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Nutrient Intake and Folic Acid Awareness among
Hispanic Women: Implications for Preventing Neural
Tube Defects

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Neural Tube Defects

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Nutrient Intake and Folic Acid Awareness among Hispanic Women: Implications for Preventing Neural Tube Defects

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Abstract

Diet is one of the leading contributors to overall health and it is important to assess how preferences in food intake among cultures can account for specific diseases. Acculturation is a term used to describe the exchange of cultures and subsequent changes that take place as a result of constant interaction. Using a bidimensional approach to acculturation and knowledge of diet, integrating dietary customs of the host society to that of the individual's country of origin can facilitate an optimal diet by bartering between foods from the two cultures. By separating (retaining only the diet of their country of origin) and assimilating (adhering totally to the host country's diet) individuals fail to see the benefit of either trying new foods, which can be healthier, or removing healthy foods from their country of origin in their diet. My overview examines the role of acculturation among Hispanic women and its relationship to NTDs. The specific research that I performed, however, addresses the knowledge Hispanic women have of NTDs and folic acid.

Introduction

The process of selecting specific types of food greatly characterizes the individual, not only in terms of health but also in relation to dietary cultural traditions. According to dietary practices, certain foods can be consumed in excess or in insufficient amounts by a group of people, which as a consequence can either prevent or increase the likelihood of contracting a certain disease. Each culture has its own unique diet according to their geographic location, traditions, religion, economics and so forth that either prevents or allows a nutritious diet. Even though different cultures adapt to their food resources to make them as rich as possible, the rise in globalization has made it possible for countries half way around the world to consume foods that their ancestors did not. As such, the introduction of foreign born food can have a positive, negative, or a mix impact on overall health to immigrants and their children. The assessment of food intake by ethnic group, and subsequently culture, is necessary to understand the implications of why certain diseases are more prevalent in some ethnic groups and not others.

A woman's diet is directly linked to her offspring; this is true even before conception. Neural Tube Defects (NTDs) are a type of birth defect that is characterized by abnormalities in the brain and spinal cord. Research has shown that women who fail to take an adequate amount of folate are at a greater risk for having an NTD affected birth. This knowledge prompted the Food and Drug Administration (FDA) to fortify cereal-grain products with folic acid, which is the synthetic form of folate, on January 1, 1998 (2). The fortified foods include most enriched breads, flours, corn meals, rice, noodles, and other grain products. Preventing an NTD affected birth requires that women take the recommended amount (400 micrograms per day) one month prior to conception and continuing through the first trimester to significantly reduce the risk of NTDs by 50% to

70% (1, 13 & 14). Since a great amount of pregnancies are unplanned, it is important for women of childbearing age to take the recommend amount. The National Center for Health Statistics examined the United States incidences of spina bifida and anencephaly (the two most common types of NTDS), over an 11 year period, and found a decrease in cases in 2001 compared to the 1997 rates. Researchers from the Center of Disease Control and Prevention , in 2001, using birth certificates in 45 U.S. States, reported a 19% decline (37.8 per 100 000 live births before fortification to 30.5 after mandatory folic acid fortification) in both anencephaly and spina bifida (4). The researchers also found that within that same time period, NTD birth prevalence declined from 53.4 per 100,000 to 46.5 per 100,000 for women who received only third-trimester or no prenatal care. Accordingly, William et al. found a decline in the prevalence of spina bifida and anencephaly, in which the intervals before fortification for Hispanic, non-Hispanic white, and non-Hispanic black women were 6.49, 5.13, and 3.57 and after mandatory fortification, the intervals were 4.18, 3.37, and 2.90 per 10,000 births for the same group, respectively. This evidence suggests that a sufficient intake of folic acid is a necessary component to prevent NTDs.

