spring semester of 2001.

NAME: Fred Williams  
TITLE: Vice President of Student Services  
DATE: April 1, 2001  
RESEARCHER: Lesa Ferguson

APPENDIX E  
INDIVIDUAL CONSENT TO PARTICIPATE

## Individual Consent to Participate

Date: \_\_\_\_\_

I, \_\_\_\_\_, willingly agree to participate in the research study, Knowledge Levels of College Students Concerning Folic Acid, conducted by Lesa Ferguson, RN, BSN, a graduate nursing student at the Mississippi University for Women at Columbus, Mississippi. I will complete Questionnaire I today and a follow-up Questionnaire II at a later date. The responses to the questions are confidential and the results will be reported as statistical totals from the entire group. My college grades will in no way be affected by my willingness to participate in this study, and I will be free to withdraw from the study at any time. There have been no identified risks for any individual answering the questionnaires. Completion of each questionnaire will require approximately 10 minutes. There are no individual benefits, but results of this study will help in evaluation of folic acid awareness and development of programs to improve the knowledge deficit.

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Signature of Participant

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Signature of Researcher

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If you have questions about this research study, the researcher, Lesa Ferguson, will be glad to answer them. Telephone number: (901) 934-4991. For more information about folic acid and birth defects, contact the March of Dimes at (901) 668-1023.