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Osteoporosis Prevention in Undergraduate College Students at Ouachita Baptist University and Henderson State University

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SENIOR THESIS APPROVAL

This Honors thesis entitled

"Osteoporosis Prevention in Undergraduate College Students at Ouachita Baptist University and Henderson State University"

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Abstract

Objective The purpose of this survey-based research project was to examine lifestyle, diet, and exercise habits of the undergraduate students at Ouachita Baptist University and Henderson State University to see if these students are making choices that will increase or decrease their risk of osteoporosis.

Design Surveys were completed by undergraduate students at Ouachita Baptist University and Henderson State University. They were asked to answer twenty-six questions about their diet, exercise, and lifestyle habits.

Subjects/Setting One hundred students at Ouachita Baptist University and 98 students at Henderson State University completed the survey in the campus student center.

Statistical Analysis Performed The results were entered into and analyzed by Microsoft Excel.

Results Answers were similar for both schools, showing that both groups of students are making poor osteoporosis prevention-related choices in lifestyle, diet, and weight-bearing exercise.

Conclusions During the course of time at college, students begin to make choices and form habits that influence their nutritional status. This study helped to pinpoint weaknesses in the osteoporosis prevention areas of lifestyle, diet, and weight-bearing exercise. This information can provide a focus for the formation of osteoporosis prevention programs and educational material that target college students.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

I. Introduction

Osteoporosis is a potentially debilitating disease that manifests itself in excessive bone loss, usually during aging and results in fragile bones. This disease is becoming more of a concern in the United States as its prevalence continues to rise. In fact, one out of every two women will have an osteoporosis-related bone fracture during her lifetime (1).

Because osteoporosis cannot be cured, the key to reducing these alarming numbers is prevention. Prevention should focus on high school and college-age students, roughly between the ages of 12 and 25 because this age group is reaching their peak bone density. After adults reach their peak bone density, the bones do not absorb as much calcium, and bone density begins to decline. This is especially true in postmenopausal women.

In order to prevent osteoporosis, it is especially critical for people to build up their bone-density during their teens and early twenties by consuming adequate calcium, phosphorous and vitamin D, participating regularly in weight-bearing exercise, and avoiding harmful lifestyles. Surveys such as the National Health and Nutrition Examination Survey (NHANES) confirm that the high school and college-age group is not getting as much calcium as they need to reach peak bone-density. In fact, adolescent calcium consumption is on the decline in the United States (1, 2). Because of the rise in osteoporosis and a decline in calcium consumption, dietitians must find ways to stress prevention.

Osteoporosis prevention begins by identifying risk factors for osteoporosis and then working to counteract those risks. There are two main kinds of risk factors for osteoporosis: genetic risk factors, which cannot be changed and lifestyle risk factors that can be changed.

Osteoporosis counteractive prevention is three fold. First, prevention begins by eating a diet rich in calcium, vitamin D, and phosphorous, the three key players in building strong and healthy bones. Second, prevention should include participation in weight-bearing exercise such as dancing, running, and stair climbing at least 2-3 times/week. Finally, prevention should involve avoiding harmful habits such as smoking and alcohol abuse that increase the risk of osteoporosis. In addition, bone density tests such as the Central Dual Energy X-Ray Absorptiometery (DEXA) test may be helpful for people at high risk for osteoporosis to monitor their bone health.

The purpose of this survey-based research project was to examine lifestyle, diet, and exercise habits of the undergraduate students at Ouachita Baptist University (OBU) and Henderson State University (HSU) to see if these students are either making choices that will increase or decrease their risk of osteoporosis.

II. Review of Literature

Osteoporosis is a potentially debilitating disease that is from excessive bone loss, usually during aging that results in fragile bones.

The Effects of Osteoporosis

Bone, the support of the human body is made up of two parts, cortical bone which is the hard outer bone covering and trabecular bone, which is the inner bone material. Trabecular bone is primarily composed of calcium crystals. This bone supports the outer cortical bone and is the primary bone that disintegrates during osteoporosis. Trabecular

bone acts as a calcium reservoir that provides the body with an ample supply of calcium to meet the body's needs. In fact, 99% of the body's calcium is stored in the bones (2).

Bone mass may be built up to age 30 (3). After this age and throughout the rest of the adult years, bone density begins to decline. This is especially true for postmenopausal women because they lose bone rapidly 6-8 years after menopause. (See Figure 1). In fact, women lose up to 35% cortical bone and 50% trabecular bone (4). Postmenopausal women are most at risk for osteoporosis. Eventually, this decline in bone mass slows and becomes the same as men their age (2). In addition, the body's ability to absorb calcium declines after the age of 65 (2).

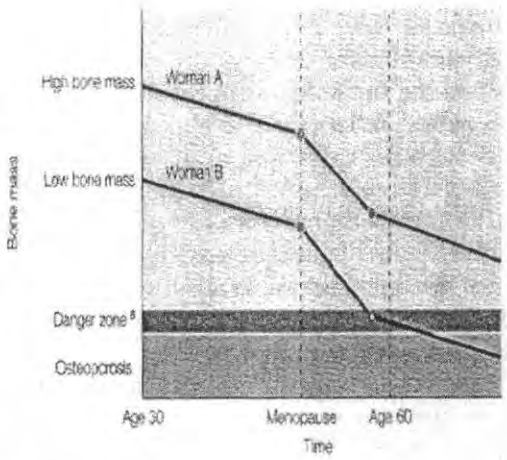
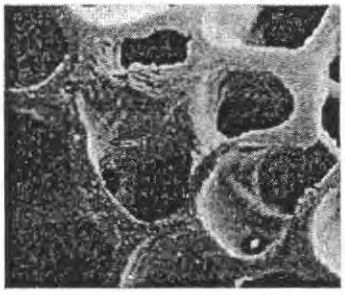
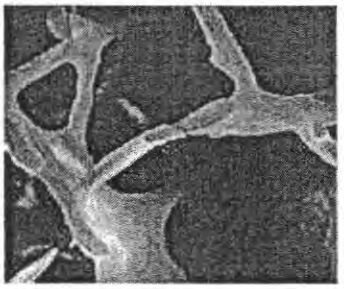


Figure 1 Calcium Decline After Age 30
Source: "Understanding Nutrition." 2002

If people do not have very dense bones to begin with, they are at a very high risk for developing osteoporosis because they have a lower amount of calcium to lose. People whose bone densities decline too much develop osteoporosis. Osteoporotic bones mean that there are large gaps in the trabecular bone making the bones very fragile. These fragile bones can easily break from a fall or even from their own weight. (See Figure 2).



Healthy Bone



Unhealthy, Osteoporotic Bone

Figure 2 Comparison of Healthy Trabecular Bone and Unhealthy Osteoporotic Trabecular Bone
Source: National Osteoporosis Foundation, 2003 <www.nof.org>

Osteoporosis is sometimes known as "the silent disease" because a person's bones can be growing dangerously fragile without that person knowing it until a bone fracture occurs (5). Osteoporosis-related fractures can take place in any bone but the most common areas are in the spine, hips, or wrists (6). Fractures can cause deformities that can be extremely painful, especially if they occur in the spine. A common trademark of osteoporosis is a loss in height due to deteriorating vertebrae. (See Figure 3). Osteoporosis drastically decreases the quality of life for many people each year. Many people who have had an osteoporosis-related fracture may permanently have to use a wheelchair or live in a healthcare facility such as a nursing home.

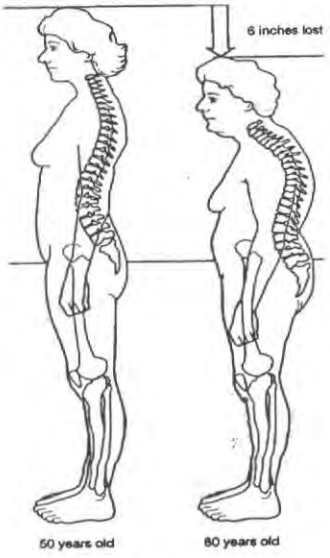


Figure 3 Height Loss Due to Osteoporosis
Source: "Understanding Nutrition." 2002

The Prevalence of Osteoporosis in the United States

Osteoporosis is one of the most prevalent diseases of aging, affecting 25 million people in the United States (U.S.), the majority of them being women (2, 7). The National

Osteoporosis Foundation estimates that osteoporosis causes over 1.5 million fractures each year that consist of:

- 300,000 hip fractures
- 700,000 vertebral fractures
- 250,000 wrist fractures
- 300,000 fractures at other sites

This foundation also estimates that the cost of national direct expenditures (hospitals and nursing homes) for osteoporosis-related fractures was $17 billion in 2001 ($47 million each day) (6).