The incidence of NTDs is highest among Mexican-Americans, especially those living along the Texas-Mexico border. The national level of NTD rates is 10 in 10,000 births (6). Studies show that those living in the Texas-Mexico border have an incidence rate of 27 in 10,000 births in 1991 (7). The higher incidence of having an NTD affected birth among Hispanics has led to conflicting studies in relation to the effectiveness of folic acid intake as a preventive factor. Some studies suggest that folic acid supplements and the fortification of folate in cereal-grain products does lower NTD affected births among high risk populations (i.e. Mexican-Americans) (5,8). In one recent study, Felkner et al. found

that among the 299 women who were enrolled in the 0.4 mg/day folic acid/folate intervention, 193 pregnancies occurred among 138 women, and of those no NTDs were detected in 130 live births who received the intervention nor were NTDs detected in the 23 women who experienced pregnancy loss (8). Another study, however, suggest that these two methods are less effective in this population, strictly implying a genetic or metabolic etiology (9). In respects to studies that have shown a decrease incidence of NTDs when women take an adequate amount of folic acid, it can be conceived that cultural factors such as diet and vitamin intake behavior plays a vital role. If NTDs can be prevented by eating a diet rich in folic acid, then research should be directed to the diet behavior of Mexican-American women of childbearing age. According to a study conducted by Suarez and Hendricks, through the Texas Department of Health, the pattern of NTD prevalence shows that Mexican-American women living in the Texas-Mexico border have an NTD incidence rate of 14.9 per 10,000 birth; however, those that were born in Mexico had a rate of 15.1 per 10,000 birth compared to woman who were born in the United States, in which the incidence rate was 9.5 per 10,000 births from 1993-1995 (10). The same study showed that in California, from 1989 to 1991, women who were born in Mexico had an incidence rate of 16 per 10,000 births compared to women who were born in the United States, who had an incidence rate of 6.8 per 10,000 births. This study shows that Mexican-American women living in the Texas-Mexico border towns have a higher incidence of NTD affected births than Mexican-American women who do not; in addition, women who were born in Mexico had a higher prevalence of having an NTD affected birth compared to women who were born in the United States. This trend may be due to the levels of acculturation. Acculturation is the exchange of cultures and subsequent changes that take place as a result

of constant interaction (11). Acculturation to a dominant culture can be either both beneficial and or harmful, to the extent that the host country has foods that are nutritious and available to foreign born people and their children.

Neural Tube Defects

Neural tube defects are malformations of the brain and spinal cord. The most common and frequent type, often referred to as open NTDs, are anencephaly and spina bifida, which occur between the 17th and 30th days after fertilization (12). During this critical period, the proper formation and closure of the neural tube, which later becomes the spinal cord, brain, and bone surrounding the spinal cord and brain, normally takes place. These malformations result when the neural tube fails to close properly. Spina bifida occurs when the lower end of the neural tube fails to close properly, which results in the malformation of the spinal cord. Sometimes a sac of fluid comes through an opening in the infants' back, and often a portion of the spinal cord is contained in this sac. The immediate outcome is paralysis in the legs and a later outcome of bladder and bowel control problems. Anencephaly is the lethal form that occurs when the upper end of the neural tube fails to close. When this happens, part or all of the brain and skull bones may be missing.

The etiologies for NTDs cannot be explained in a homogenous manner. In just the last three decades, the literature has suggested a plethora of contributing causes ranging anywhere from nutritional, genetic, environmental, and social-psychological factors, which can all be interrelated in some way or another. The focus of interest in this paper delves into the dietary intake of Hispanic women of childbearing age. Since this birth abnormality has multi-factorial causes, it is important to analyze other widely held etiologies, other than nutrition, to achieve a better understanding of this birth disorder.

Literature Review of the Risk Factors for NTDs

Nutrition

Folate is a water soluble B vitamin; its synthetic form is folic acid, which is fortified in cereal and grain products. Natural foods that provide sources of folate include leafy dark green vegetables, citrus fruits, legumes (dried beans and peas) and most berries (2). Folate helps create and sustain new cells, so it is important to take it during infancy and pregnancy because this is the period in which there is rapid cell division and growth (15). The exact way in which folic acid works to prevent NTDs is not fully understood but its role in forming tissue is essential. Since most of the naturally occurring folate foods have a more complex structure, it affects the intestine's ability to process and absorb food folate in comparison to that of the synthetic folic acid. It is also important to recognize that since folate is a water-soluble vitamin, it loses some of its properties in the form of heat, light, and air. Therefore, folic acid is absorbed better than foods that naturally contain folate. According to the Institute of Medicine, folic acid is about twice as absorbable as naturally occurring folate food (16). Giving this information, women of childbearing age should opt for foods that contain folic acid more than naturally occurring folate foods because they will provide the most absorbable nutrients. This is especially true for Hispanic women who are at a greater risk for having an NTD affected birth.

Genetic

Research has not reported any Mendelian pattern of inheritance for NTDs. There is, however, an association with single gene defects. For example, studies show that females and monozygotic twins have a higher frequency of NTDs compared to dizygotic twins (17). The study found that identical twins had an increased prevalence of encephalocele (another type of NTD) and anencephaly while a decreased prevalence in spina bifida. Another study found that

the frequency risk for NTDs in siblings of patients with myelomeningocele (another type of NTD) ranged from 2 to 5% (18). Research also shows that women with a previous NTD affected birth to be 1% to 3% more likely to have another compared to the general population (19). This finding supports a genetic cause but could also support a potential environmental cause, such as the socioeconomic status of the parents and their ability to afford visiting family planning physicians. Therefore, it is important for individuals with a previous NTD affected birth to seek preventive measures, such as periconceptional counseling combined with an increased intake of folic acid.

One of the genes associated with folate metabolism is called methylenetetrahydrofolate reductase (MTHFR), which encodes an enzyme that converts 5-methylenetetrahydrofolate into 5-methyltetrahydrofolate (the major circulating form of folate) (20). There are two major polymorphisms, C677T and A1298C, in the MTHFR gene that have been shown to reduce MTHFR activity. The C677T allele has been shown to increase the risks for NTDs in certain populations (21, 22). One study showed that Mexican-American women (18.1%) had a higher frequency of the 677 TT genotype compared with non-Hispanic White (7.2%), Asian-American (3.8%), and African American (0%) women (21). This study suggests that Mexican-American women need a higher folate requirement compared with other ethnic groups. This study is also consistent with NTD trends, in which Mexican American women have the highest rate, followed by an intermediate rate in non-Hispanic White women, and finally the lowest rate among non-Hispanic Black women.

Environmental

Some of the environmental causes given in epidemiological and experimental studies provide a spread of physical agents and conditions. Other than nutrition, some other

environmental risk factors found in the literature include high temperature, toxins, obesity, maternal insulin-dependent diabetes, and low socio-economic status. These risk factors can be viewed as interacting with others, in which no single reason can explain the absolute cause of NTD affected births.

Studies have established, both in animals and humans, that the neural tube is sensitive to heat stress. In animals, results of in-vivo and in-vitro experimental studies on guinea pigs, rats, mouse, and chick embryos, showed that enhanced core temperatures interfered with critical development stages such as cell proliferation, migration, differentiation, and apoptosis (12). Although it is not possible to imply a direct relationship between animals and humans, studies have found an association between enhanced heat stress and the incident of NTDs. For example, one study found that maternal exposure to heat stress, such as hot tubs and saunas, interfered with several critical periods of neuralation, and the results of this study showed that women in a Texas-Mexico border population were at an increased risk of having an NTD affected birth (23). Another study found that maternal hypothermia during gestation, which also supports the animal model of sensitivity to heat stress, is associated with an enhanced incidence of NTDs (24). It is important to note that the level of gestation and the gestational stage of exposure as well as the genotypes of the parents and offspring might reflect the unpredictability between studies (12).