Osteoporosis is unfortunately on the rise in the U.S. In fact, one out of every two women will have an osteoporosis-related bone fracture during her lifetime. As the baby boomer population ages, there will especially be a drastic increase in osteoporosis (8). As osteoporosis continues to increase in prevalence, its cost will also continue to increase.

III. Why Prevention Should Focus on High School and College-Age

Although osteoporosis is treatable, it cannot be cured; therefore, prevention is crucial. The good news is that osteoporosis can largely be prevented. In fact, one researcher estimated that by simply consuming adequate amounts of calcium and Vitamin D, half of the osteoporosis cases in the U.S. could be prevented (2).

The bones are living tissue and are constantly being remodeled (torn down and rebuilt). For this reason, it is important for people to get sufficient amounts of calcium

throughout their lifetimes. However, the building of the bones is especially key during the ages of 12 and 25 because this is the time when bones store calcium the most. This is the time in life when the most growth is taking place. Research verifies that 45% of the body's skeletal mass is added during adolescence and 2 times more calcium deposition in the bones during peak growth (4). It is at this time in life that people reach their peak bone density, providing themselves with ample calcium for the rapid decline that will take place later in life.

In the past, osteoporosis has been viewed as a disease that concerns only the elderly. Young adults do not stop to think that their present choices will affect their health later on in life. Calcium consumption and osteoporosis may not seem very important when a woman is 15, but when her hip fractures due to osteoporosis it will seem important. Unfortunately, by that time, she will not be able to replenish her bones with calcium sufficiently to cure her osteoporosis. In reality, osteoporosis should be viewed as a "pediatric disease that manifests itself in old age" (9).

High school and college women should be especially targeted because although osteoporosis is not solely a women's disease, it is much more prevalent in women than men (3). Women are four times more likely to develop osteoporosis than men and of those diagnosed with osteoporosis, 80% are women (1). Men are still at risk for developing osteoporosis, but they naturally have more protection against osteoporosis due to greater bone mass and fewer hormonal changes.

Just as osteoporosis is increasing in the U.S., calcium consumption is decreasing. (See Table 1). According to the NHANES III, "only 19% of girls and 52%

Age	NHANES II	NHANES III
	(1976-1980)	**(1988-1991)**
6-11	1,209 (mg/day)	867 (mg/day)
12-15	854 (mg/day)	796 (mg/day)
16-19	725 (mg/day)	822 (mg/day)

Table 1 Decline in Calcium Consumption from NHANES II (1976-1980) to NHANES III (1988-1991)
Source: "Nutrition Throughout the Lifecycle." 2000

of boys met calcium requirements (7)."

This decrease in calcium consumption is partly due to the increasing popularity of soft drinks (7). The latest research shows that teens now consume twice as many soft drinks as milk (7). Soft drinks do not provide any calcium and when caffeinated, actually remove small amounts of calcium from the bones encouraging it to be excreted (7). In addition, soft drinks also have phosphoric acid which may encourage bone resorption (bone breakdown).

Soft drink over-consumption is a serious threat to bone health as evidenced by the fact that girls consuming soft drinks were three times more likely to have a bone fracture (7). Research has shown that people tend to eat the foods they like the most more frequently (10). Therefore, if people grow up drinking soft drinks instead of milk, they will enjoy the sugary beverage more than milk and continue this habit regardless of health concerns.

In 1997, 34% of all 18-24 year olds were college students (11). The college years are a key time to form healthful habits. Although college students and graduates do tend to make more healthful choices such as choosing skim milk over whole milk than do nonstudents, both groups do not eat adequate amounts of calcium-rich vegetables or dairy foods (11). Other studies such as the Tufts Longitudinal Health Study (TLHS) back up the fact that the vast majority of college students are not getting the calcium their bones need to reach optimum peak bone mass (12). The TLHS study found that 57% of college men and 42% of college women were at moderate risk for getting osteoporosis later in life with 18% of college women at a high risk (12). Clearly, most students are lacking in calcium regardless of their gender or ethnicity (7, 13).

Not only are college students not getting the calcium that they need for optimum bone density, they are also participating in a host of lifestyle choices that compromise their bone growth putting them at further risk for osteoporosis. The unhealthy choices college students and adolescents are making impact their health not only in the present, but also set them up for developing chronic diseases later in life (7, 14). The National College Health Risk Behavior Survey found that 29% of undergraduate college students in the U.S. smoked, 34.5% participated in episodic heavy drinking, and only 53.6% exercised at all with even lower percentages participating in vigorous or strengthening exercises all risk factors for developing osteoporosis (15).

Health patterns and habits formed during the college years should be taken seriously because these habits will not only often last life-long, but also tend to be passed down to the next generation. An example of this is a mother-daughter study that showed that

mothers who drank milk frequently throughout their lives passed this healthful habit on to their daughters (16).

Questionable dieting is a major problem among adolescent and college-age students regardless of education or gender with an estimated 30% of young men and 80% of young women participating in diets (17). In fact, in an Indianapolis study, 64% of college women reported omitting certain foods from their diets to the extreme of excluding entire food groups to lose weight (18). Unfortunately, many times one of the food groups most often excluded from the diet is the dairy group. This group is often, unjustly, considered a fattening extra. Busy college students need to realize the importance of selecting healthy choices from the dairy group such as skim milk, and low-fat cheese and yogurt.

Eating disorders are an extreme case of questionable student dieting practices. These disorders are prevalent in both U.S. and Canadian students (1, 19, 20, 21). Unfortunately, 85% of these eating disorders are in girls still growing (1). Students who participate in sports in which thinness is demanded for high performance are especially at risk for developing an eating disorder because of pressure from themselves and sometimes even from coaches (1, 22).

Although 70% of college students reported looking at the Nutrition Facts label when purchasing a new product, the majority of the students focused solely on the fat and caloric content and tended to ignore other nutrients; only 29.3% used the label to find out calcium content of foods (23). Students need to stop viewing nutrition as merely a method to lose or maintain weight and focus on total wellness (23).

College students are constantly bombarded with opportunities to study and activities to be involved in. Because of this busy lifestyle, participation in regular physical activity often falls through the cracks. In a report by the Surgeon General on physical activity, it was reported that "half of American youths aged 12-21 years are not vigorously active on a regular basis (24)."

IV. How to Prevent Osteoporosis

Osteoporosis is largely preventable by identifying risk factors and then working to counteract them with diet, exercise, and lifestyle. For people at high risk, bone density testing is advisable.

Identifying Risk Factors

Identifying risk factors for osteoporosis is important to preventing it because not everyone is at the same level of risk. People at high risk should especially consider bone density testing and should follow prevention measures closely. Risk factors fall into two major groups: genetic, and lifestyle.

Genetic Risk Factors

Genetic risk factors are natural genetic conditions that predispose a person to developing osteoporosis. Some of these genetic risk factors include:

- *Gender*-- women are especially at risk
- *Age*-- postmenopausal women are especially at risk
- *Body type*-- people who are very tall or short are especially at risk
- *Ethnicity*-- people of Caucasian or East Asian decent are especially at risk

- *Family history of osteoporosis*
- *Type I diabetes*
- *Rheumatoid arthritis*
- *Early menopause*

Lifestyle Risk Factors

Lifestyle risk factors are controllable conditions that increase the risk of developing osteoporosis. These risk factors are usually the result of poor lifestyle choices. Some of the lifestyle risk factors include:

- *Diet low in Calcium*
- *Diet low in vitamin D*—if insufficient (about 15 min/day) sun exposure
- *Sedimentary lifestyle without weight-bearing exercise*
- *Alcohol abuse*— slows bone formation and upsets hormonal balance
- *Smoking*—damages bones, and makes them lose calcium
- *Steroid use*
- *Antacid abuse*
- *Eating disorders*—leads to an early menopause

After risk factors are identified prevention needs to begin with proper diet, sufficient weight-bearing exercise, and a healthy lifestyle.

Diet

Diet plays the largest role in osteoporosis prevention. It is estimated that if everyone obtained the levels of calcium, phosphorous, and vitamin D, the impact of osteoporosis would be cut in half; all three of these nutrients are essential to prevention (25, 26).

Calcium

Calcium provides the material that forms the bones themselves. It is the single most important nutrient to consume to build dense and healthy bones. The Dietary Reference Intake (DRI) for young adults between the ages of 12 and 18 is 1300 mg/day. After the age of 18 the DRI is lowered to 1000 mg/day. However, many researchers and dietitians argue that to obtain optimum levels of calcium, young adults should continue to consume the higher DRI until their mid-twenties. The National Institutes of Health Consensus Development Conference Statement on Optimal Calcium intake recommended 1,200-1,500 mg of calcium/day for adolescents ages 11 to 24 (4). This higher calcium intake allows adolescents to reach optimum peak bone mass for their genetics. A good rule of thumb should be to drink at least 3 cups of milk each day to obtain adequate amounts of calcium (2).