Ambient and chemical exposures have also been associated with a higher risk of having an NTD affected birth. A recent study found that exposure to fumonisins, which is a mycotoxin that contaminates corn, along the Texas-Mexico Border increased the risk of NTD according to dose, up to a threshold level, in which fetal death was more likely to occur (25). Since fumonisins are found in corn and inhibit the biosynthesis of sphingolipids, which interferes with the uptake of 5-methyltetrahydrofolate and decreases total folate binding (26), it is viable to

assume that their cultural diet, and perhaps not necessarily Mexican-Americans metabolic deficiency to folate, plays a greater role in why this group has a higher prevalence than non-Hispanic White and non-Hispanic Black women. This study thus gives insight into dietary practices according to acculturation levels, in which it is more likely that high acculturated women consume less corn tortillas than low acculturated women (10). Accordingly, the trends of prevalence of NTDs are consistent, in which Mexican-American women living in the Texas-Mexico Border having a higher prevalence than those do not.

Studies have shown that maternal obesity is linked to an increase rate of NTD affected births. In one study, women who had a BMI greater than 29 doubled the risk of having an NTD affected birth compared with women whose BMI was less than or equal to 29 (27). Another study showed that obese women were more likely than average-weight women to have an infant with spina bifida (28). This line of evidence, again, partially helps explain why women of Mexican descent have a higher prevalence of NTD affected births, in terms of how the obesity rates in Mexican-Americans is on the rise. According to the National Center for Health Statistics, nearly half of Mexican-American women are overweight (29).

Maternal diabetes is also another risk factor of NTDs. One study showed that hyperinsulinemia is a strong risk factor for NTDs in Mexican-American women (30). The fact that Mexican-Americans are genetically predisposed to diabetes mellitus addresses the issue whether this population should take a higher level of folic acid to prevent NTDs.

The socioeconomic status of the parents has also been associated with higher rates of NTDs. One study showed that NTDs were higher among populations with lower socioeconomic status, in terms of education, occupation, and income (31). The fact that Hispanics are generally economically and educationally disadvantaged, compared to other groups, makes it difficult for

mothers to seek periconceptional counseling and be aware of preventative measures to have a healthy baby.

Social-Psychological

There have also been studies analyzing psychological variables, such as stress and emotional support and its association to the prevalence of NTDs. One study shows that women who experience one or more stressful life event during the year before conception had an increased risk of conceiving an NTD affected offspring compared to mothers who did not experience such events (32). The author suggests that stress may be exacerbated in a group that already has inadequate nutritional and economic resources.

Incidence of Neural Tube Defects

Higher Incidence of NTDs in Hispanics

The literature provides mixed evidence of adequate intake of periconceptional use of folic acid and its protection against NTDs among Hispanic populations. Past literature has suggested that there is a higher prevalence of NTDs in Mexico (rates of 32.6 per 10,000 live births) and foreign born Mexican women (16 per 10,000 births) than in U.S. born Mexican (6.8/10,000) and Caucasian women (5.5/10,000) (33, 34). A study suggesting that adequate folate is not a preventive factor against NTDs among women of Mexican descents comes from the California Birth Defects of Monitoring Programs (35). The researchers reported that of 538 cases of NTDs and 539 controls, there was a 35% reduction in NTD risk from periconceptional use of folic acid-containing multivitamins among whites but was not apparent among the California Hispanic population. Other research suggests that there was a significant decline in spina bifida and anencephaly (36% in Hispanics compared to 34% non-Hispanic white births) following the fortification of folic acid in enriched grain products (5). The study indicates that the magnitude

of the decline was similar between Hispanics and non-Hispanic white women, which conversely suggest that folic acid is a sufficient measure in decreasing NTD affected births among Hispanics. Another study, conducted in Mexico, reported that there was a 43% decline in the prevalence of NTDs when women were given folic acid supplements (5-mg) and were encouraged to take them once per week (36).

Dietary Patterns and Acculturation among Mexican-American Women

The dietary patterns of Hispanic women are going to vary significantly depending on the level of acculturation as well as among other factors. The retention, abandonment, or the adoption of new dietary practices can either enhance or decrease the chances of practicing a healthy diet, and thus help produce a healthy baby. Integrating diets from both cultures, in which the individual leaves behind certain unhealthy traditional foods and adopts others that are healthy, can result in a healthier eating lifestyle and consequently prevent certain types of diseases.

Acculturation

Acculturation is a term used to describe the process by which “cultures in contact borrow ideas and practices from one another, thereby modifying or replacing traditional ideas and practices”(Lavenda & Schultz, 2007, p. 200). The process of acculturation requires the ethnic group to acquire and share their culture to that of the dominant society. Given that some traditional norms in certain cultures can be adaptive to overall well-being, the reverse effect is also possible in which acculturation can lead to maladaptive behavior.

Bidimensional Model of Acculturation

The bidimensional model postulates that original cultural identity and mainstream culture are independent factors of acculturation (38). This model emphasizes how an individual can have

a type of bicultural identity, in which they accept customs, values, behaviors, and attitudes from their original culture and the dominant culture. There are four subcategories that are possible: assimilation, separation, integration, and marginalization. Assimilation refers to the total adherence to the dominant society while separation refers to the rejection of the dominant culture and the maintenance of their original culture. Integration, which seems to be the most optimal in adjusting, is when the individual embraces and values both cultures. In other words, the individual feels equally at home in both their old and new culture. Marginalization refers to the exclusion of the individual by both cultures.

Assimilation, in a dietary context, refers to adhering totally to an American diet. This can include anywhere from eating canned, dried, packaged, frozen, and other forms of processed foods, fast foods, and other foods that are typical of the American diet (which may not necessarily be considered unhealthy). The individual, which in this case is a Mexican-American woman, largely, if not completely, abandons the foods from her culture and adopts the American diet. The process of assimilation does not happen all at once, it can take many generations before a woman leaves behind foods from her country of origin and embraces the food from the host country. Assimilating to the diet of the host country can be either beneficial or detrimental to health depending on what food choices the individual adopts.

Separation, in contrast to assimilation, occurs when the individual largely retains the diet of their original country and rejects the food of the host country. This subcategory is more difficult to achieve because of the potential scarcity of available ingredients necessary to cook foods from their country of origin. Another factor that makes separation hard to completely realize is the influence social connections have on the diet to an individual. Separation from the

mainstream diet can also be advantageous to health but it can also be unfavorable if the diet of the country of origin did not have the necessary nutrients for a healthy lifestyle.

The most optimal form of acculturation, in terms of a balanced identity between the two cultures, is integration. The individual embraces the diet of both the original and new culture. He or she picks and chooses which foods are best suitable for their dietary needs. This can be beneficial because it can allow the individual to take on a more nutritious diet than he or she once had and leave behind food that would not be considered healthy. For example, Hispanic cultures could retain traditional foods such as beans, corn tortillas, rice, fruits and vegetables and leave behind foods high in fat, such as lard used in *tamales*. Likewise, the individual could consume reduced-fat milk or other low-fat products, which are new to recent immigrants. The process of integration therefore allows more choices and variety that can ultimately lead to a better nutritional diet, and subsequently to having a healthy baby.

Negative Effects of Acculturation on Hispanic Diet and Health

Researchers have studied the adverse effects of acculturation on immigrant groups' deteriorated health. Epidemiologic studies show that immigrant groups, along with adopting the culture of the host society, inadvertently take on chronic disease patterns. Studies have shown that chronic diseases, such as diabetes (39, 40) and obesity (41) are associated with greater acculturation level to the United States among Hispanics. The influential change of environment, such as diet, has caused higher rates of cardiovascular disease in Mexican immigrants compared with those living in their home countries (42, 43). The evidence of this literature implicates that there may be something about either the dietary transition of cultural foods, the availability of certain foods in the United States, or some other factor that causes illnesses among this ethnic groups.