Good sources of calcium in the diet are milk, yogurt, cheese, dark green leafy vegetables, and broccoli. Dairy food sources are the best and the most bioavailable of common US sources; milk is by far the most widely consumed (3, 27, 28).

Researchers agree that it is better to get calcium from food sources; however, a person who is lactose intolerant (cannot consume milk or milk products), a vegan (strict vegetarian), or a person who simply does not like milk should consider taking a calcium supplement. Ironically, people who consume more calcium are more likely to also take a supplement while often those who are in most need of a supplement do not take one (27).

Vegan diets have been shown to be lower in calcium because of the elimination of dairy products. However, the body does partially compensate for this decrease by

excreting less of the ingested calcium. In addition, and vegan diets that are naturally low in protein may help the calcium from being further excreted (29).

There are two main types of calcium supplements: calcium citrate and calcium carbonate. Both supplements are very bioavailabe, but need to be consumed several times a day because the body can only absorb amounts of 500 mg or less at one time (6, 28). Calcium carbonate supplements are absorbed best when consumed with food and may have a slight constipation affect in some people, but both supplements are very similar (28). Researchers concluded in one study that it makes no difference what time of day the supplement is taken (30). Some people are concerned about an increased production of kidney stones with calcium supplementation, but researchers have found that calcium citrate supplementation did not increase kidney stone production in stone formers which is a concern for some people (31).

Some researchers are skeptical about how much calcium consumption prevents fractures later in life (32, 33, 34). Especially people in the vegan community wonder if vitamin D has more to do with bone health than dietary calcium (33, 34). Some researchers also question the fortification of milk with vitamin A because excessive amounts have been linked to increased risk for hip fracture (28, 34).

Yet, regardless of the debate on the effect of calcium consumption later in life on number of fractures, scientists agree that calcium is needed for bone growth. Furthermore, they agree that without adequate amounts of calcium in the bone building years, bone mineralization will not adequately take place and optimum peak bone mass will not be reached (35). In other words, if calcium is not deposited in adequate amounts, people will not have sufficient calcium to spare when retirement hits. The debate on

whether calcium consumption will help prevent fractures when consumed past peak bone mass only increases the urgency for college students to consume adequate calcium. Several computer-based and other food frequency questionnaires are specifically designed to compute calcium consumption adequacy such as OsteoCal (5, 9).

Phosphorous and Vitamin D

Phosphorous and vitamin D are also important nutrients for building healthy and dense bones. Phosphorous is part of bone mineralization. A phosphorous deficiency is rare, especially if the individual is eating a diet that includes dairy products.

Vitamin D plays an essential role in bone growth because without this important vitamin, the body cannot absorb more than 10-15% of dietary calcium. This is less than half the amount of dietary calcium normally absorbed which is insufficient for proper bone growth (36). In addition, a deficiency leads to hyperparathyroidism which worsens osteoporosis.

Except in rare cases, vitamin D is made in the body as long as the skin is exposed to adequate sunlight. Although it varies depending on the melanin in the skin, latitude, time of day, season, and ozone pollution, people exposed to 15 minutes of sunlight each day usually have adequate vitamin D stores (37). People with very dark skin pigmentation, those who rarely go outside, or those who always use sunscreen are at risk for vitamin D deficiency (36). The obese are at greater risk because the vitamin often gets stored in their fat and is not bioavailable (36).

Vitamin D deficiency is more common than once thought though it is usually just a problem in breastfed infants or the elderly because this vitamin can be stored for long

periods of time (36, 38). In rare cases, in which a person has insufficient exposure to sunlight, that person may need to consult a dietitian about taking a vitamin D supplement in order to meet the minimum 1000 IU recommendation. Not many non-fortified foods contain vitamin D, only a few foods such as certain oily fish are good sources (36). However, a few products are commonly vitamin D fortified such as milk, orange juice, and cereals.

Weight-Bearing Exercise

Weight-bearing exercise plays the second largest role in osteoporosis prevention. Even if a person's genetics are predisposed to osteoporosis, weight-bearing exercise significantly reduces the risk (16, 25). In this type of exercise, the bones and muscles have to work against gravity. When this happens, the bones receive a signal that tells them to strengthen themselves. Also, increased muscle mass, as a result of exercise, makes the bones work harder sending a similar signal.

In order to prevent osteoporosis, a person should participate in weight-bearing exercise 2 to 3 times per week. Most exercise is weight-bearing; some examples of weight bearing exercise are dancing, walking, running, soccer and stair-climbing. Bicycling and swimming are not weight-bearing exercises because the feet and legs are not working against gravity to bear a person's weight. In addition, resistance exercises such as weight lifting are a part of prevention.

Lifestyle

Lifestyle plays the third largest role in osteoporosis prevention. People should be careful to live a healthy lifestyle free of osteoporosis lifestyle risk factors such as smoking, alcohol abuse, steroid use, antacid abuse and eating disorders.

Smoking and alcohol abuse weaken the entire body including the bones. Smoking damages the bones and causes the bones to lose calcium (39, 40). Alcohol abuse slows bone formation and upsets hormonal balances that are key to building and maintaining healthy bones.

Likewise, steroid use and antacid abuse upset these hormonal balances. Eating disorders in women, lead to lengthy lapses or a permanent end to the menstrual cycle that drastically decreases the amount of estrogen found in the woman's body thus causing the body to react the same way it would after menopause. Calcium stores can begin the rapid decline even if a woman is still in her twenties.

V. Bone Density Testing

Bone density testing should be conducted on people who are at a high risk for developing osteoporosis. Bone density testing helps those at high risk to monitor the density and thus health of their bones. This testing can catch osteoporosis at an early stage so that treatment can begin before the disease progresses.

The best method of bone density testing is using a machine called the DEXA. This machine is used in hospitals and clinics to determine the bone density particularly of the hip and spine-- the most common areas for osteoporosis-related fractures to occur. DEXA is used primarily to diagnose osteoporosis, assess risk of fractures due to bone

loss, and help to monitor osteoporosis treatment. The process is painless and lasts only 10-15 minutes (3, 41).

VI. Materials and Methods

Subjects

All current students enrolled at Ouachita Baptist University (OBU) and Henderson State University (HSU) were eligible to take the survey. OBU is a private, Christian, liberal arts university of 1,332 undergraduate students. HSU is a larger state university of 3,047 undergraduate students. Both schools are in Arkadelphia, Arkansas. One hundred OBU students and 98 HSU students participated in the survey. Four of the HSU surveys had to be discarded because three were filled out by graduate students and one student neglected to fill-out the first section, leaving 94 HSU surveys and 194 surveys in all.

Of the OBU students, 23.0% were freshmen, 20.0% were sophomores, 31.0% were juniors, and 26.0% were seniors. Of the HSU students, 22.3% were freshmen, 22.3% were sophomores, 25.5% were juniors, and 29.8% were seniors. Therefore, both samples were very evenly distributed between classifications. (See Figure 4).

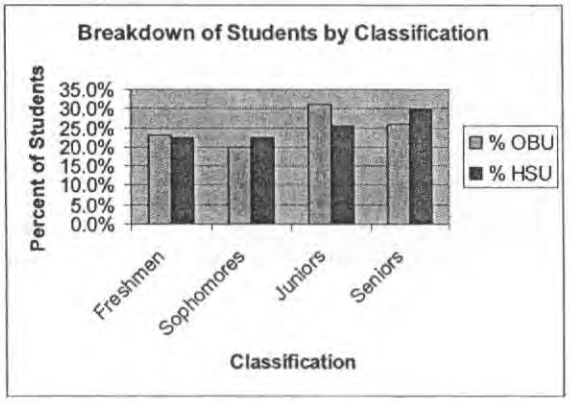


Figure 4 Breakdown of Students by Classification

Likewise, the samples were relatively evenly distributed between the genders for both OBU and HSU students with a slightly higher number of female students on both campuses taking the survey. Thirty-seven percent of the OBU students were male and 63.0% were female; 48% of the HSU students were male and 52% were female. (See Figure 5).

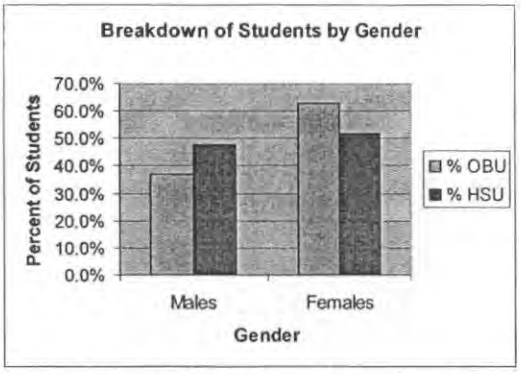


Figure 5 Breakdown of Students by Gender

Ethnically, the campuses differed significantly. The vast majority of OBU students were Caucasian, 96.0%, with the remaining 4.0% made up of 3.0% African American and 1.0% Hispanic. In contrast, the HSU campus was split more evenly between Caucasian, 48.9%, and African American students, 44.7% with the remaining 6.4% made up of Hispanic and "Other" students. (See Figure 6).