A study in which acculturation was measured independently in predicting fat, fruit, and vegetable intake among women of Mexican descent showed that Hispanics consumed one more serving of fruits and vegetables per day than non-Hispanic whites (44). Hispanics who measured high in acculturation ate close to half a serving or fewer of fruits and vegetables per day compared with Hispanics who were low acculturated. Another important finding in the study was that low acculturated Hispanics reported using less lard or oil when cooking tortillas than high acculturated Hispanics and non-Hispanic whites. While this study may suggest that low acculturation among Hispanic women is associated with a higher intake of fruits and vegetables, which are good sources of folate, it is important to see how geographic location has its limitations in generalizing the results to other Hispanic segments of the population who rate low on acculturation. Given this data, it is important to analyze how acculturation, as an independent factor of diet, affects a Hispanic woman's chance of producing a healthy baby.

Romero-Gwynn & Gwynn analyzed the dietary patterns of Mexican women born in Mexico and first generation Mexican American women, and they found both positive and negative dietary changes (45). The sample included, with an average age of 35, 165 Mexican-born women and 101 first generation Mexican-American women. The authors found an overall trend of a decline in traditional foods and above all the adoption of new foods. The authors note that although there was an increase in vegetables, inadvertently, there was an increased use of fat in the form of salad dressing and mayonnaise. There was also a significant increase in cooking oil, margarine, and American sour cream. Other unhealthy diet changes in the study included less consumption of a traditional fruit-based drink, *aguas frescas*, and increased consumption of sodas. Another important change, which is extremely relevant to the current study, is the

increased intake of cereal. Although some cereals are high in sugar, they have the health benefit of containing an adequate amount of folic acid.

Duerksen et al. studied a sample of Mexican-American families and found that children were more likely to be at risk for being overweight in families who ate most often at fast-food chains (46). Parents also were associated to being overweight and eating at American restaurants. In interesting finding of this study reported that both child and parent BMI were lowest in families who selected to eat in Mexican restaurants. This study showed that choosing American style restaurants contributed to higher obesity rates, which was linked to the level of acculturation among Mexican Americans.

Positive Effects of Acculturation on Hispanic Health and Diet

Some studies, on the contrary, have shown that acculturation to the United States is associated with healthful dietary choices. For example, one study found that more acculturated women tend to eat more cereals compared to less acculturated women (45). This is a positive change in eating behavior, seeing as how cereal is fortified with folic acid. The same study also reported that highly acculturated women had a higher intake in fruits and vegetables and a decrease in the consumption of lard and Mexican cream compared to the low acculturated women. This finding, again, promotes a better diet that provides a greater source of folate, and thus another factor in preventing NTDs. Several studies have also shown that more acculturated individuals consume less fat and practice more fat avoidance cooking practices than less acculturated individuals (48-50). It is important to keep in mind which measures of acculturation each study uses, since they are all inconsistent, these findings are tentative to the proxy measure of acculturation. Nevertheless, these studies provide a good glimpse to how Hispanics have abandoned some practices (such as using less lard) with greater acculturation and adopted other

eating behaviors (such as ready to eat cereal products) that has an overall positive effect on health.

Acculturation is also related to the use of health services. Several studies have shown that more acculturated Hispanics use preventative health services (51, 52). The association between a greater level of acculturation to using preventative health services, such as cervical cancer screenings and breast cancer screenings (53), provides insight in evaluating if highly acculturated women would be more likely to utilize preconceptional services to prevent birth disorders, such as NTDs. Another positive aspect of acculturation for Hispanics is the regular source of care (43) and insurance (53, 54). Women who use a regular source of care and have insurance are more likely to take preventative measures upon conception, and perhaps before, which can ultimately reduce the risk of birth defects.

Even though the literature provides a mixture of positive and negative effects due to acculturation, it is easy to detect that no matter what country one migrates to there is bound to be both advantages and disadvantages to overall health. The way in which the individual chooses to adopt certain foods and leave some food practices behind is a measure of adaptation that can be most beneficial if it is carried out through an integrative approach.

The Current Study

The current study is geared towards the prevention of NTDs in Hispanic women. Since the intake of folic acid greatly reduces the risk of NTDs, the goal is to differentiate those who take an adequate amount from those who fail to do so. One part of the study assesses health and general nutrition. Another section addresses acculturation level. The participants are also tested on their knowledge and experience with folic acid and neural tube defects. Finally, participants will be asked questions regarding their pregnancy history. The hypothesis of the study is that

acculturation is a variable (as measured by language spoken at home, ability to carry out a conversation and read in Spanish, and family generation to the United States) that predicts knowledge of NTDs and folic acid. The five outcome variables that assessed knowledge of NTDs and folic acid were as followed: having heard or read anything about vitamin supplements preventing birth defects, knowledge of the specific vitamin to take that prevents birth defects, knowledge of when a woman should begin to take folic acid if she wants to conceive a baby, knowledge of the minimum folic acid needed to prevent NTDs, and finally the knowledge of which grains, fruits, or vegetables are richest in folic acid. The hypotheses seeks to investigate how acculturation plays a role in the knowledge level of neural tube defects and its preventative measure (sufficient intake of folic acid prior to conception) in this high risk population.

Method

Sample

The sample includes 64 Hispanic undergraduate women who attend Texas State University in San Marcos, Texas. The participants were attracted to participate in the study by flyers distributed out randomly in the center of the University, e-mails to students in Hispanic organizations, such as Latinas Unidas and the Hispanic Association, and by professors in the Psychology Department.

Materials

The study was conducted in the Texas State University Psychology building. The materials used in the study included a survey that contained questions on demographics, acculturation level, knowledge of neural tube defects and folic acid, food intake, vitamin intake, and exercise. In order to randomize the control group, a randomization sheet of odd and even numbers were used to mitigate order effects. A scale, to measure their weight and height, was

used to calculate Body Mass Index (BMI). At the conclusion of the study participants were given a \$10.00 gift card, to either Wal-mart or HEB, in exchange for their participation.

Procedures

Prior to the study participants read, understood, and signed the consent form that explained the logic of the study. Participants were first asked to answer questions that measured acculturation level. Women were asked: *Is Spanish the language most often spoken in your parent's home? How well can you carry out a conversation and read in Spanish? Who is the first of your family to be born in the United States?* In order to get a better glimpse of their knowledge about NTDs, women were asked: *Have you heard or read anything about vitamin supplements preventing birth defects? Which type of vitamin prevents birth defects? When should a woman, who wants to have a baby, begin to take folic acid? What is the minimum folic acid intake that is needed to prevent neural tube defects? Which grains, fruits, or vegetables are richest in folic acid?* At the conclusion of the study, participants were weighed and their height was taken in order to calculate their Body Mass Index (BMI).

Results

Using the Pearson correlation, the data shows that language spoken at home is correlated with an ability to carry out a conversation and read in Spanish ($r = .666, p > .01, N = 64$), family generation to the United States is correlated with language spoken at home ($r = .601, p > .01, N = 64$), and the ability to carry out a conversation and read in Spanish is correlated with family's generation to the United States ($r = .524, p > .01, N = 46$) (see Table 1). Women who said that Spanish is the language most often spoken in their parent's home was correlated with how well they can carry out a conversation and read in Spanish as well as who was the first person in their

family to be born in the United States. This statistically significant correlation provides for internal consistency in the measure of acculturation.

Using Spearman's rho, the data shows that acculturation is correlated to having heard or read anything about vitamin supplements that prevent birth defect ($r = .473, p > .01, N = 46$) (see Table 2). The mean of having heard or read anything about vitamin supplements preventing birth defects was 1.67 with a standard deviation of .47; it appears that more women answered "no" than "yes". Acculturation is also correlated with knowledge of which grains, fruits, or vegetables are richest in folic acid ($r = -.362, p > .05, N = 25$) (see Table 2). The mean of this variable was .91 with a standard deviation of 1.50. This indicates that, on average, there was less than one food item that the participants listed that contained a rich source of folic acid. The other three outcome variables (knowledge of the specific vitamin to take that prevents birth defects, knowledge of when a woman should begin to take folic acid if she wants to conceive a baby and knowledge of the minimum folic acid needed to prevent NTDs) were not statistically correlated to acculturation. Overall, acculturation is a predicting factor on whether Hispanic women at Texas State University have heard or read anything about vitamin supplements preventing birth defects and their level of knowledge of which grains, fruits, or vegetables are richest in folic acid.