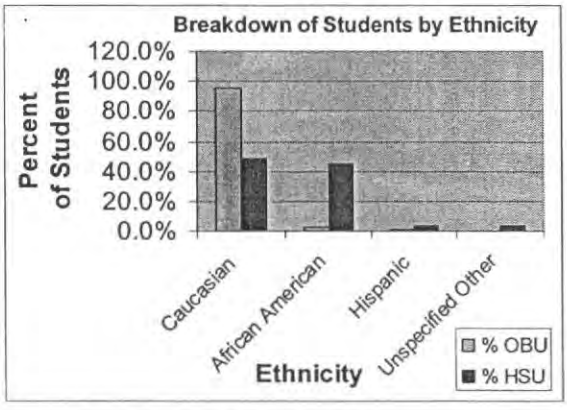


Figure 6 Breakdown of Students by Ethnicity

In addition, the majority of students were non-smokers with a significantly higher number of HSU students reporting to be smokers than OBU students. Ninety-seven percent of OBU students reported being non-smokers, compared to the 81.9% of HSU students, 1.0% reported to being smokers of the OBU students, compared to the 17.0% of HSU students, and 2.0% of OBU students and 1.1% of HSU students did specify. (See Figure 7).

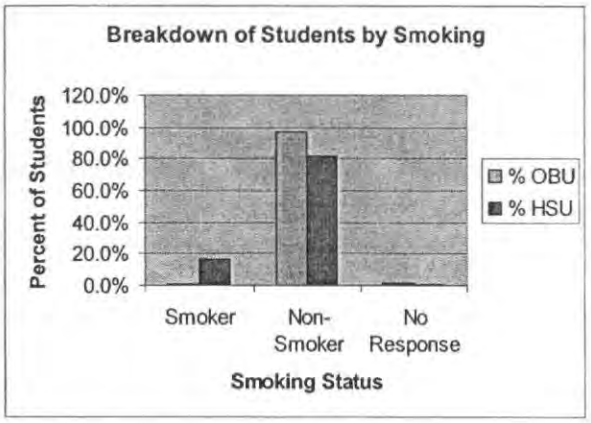


Figure 7 Breakdown of Students by Smoking Status

OBU subjects were recruited by a campus-wide e-mail advertising the study. The e-mail included the purpose of the study, the date, times, and place where the study would be conducted, and a list of incentives for students who would complete the survey. Both OBU and HSU students were actively recruited at the survey sites.

Experimental Design

The study used a one-page, twenty-six question survey. The survey was based on other calcium and osteoporosis risk factor questionnaires and then made specific to this population (42, 43, 44, 45, 46). Survey questions were divided into three, easy-to-understand categories: About You, Nutrition/Exercise, and Your Opinion. (See Appendix A for a copy of the survey). Questions that asked about the frequency of the

consumption of calcium-rich foods were based on the students' average or normal intake. Student names were not included in the surveys in order to keep answers anonymous. The survey was pilot tested on both dietetics majors and non-majors. After corrections were made to the survey, 200 copies were made at the OBU Print Shop. One hundred copies were printed on golden yellow paper for OBU students and 100 copies were printed on plain white paper for HSU students in order to separate the two survey groups without asking the students which school they were currently attending. This method was done to alleviate any bias of answers to questions based on school rivalry.

Local restaurants and businesses were contacted several weeks prior to the survey in order to obtain incentives for students who completed the survey. Incentives included a $25 dollar gift card from Brookshires, three free tacos from Taco Tico, and two free buffets from Mazzios. In addition, Maurices donated 200 25% off coupons, one for each participant. Pens were purchased for the survey and brought to the surveying sites. Permission was obtained from both OBU and HSU to proceed with the survey.

An eye-catching poster was made that explained the purpose of the study and advertised incentives. The poster was hung on the tables where the surveys were being conducted. The poster clearly identified the targeted sample and advertised incentives. Because the incentives were donated, the cost of this research was minimal.

Data Collection

The survey was conducted on two different campuses (OBU and HSU) on two separate days in order to get a better sample from the college population. Tables were set up at each survey site with 100 surveys. The OBU survey was conducted in the OBU student center between the entrance into the building and Chic-Fil-A from 11AM to 1PM. The

HSU survey was conducted in the HSU student center by the entrance to the building across from Quiznos from 10AM to 12PM. Both surveys were conducted on Thursdays during the times reported to have the heaviest traffic. Methods used for data collection at both sites were the same.

On the day of the surveys, a poster was hung on the survey table to attract the attention of passing students. In addition, all students passing by were actively invited to participate in the survey. Interested students were provided with a copy of the survey and a pen and asked to circle their answers. A monitor was available at all times during the survey to answer questions.

Students who turned in their completed surveys were registered for the incentive drawing by filling out their name and telephone number on a sheet separate from the survey. Registration for the drawing was optional. All students who completed the survey received a 25% discount coupon from Maurices. A total of 194 surveys were correctly completed, 100 at OBU and 94 at HSU.

Follow Up

After the survey was completed, the names registered for the incentive drawing were numbered. Numbered slips of paper were placed into a hat and randomly drawn. The students whose number corresponded to the number drawn won one of the incentives. Approximately half of the incentives went to HSU students and half to OBU students. The incentives were then mailed directly to each winner through campus or regular mail.

An announcement thanking all participants and listing the winners was posted on the OBU campus internet billboard. In addition, an article was placed in the campus newspaper, the Signal, thanking the area businesses that donated incentives. (See

Appendix B for a copy of the article). Copies of the published article were sent to the businesses to thank them and encourage their support of OBU research.

Statistical Analyses

Each school and answer was given a number code. For example, 1 for seniors and 2 for freshmen, etc. The raw data was entered into a Microsoft Excel spreadsheet. The OBU and HSU data were put into separate worksheets. Totals and percentages were obtained for the numerical data. Charts were made in Excel to provide a visual interpretation of the numerical data. Averages overall including the data from both campuses were found for questions 5-11, and question 14 in order to be able to find an approximate consumption of certain foods and participation in exercise. The averages were obtained to allow comparison of the overall student habits with diet and exercise recommendations. Descriptive data was compiled and the data summarized.

VII. Results

Milk consumption was very low for both groups. Of the OBU students, 44.0% reported not consuming any milk per day, 37.0% reported consuming 1, 8 oz. glass of milk per day, 13.0% reported consuming 2, 8 oz. glasses of milk per day, 3.0% reported consuming 3, 8 oz. glasses of milk per day, and 3.0% reported consuming 4 or more 8 oz. glasses of milk per day. Of the HSU students, 45.7% reported not consuming any milk per day, 33.0% reported consuming 1, 8 oz. glass of milk per day, 14.9% reported consuming 2, 8 oz. glasses of milk per day, 4.3% reported consuming 3, 8 oz. glasses of milk per day, and 2.1% reported consuming 4 or more 8 oz. glasses of milk per day. (See

Figure 8). The approximate number of 8 oz. glasses of milk consumed per day for both groups was from 0-1 glass/day.

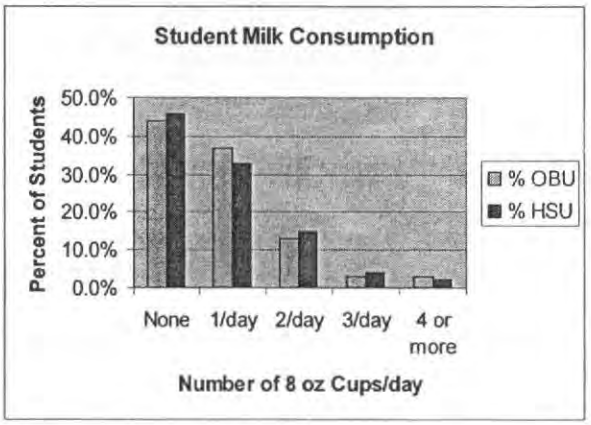


Figure 8 Student Milk Consumption

Dark-green cooked vegetable consumption was fairly good for both groups, with OBU students consuming a slightly higher amount. Of the OBU students, 37.0% reported consuming 1, ½ c. serving per day, 28.0% reported consuming 3 servings per week, 14.0% reported consuming 1 serving per week, 20.0% reported consuming no servings per week, and 1.0% did not answer the question. Of the HSU students, 28.7% reported consuming 1, ½ c. serving per day, 29.8% reported consuming 3 servings per week, 22.3% reported consuming 1 serving per week, 14.9% reported consuming no servings per week, and 4.3% did not answer the question. (See Figure 9). The approximate number of ½ c. servings of dark-green vegetables consumed was 3 servings per week for both groups.