Discussion

Neural tube defects are a problem for Hispanic women, and knowledge of preventing this birth defect and changing eating habits are two essential ingredients to making this problem a thing of the past. Food intake and awareness of which foods to take at specific times in the lifespan can be partially explained by an individual's degree of acculturation to the larger society. The literature provides mixed evidence in respects to whether adopting American eating styles erodes the Hispanic diet. The important factor to take into consideration is that combining

both food traditions can result in a better chance of leading a healthy lifestyle. There needs to be preventative measures that should focus individuals in adopting a bicultural (integrated) approach to nutrition. Nutrition education programs should aim at improving the quality of the Hispanic diet, which should be based on preserving some elements of the traditional Hispanic diet, including a reliance on beans, rice, and tortillas, and a change in others, such as increasing the consumption of vegetables and grain products that are enriched in folic acid. Another method that can help this population consume a healthier diet is to fortify foods that are specifically eaten by Hispanics.

According to the data, acculturation predicts on whether these women are knowledgeable on the types of foods that can prevent NTDs. Acculturation was also statistically correlated on whether women heard or read anything about vitamin supplements that can prevent birth defects. College educated Hispanic women who live in Texas, not too far from the Texas-Mexico border, on average have never heard or read anything about vitamin supplements preventing birth defects and could list less than one item that contained a rich source of folic acid. Given that this sample population is not typical of the general population, in terms of education level and geographic location, it is viable to say that there needs to be more NTD awareness campaigns and education programs. According to a study conducted by the Texas Department of Health, less than 15% of women knew that they had to consume folic acid prior to conception, and less than 16% knew that it was a preventive measure for NTDs (37). Given that this study was conducted almost 10 years ago, the need for greater awareness of the preventive measures of NTDs is still a problem.

Author Notes

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Table

Table I: Measurements of Acculturation

		Span	Convers	Firstgen
Span	Pearson	1	.66 *	.60 *
	Sig. (1-		.00	.00
	N	6	6	4
Convers	Pearson	.66 *	1	.52 *
	Sig. (1-	.00		.00
	N	6	6	4
Firstgen	Pearson	.60 *	.52 *	1
	Sig. (1-	.00	.00	
	N	4	4	4

** Correlation is significant at the 0.01 level (1-

Table

Table 2: NTD and Nutrient Knowledge

			Firstgen	Read1	Vitam1	Begin1	MinFol2	Rich2
Spearman's	Firstgen	Correlation	1.00	.47 *	.15	.01	.00	- *
		Sig. (1-	.	.00	.28	.46	.50	.03
		N	4	4	1	4	4	2
	Read1	Correlation	.47 *	1.00	.32	.12	- *	- *
		Sig. (1-	.00	.	.07	.18	.03	.01
		N	4	6	2	5	5	3
	Vitam1	Correlation	.15	.32	1.00	-	-	.04
		Sig. (1-	.28	.07	.	.38	.16	.44
		N	1	2	2	2	2	1
	Begin1	Correlation	.01	.12	-	1.00	.08	- *
		Sig. (1-	.46	.18	.38	.	.25	.02
		N	4	5	2	5	5	3
	MinFol2	Correlation	.00	- *	-	.08	1.00	.24
		Sig. (1-	.50	.03	.16	.25	.	.08
		N	4	5	2	5	5	3
	Rich2	Correlation	- *	- *	.04	- *	.24	1.00
		Sig. (1-	.03	.01	.44	.02	.08	.
		N	2	3	1	3	3	3

** Correlation is significant at the 0.01 level (1-

* Correlation is significant at the 0.05 level (1-