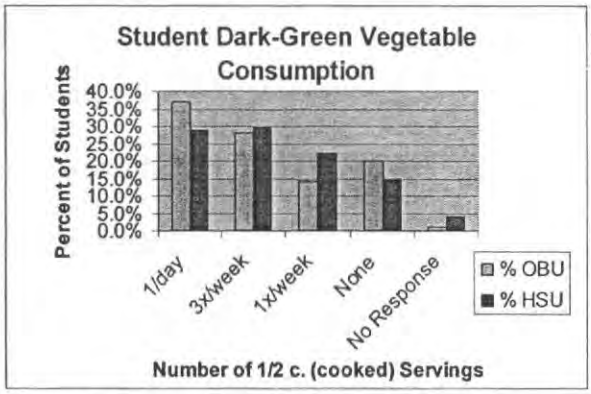


Figure 9 Student Dark-Green Vegetable Consumption

Likewise, cheese consumption was fairly good for both groups with the OBU students consuming a higher amount. Of the OBU students, 45.0% reported consuming 1, 1oz. slice of cheese per day, 41.0% reported consuming 3 slices per week, 6.0% reported consuming 1 slice per week, 7.0% reported consuming no slices per week, and 1.0% did not answer the question. Of the HSU students, 36.2% reported consuming 1, 1oz. slice of cheese per day, 38.3% reported consuming 3 slices per week, 11.7% reported consuming 1 slice per week, and 13.8% reported consuming no slices per week. (See Figure 10). The approximate number of 1oz. slices of cheese consumed was 3 slices per week for both groups.

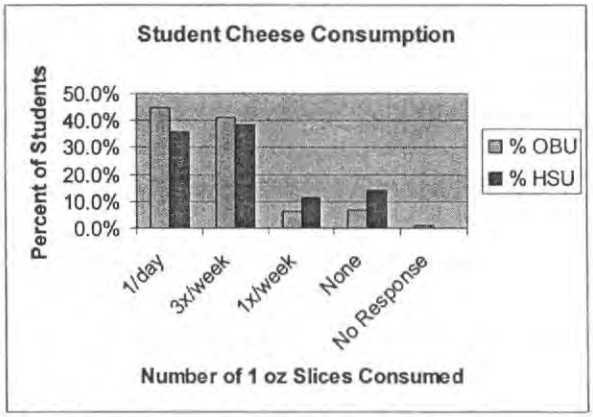


Figure 10 Student Cheese Consumption

Like milk consumption, yogurt consumption was poor for both groups with the OBU students consuming a higher amount. Of the OBU students, 11.0% reported consuming

1, 1 c. serving of yogurt per day, 15.0% reported consuming 3 servings per week, 32.0% reported consuming 1 serving per week, 41.0% reported consuming no servings per week, and 1.0% did not answer the question. Of the HSU students, 9.6% reported consuming 1, 1 c. serving of yogurt per day, 10.6% reported consuming 3 servings per week, 12.8% reported consuming 1 serving per week, 63.8% reported consuming no servings per week, and 3.2% did not answer the question. (See Figure 11). The approximate number of 1 c. servings of yogurt consumed was between none-1 serving per week for both groups.

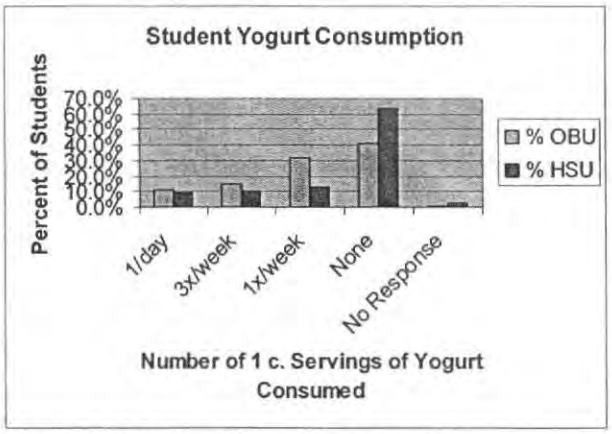


Figure 11 Student Yogurt Consumption

Ice cream and frozen yogurt consumption was low for both groups with the OBU students consuming a higher amount. Of the OBU students, 5.0% reported consuming 1, ½ c. serving of ice cream or frozen yogurt per day, 16.0% reported consuming 3 servings per week, 44.0% reported consuming 1 serving per week, 34.0% reported consuming no servings per week, and 1.0% did not answer the question. Of the HSU students, 12.8% reported consuming 1, ½ c. serving of ice cream or frozen yogurt per day, 11.7% reported consuming 3 servings per week, 34.0% reported consuming 1 serving per week, 39.4% reported consuming no servings per week, and 2.1% did not answer the question. (See

Figure 12). The approximate number of ½ c. servings of yogurt consumed was 1 serving per week for both groups.

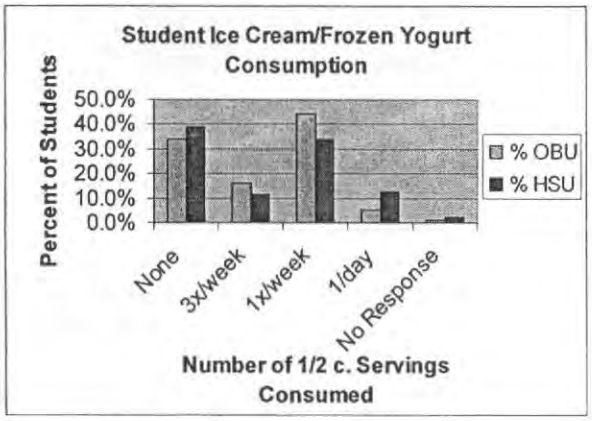


Figure 12 Student Ice Cream/Frozen Yogurt Consumption

Calcium-fortified food consumption was fairly high for both groups especially considering limited knowledge of students on what foods are calcium-fortified, again OBU students consumed a higher amount. Of the OBU students, 36.0% reported consuming 1 serving of a calcium-fortified food per day. Examples given in the questionnaire were cereals, orange juice, cottage cheese and breakfast bars, but the question was not limited to these foods. Thirty-four percent reported consuming 3 servings per week, 15.0% reported consuming 1 serving per week, 12.0% reported consuming no servings per week, and 3.0% did not answer the question. Of the HSU students, 33.3% reported consuming 1 serving of a calcium-fortified food per day, 36.2% reported consuming 3 servings per week, 8.5% reported consuming 1 serving per week, and 22.3% reported consuming no servings per week. (See Figure 13). The approximate number of servings of calcium-fortified foods consumed was 3 servings per week for both groups.

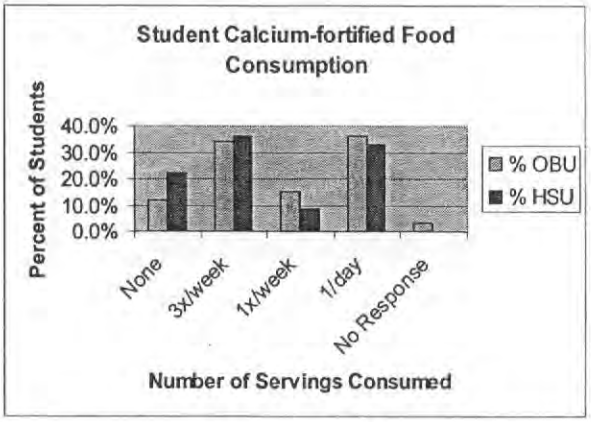


Figure 13 Student Calcium-fortified Food Consumption

Alcohol consumption varied greatly between the two campuses with OBU consuming less. Because campus policy prohibits drinking, and OBU is a Baptist University, this may account for the vast difference. Of the OBU students, 3.0% reported consuming 1 alcoholic beverage per day, 1.0% reported consuming 3 alcoholic beverages per week, 11.0% reported consuming 1 serving per week, 82.0% reported consuming no alcoholic beverages per week, and 3.0% did not answer the question. Of the HSU students, 10.6% reported consuming 1 alcoholic beverage per day, 7.4% reported consuming 3 alcoholic beverages per week, 25.5% reported consuming 1 alcoholic beverage per week, 53.2% reported consuming no alcoholic beverages per week, and 3.2% did not answer the question. (See Figure 14). The approximate number of alcoholic beverages consumed was between none-1 servings per week for both groups.

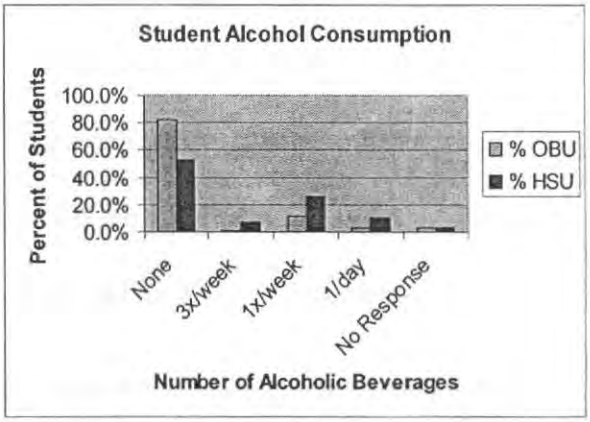


Figure 14 Student Alcohol Consumption

The majority of both groups of students did not take a multivitamin supplement on a regular basis, with OBU students reporting taking a multivitamin supplement slightly more often than HSU students. Of the OBU students, 29.0% reported regularly taking a multivitamin supplement while 71.0% reported that they did not. Of the HSU students, 25.5% reported regularly taking a multivitamin supplement while 74.5% reported that they did not. (See Figure 15).

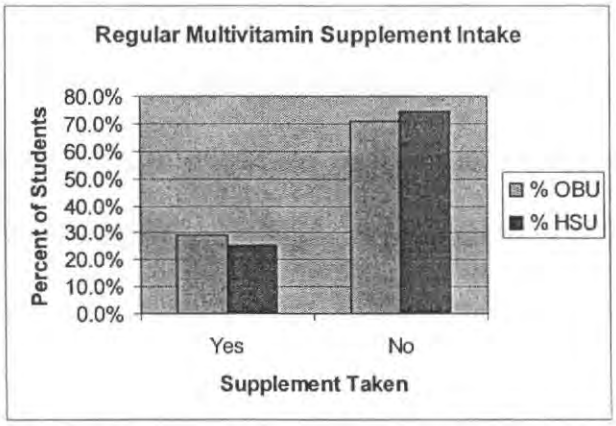


Figure 15 Regular Multivitamin Supplement Intake

Even fewer students reported taking a calcium supplement on a regular basis with a slightly higher number of OBU students reporting a regular intake. Of the OBU students, only 13.0% reported taking a calcium supplement on a regular basis while 13.0% reported that they did not. Of the HSU students, only 11.7% reported taking a calcium supplement on a regular basis while 87.2% reported that they did not. (See Figure 16).

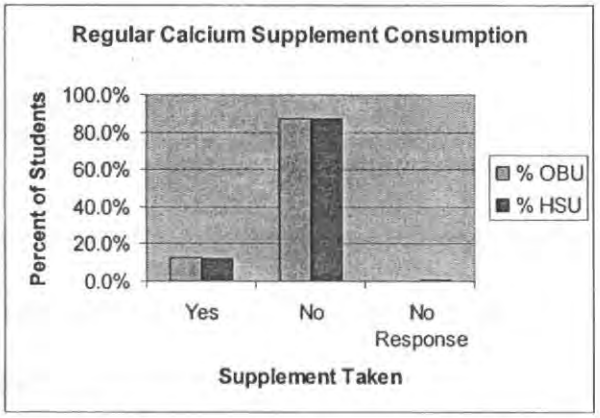


Figure 16 Regular Calcium Supplement Intake

Of the total students who reported taking a calcium supplement on a regular basis, most reported taking 1 tablet per day for both groups. Of the OBU students, 15.4% reported taking 2 tablets per day, 53.8% reported taking 1 tablet per day, 7.7% reported taking 3 tablets per week, 7.7% reported taking 1 tablet per week, and 15.4% did not answer the question. Of the HSU students, 18.2% reported taking 2 tablets per day, 72.7% reported taking 1 tablet per day, and 9.1% did not answer the question. (See Figure 17).

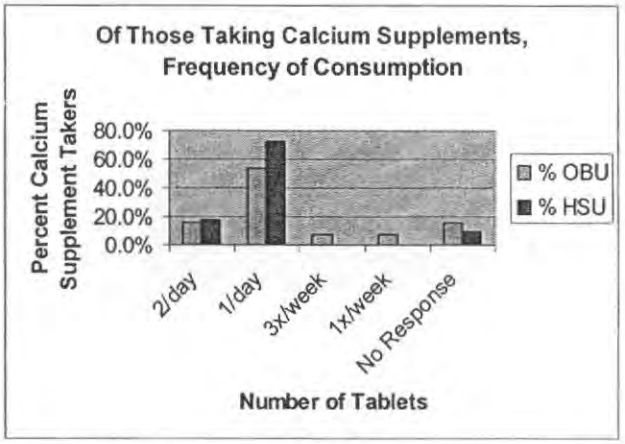


Figure 17 Of Those Taking Calcium Supplements, Frequency of Consumption

Students who reported taking a calcium supplement regularly reported obtaining the calcium from both citrate and carbonate forms in supplemental pills, prenatal vitamins, Viactin® calcium chews, and TUMS®.

The majority of students on both campuses did not participate in weight-bearing exercise 3 or more times per week. OBU students reported participating in weight-bearing exercise more often than HSU students. Of the OBU students, 19.0% reported never participating in weight-bearing exercise, 36.0% reported participating 1-2 times per week, 28.0% reported participating 3-4 times per week, 11.0% reported participating 5 or more times per week, and 6.0% did not answer the question. Of the HSU students, 29.8% reported never participating in weight-bearing exercise, 35.1% reported participating 1-2 times per week, 24.5% reported participating 3-4 times per week, 8.5% reported participating 5 or more times per week, and 2.1% did not answer the question. (See Figure 18). The approximate participation of students in weight-bearing exercise was 1-2 times per week for both groups.

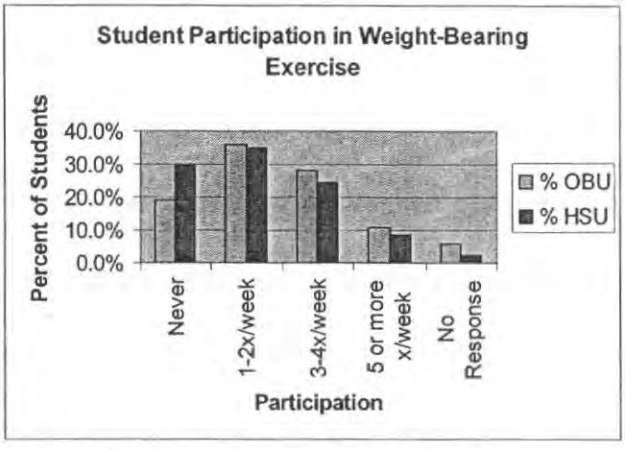


Figure 18 Student Participation in Weight-Bearing Exercise

The vast majority of both groups of students felt that it was important to participate regularly in weight-bearing exercise. Comparatively, OBU and HSU answers for this question were very similar. Of the OBU students, 88.0% reported that they thought it was important to participate regularly in weight-bearing exercise, 8.0% did not feel that it was important and 4.0% did not answer the question. Of the HSU students, 86.2% reported that they thought it was important to participate regularly in weight-bearing exercise, 12.8% did not feel that it was important and 1.1% did not answer the question. (See Figure 19).

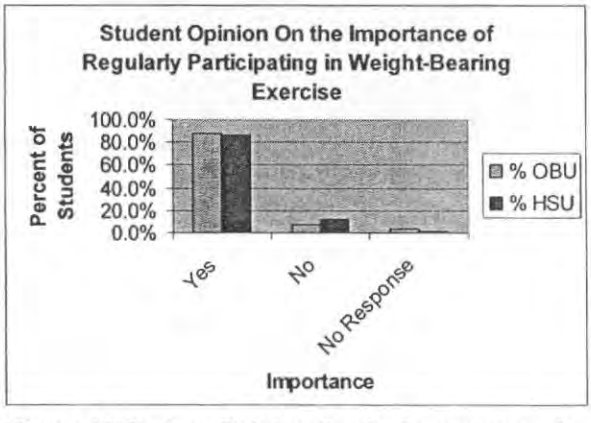


Figure 19 Student Opinion On the Importance of Regularly Participating in Weight-Bearing Exercise

When asked why they did not exercise regularly if they did not, students primarily reported that they did not exercise because they were too busy although a few admitted to being unmotivated. Other answers were that it was hard on their joints, they were too tired, their medication made them lethargic, health reasons, work, injury, convenience, and being thin. These results are consistent with other college health surveys such as the University of British Columbia Health Survey (20). In other studies college men tend to exercise more often, while college women tend to eat more healthfully (20).

The majority of both groups of students felt that it was important to include calcium-rich foods in their diets. OBU students reported valuing calcium-rich foods slightly more. Of the OBU students, 94.0% reported that they thought it was important to include calcium-rich foods in the diet, and 6.0% reported that they did not think it was important. Of the HSU students, 81.9% reported that they thought it was important to include calcium-rich foods in the diet, 17.0% reported that they did not think it was important, and 1.1% did not answer the question. (See Figure 20).

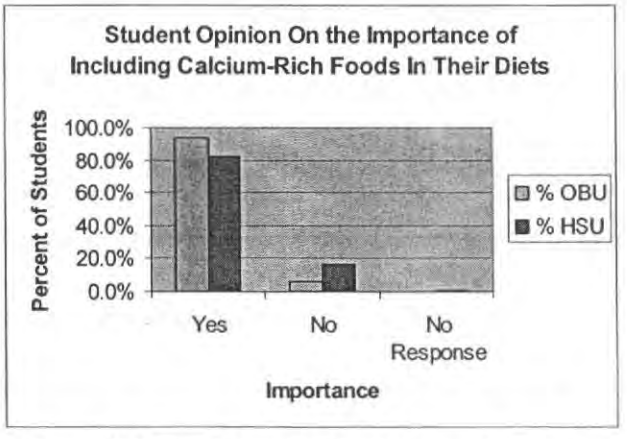


Figure 20 Student Opinion On the Importance of Including Calcium-Rich Foods In Their Diets

Only little over half of both groups of students reported that they felt their diets contained adequate amounts of calcium; answers for both groups were nearly identical. Of the OBU students, 58.0% reported that they felt their diets contained adequate amounts of calcium, and 42.0% felt that they did not. Of the HSU students, 53.2% reported that they felt their diets contained adequate amounts of calcium, 44.7% felt that they did not, and 2.1% did not answer the question. (See Figure 21).

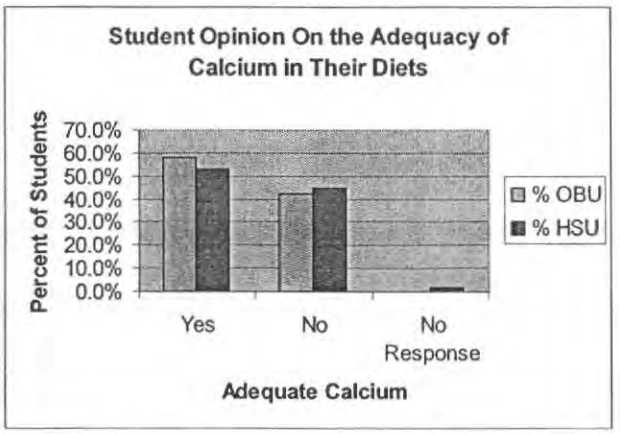


Figure 21 Student Opinion On the Adequacy of Calcium In Their Diets

Of the students who reported that they felt they did not get adequate calcium in their diets, the majority of students from both schools reported that the main reason they do not get enough is because they do not like milk or other calcium choices. Other reasons reported were lactose intolerance, time, expense, allergies, bad cafeteria food, not enough motivation, an overall poor diet, and upset stomach for sports.

Most of the students reported being familiar with osteoporosis (its causes, affects, and risk factors); answers for both groups were nearly identical. Of the OBU students, 84.0% reported that they were familiar with osteoporosis, 14.0% reported that they were not familiar with osteoporosis, and 2.0% did not answer the question. Of the HSU students,

85.1% reported that they were familiar with osteoporosis, 13.8% reported that they were not familiar with osteoporosis, and 1.1% did not answer the question. (See Figure 22).

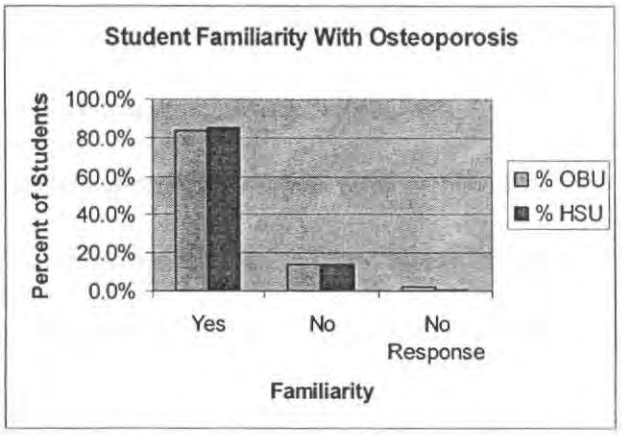


Figure 22 Student Familiarity With Osteoporosis

Although, many students feel that they are familiar with osteoporosis, the majority of both groups reported receiving no formal osteoporosis information or education. OBU students reported receiving a slightly higher amount of education. Of OBU students, 31.0% reported receiving formal osteoporosis information or education, 68.0% reported that they did not, and 1.0% did not answer the question. Of the HSU students, 21.3% reported receiving formal osteoporosis information or education, 77.6% reported that they did not, and 1.1% did not answer the question. (See Figure 23).

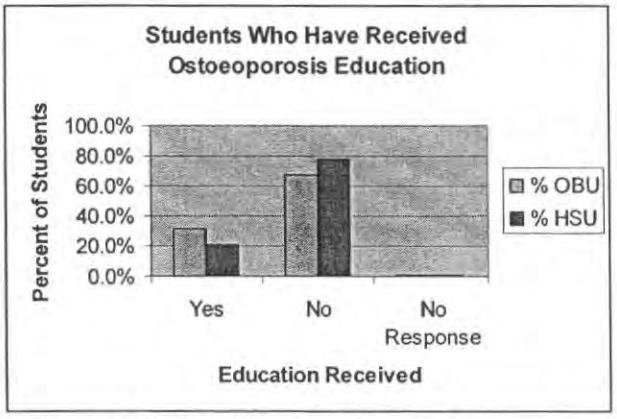


Figure 23 Student Who Have Received Osteoporosis Education

Of the students who reported receiving osteoporosis information or education, the majority reported receiving this information in class (OBU students specified the Wellness, and Anatomy classes), other means reported were from teachers, parents, at the doctor's office, from pamphlets, and solicited e-mails.

Students guessed the age group that they thought peak bone mass was reached. Both groups answered similarly; however, the OBU students' answers were closer to the correct answer of the age group of 20-30. Of the OBU students, 2.0% guessed the age group of 1-10 years old, 30.0% guessed 10-20 years old, 58.0% guessed the correct answer of 20-30 years old, 6.0% guessed 30-40 years old, 2.0% guessed above 40 years old, and 2.0% did not answer the question. Of the HSU students, 5.3% guessed the age group of 1-10 years old, 27.7% guessed 10-20 years old, 45.7% guessed the correct answer of 20-30 years old, 13.8% guessed 30-40 years old, 4.3% guessed above 40 years old, and 3.2% did not answer the question. (See Figure 24).

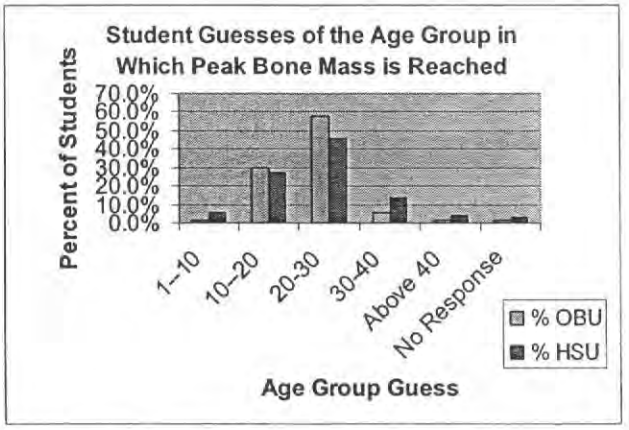


Figure 24 Student Guesses of the Age Group in Which Peak Bone Mass is Reached

Students reported their opinion on the age group that osteoporosis prevention should target. Of the OBU students, 2.0% reported the age group of 1-10 years old, 25.0%

reported 10-20 years old, 32.0% reported the correct answer of 20-30 years old, 21.0% reported 30-40 years old, 15.0% reported above 40 years old, and 5.0% did not answer the question. Of the HSU students, 6.4% reported the age group of 1-10 years old, 22.3% reported 10-20 years old, 23.4% guessed the correct answer of 20-30 years old, 29.8% guessed 30-40 years old, 12.8% guessed above 40 years old, and 5.3% did not answer the question. (See Figure 25).

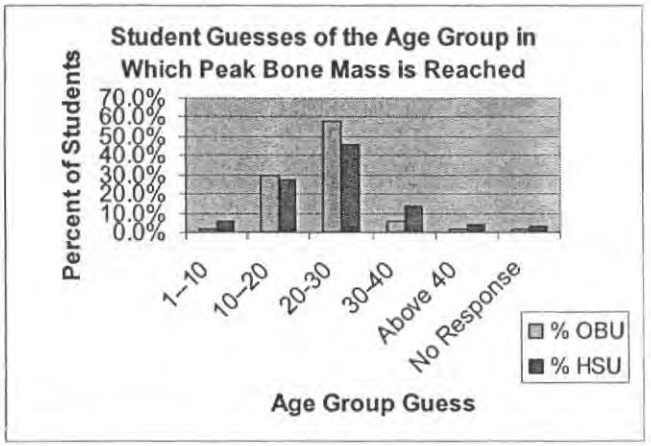


Figure 25 Student Guesses of the Age Group in Which Peak Bone Mass is Reached

VIII. Discussion

Overall, OBU and HSU students' answers were very similar. From this survey, both OBU and HSU students appear to make poor lifestyle, diet and exercise choices. The majority of both OBU and HSU students surveyed were Caucasian which puts these students at a greater risk of developing osteoporosis. Furthermore, HSU students tend to make poor lifestyle and exercise choices such as smoking, consuming alcohol, and participating less often in weight-bearing exercise more often than OBU students putting them at even greater risk.

Both schools' overall consumption of the richest sources of calcium (milk and yogurt) was disturbingly low. The students tended to eat more dark-green vegetables over milk or yogurt which is good, but these sources are not as bioavailable for calcium. Of calcium of the foods the students reported frequently consuming, the main sources of calcium were cheese and calcium-fortified foods.

Supplements do not seem to be very popular with the students, although a little over of a quarter of the students were taking a multivitamin supplement which contains approximately 45% of the Daily Value for calcium depending on the multivitamin. However, it would be better for "at risk" students to consume a calcium supplement rather than a multivitamin because the calcium may be more bioavailable when taken separately.

Though students report that they value both diet and weight-bearing exercise, they do not show this in their actions. In addition, the students seem to have knowledge of osteoporosis and osteoporosis prevention yet they seem to not be practicing what they know. Students should be encouraged and motivated to start prevention now instead of waiting.

IX. Limitations

In addition, the phrasing of weight-bearing exercise may have lead students to think of weight-lifting. Precautions were taken to help clarify the question by telling students to exclude exercise done with elliptical machines, bicycling, or swimming, but the question may still have lead to a small amount of confusion. It would have been helpful to have had two monitors at each site, one to assist students who were confused, and one to

actively recruit students to take the survey. Without access to food models at the surveying sites, students may have not had a clear understanding of serving sizes such as ½ c. of a deep-green vegetable or 1 oz. of cheese.

X. Areas of Further Research

Because the survey was limited to one page to make it more cost-effective and college-friendly to busy students, question number was limited. Therefore, there are many other factors that may contribute to the overall bone health of students that time and survey space did not permit me to research. Some of these factors that could be studied in future research are on- or off-campus stasis of students, pregnancy, and the HSU graduate students. In addition, it would be interesting to do a correlation study of stacking variables to see, for example, if smokers tended to choose other unhealthy behaviors such as poor diet and/or exercise.

XI. Application

The results provide information on osteoporosis prevention-related lifestyle, diet and exercise habits of OBU and HSU undergraduate students. This information can be used in the formation of osteoporosis prevention education programs and campaigns that target college students. Certain research methods used may be helpful to future OBU researchers such as offering incentives. Incentives were an effective way to thank the students who participated, as well as to increase the sample size. I would highly recommend that this method be used in future OBU research.

XII. Conclusions

Osteoporosis is a very prevalent disease in the United States and is on the rise. Prevention is crucial to stop this rise in osteoporosis. Since women are most at risk for osteoporosis and women reach peak bone density from the ages of 12 to 25, prevention should especially target this gender and age group. Prevention begins with identifying both genetic and lifestyle risk factors and then continues by counteracting these risks through diet, weight-bearing exercise and a healthy lifestyle. Women with a high risk for osteoporosis should consider a bone density test.

College students are undergoing a time of transition as they acquire new information and skills. During the course of time between their freshman and senior years, students begin to make choices and form habits. This survey showed that OBU and HSU students are not making the most preventive or healthful lifestyle, diet and weight-bearing exercise choices even though they seem to be fairly knowledgeable about prevention. Prevention must be stressed even more to help provide motivation for student change. Making healthy decisions is ultimately up to the individual, but this study helped to pinpoint the weaknesses of the undergraduate students. This information can provide a focus for the formation of osteoporosis prevention materials and educational programs. This additional education could be critical to helping college students form healthy habits

XIII. Recommendations

I recommend that dietitians and other health professionals change their view of osteoporosis from treatment to prevention. Osteoporosis cannot be cured, but it can be prevented, therefore, osteoporosis awareness should be increased and prevention should

be stressed, targeting the age group of 12 to 25. College students fit into this age category and are at a time of growth when their habits are still being formed.

Further work needs to be done to create curriculum for osteoporosis prevention education programs that target the 12 to 25 year old age group. Current research implies that interactive methods of education are often the most effective such as CD-ROMS (47, 48). In addition, on-line tools such as the USDA's Interactive Healthy Eating Index can help college students make more healthful choices (13). When it comes to osteoporosis prevention and college students, the motto should be "seize the day" for tomorrow it may be too late.

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Appendix A

Health Survey

Please circle your answers to the following questions

About You

1. I am a: Freshman Sophomore Junior Senior
2. I am a: Male Female
3. I am: Caucasian, African American, Asian, Hispanic, other
4. I am: a smoker a non-smoker

Nutrition/Exercise

5. How many 8oz cups of milk do you drink?	none	1/day	2/day	3/day	4 or more
6. How many 1/2 c. (cooked) servings of deep-green vegetables do you eat?	none	1/day	3x/week	1x/week	
Ex. Broccoli, dark-green lettuce, collard greens, spinach, etc					
7. How many 1oz (1 slice) servings of cheese do you eat?	none	1/day	3x/week	1x/week	
8. How many 1 c. servings of yogurt do you eat?	none	1/day	3x/week	1x/week	
9. How many 1/2 c. servings of ice cream or frozen yogurt do you eat?	none	1/day	3x/week	1x/week	
10. How many servings of calcium-fortified foods do you eat?	none	1/day	3x/week	1x/week	
Ex. Cereals, orange juice, cottage cheese, breakfast bars	none	1/day	3x/week	1x/week	
11. How many alcoholic beverages do you drink on a regular basis?	none	1/day	3x/week	1x/week	
12. Do you take a multivitamin supplement regularly?	yes	no			
13a. Do you take a calcium supplement regularly?	yes	no			
13b. If yes, what supplement?_____					
13c. If yes, how many tablets do you take?	2/day	1/day	3x/week	1x/week	
14. **Excluding** elliptical machines, swimming, and bicycling, how many times per week do you participate in weight-bearing exercise?	never	1--2	3--4	5 or more	

Your Opinion

15. Do you feel it is important to daily drink milk or include other calcium-rich food in your diet?	yes	no			
16a. Do you feel you are getting adequate amounts of calcium?	yes	no			
16b. If no, why not?_____					
17. Do you feel it is important to regularly (2-3x/wk) participate in weight-bearing exercise?	yes	no			
18. If you do not exercise regularly, why not?_____					
19. Are you familiar with osteoporosis (its cause, its affects, risk factors)?	yes	no			
20. What age group do you think is at peak bone mass?	1-10	11-20	20-30	30-40	above 40
21. What age group do you think osteoporosis prevention should target?	1-10	11-20	20-30	30-40	above 40
22a. Have you ever received osteoporosis prevention information or education?	yes	no			
22b. If yes, what form?_____					

Appendix B

Article Thanking Local Businesses

Local Businesses Support OBU Research

It has always been a challenge to get busy college students to take several moments from their hectic days and fill-out a survey. However, without a large campus sample, any research project's validity is called into question. This was the problem that faced me as August rolled around, and I began to contemplate the two separate surveys I needed to conduct during the fall semester. Not only did I need to conduct a general wellness survey of OBU seniors and freshmen for a research class, I also needed to collect data from HSU and OBU for my senior honors thesis project on osteoporosis prevention. Fortunately for me and many other students on campus, Arkadelphia businesses are full of generosity. Someone in my research group came up with the idea of contacting local businesses to ask if they would be willing to donate incentives for students to fill-out our surveys. Western Sizzlin', Sonic, and Subway agreed to donate free food certificates for our project. Students who completed a survey were then eligible for the free food drawing. This method worked so well that I decided to use it for my senior thesis project. Once again, local businesses gave generously. This time Taco Tico, Mazzio's Pizza, and Brookshire's gave free food certificates. In addition, Maurices donated 200 20% off coupons. I know for a fact that Arkadelphia businesses are constantly being bombarded with requests for free food and gifts by various clubs and organizations. I am so thankful that our local businesses give so generously to our community. Remember to support our local businesses because they support us.

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