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Adolescent Knowledge About the Relationship Between Exercise and Prevention of Osteoporosis

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ADOLESCENT KNOWLEDGE ABOUT THE RELATIONSHIP BETWEEN EXERCISE AND PREVENTION OF OSTEOPOROSIS

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ABSTRACT

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The purpose of this study was to assess the impact of an educational intervention on adolescent knowledge concerning exercise as an osteoporosis preventive behavior. This study examined whether there was a knowledge gain in each group (girls and boys) after receiving the education intervention and it investigated the difference in knowledge gain between groups.

This was a secondary analysis of data from a study that used a pre-experimental pretest-posttest, no control group design. There were 82 boys and 102 girls who completed the Healthy Bones Knowledge Questionnaire as a pretest, received an education intervention based primarily on nutrition, then completed the questionnaire again as a posttest. This study examined the knowledge gain on the exercise items only.

There was no significant knowledge gain about exercise as an osteoporosis preventive behavior, within either the girls or boys group. In addition, there was no significant difference in knowledge gain between groups.

Dedication

To my mother, Nancy, who has always believed I could do anything and then fully supported me when I choose to accept a new challenge. Our monthly adventures will soon be back!

To my husband, Ken, who willingly tolerates, and even encourages, my constant pursuit of education. Your emotional and financial support are luxuries that are greatly appreciated.

To my children, Ken, Kristen, and Kathi, who enthusiastically cheer me on and have to fend for themselves more often. As you work to achieve your goals in life, I also will be there for you.

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CHAPTER ONE

INTRODUCTION

Osteoporosis is the most common skeletal disorder in the world and is a major public health problem among the elderly (Barrett-Connor, 1995). This is a metabolic bone disorder characterized by a gradual reduction in bone, which leads to diminished physical strength of the skeleton and an increased susceptibility to fracture (Riis, 1996). The disease affects more than 25 million people in the United States and accounts for more than 1.5 million fractures each year (National Institutes of Health, 1994). Although osteoporosis can affect either sex, 80% of Americans affected are women (Galsworthy & Wilson, 1996). It is now predicted that one out of two women and one out of five men will suffer an osteoporosis related fracture at some time in their lives (Renfro & Brown, 1998). This is a disease costing the United States more than $10 billion a year for diagnosis, treatment and rehabilitation (Drugay, 1997).

Osteoporosis is often called a silent disease because it may be present without symptoms (Drugay, 1997). The first visible clinical manifestation is often a fracture of the hip or spine. More than 270,000 hip fractures occur each year and one in four of those patients die within a year of the injury (Vuori, 1996). Given the increasing proportion of the elderly population, the disease is expected to increase dramatically in the next 50 years, predicting fracture rates at 650,000 by the year 2050 (Barrett-Conner, 1995).Yet,

most women and many health providers do not know enough about it or accept it as a normal consequence of the aging process.

Bone is a dynamic tissue that undergoes a lifelong process called remodeling. This is a delicate balance between the activities of bone-forming by cells called osteoblasts and by bone-eroding cells called osteoclasts (Drugay, 1997). During bodily growth, the rate of bone mass formation exceeds resorption until peak bone mass is reached, after which the rate of degradation is faster than absorption (Ausenhus, 1988). In women, bone loss before menopause is low and parallels that of men, however, bone loss accelerates after menopause averaging 2% per year over the next 5-10 years (Riis, 1996). This accelerated postmenopausal bone loss and the relatively lower peak bone mass in women explain why osteoporosis is much more common in women than in men.

A considerable amount of the osteoporosis research has focused on the management and treatment of bone loss in later life. At present there is no satisfactory way to replace lost bone and treatment of osteoporosis is difficult once the disease is established (Kessenich, 1997). More recently, a limited amount of research has been directed toward the prevention of osteoporosis during the adolescent and young adult years (Ausenhus, 1988; Bailey & Martin, 1994; Kasper, et al., 1994). Bone mass is accumulated in the early part of life with bone stores developing and bone mineral density increasing until approximately age 30 when peak bone mass is attained (Drugay, 1997). However, most of the bone mass is accumulated by late adolescence, on average at about 18 years for American females (Matkovic et al. 1994). Research has shown that peak bone mass at skeletal maturity may be the single most important factor in the development of osteoporosis (Mikhail, 1992).

Small changes in peak bone mass could make large differences in fracture risk (Riis, 1996). This implies that osteoporosis is a pediatric disease with geriatric consequences and that interventions aimed at children could result in improved skeletal health throughout life.

Several risk factors have been identified as increasing an individual's risk of developing osteoporosis. Some of these factors cannot be altered, such as sex and race, however, 20-50% of the variation of bone density is left to be explained by modifiable factors (Vuori, 1996). A modifiable factor that will be explored is exercise.

Exercise plays an important role in encouraging bone formation. Heaney (1996) states that even a high calcium intake will not counteract the effects of physical inactivity. Regular weight-bearing exercise is an essential stimulus to increase bone mass at an early age and to maintain it later in life (Matkovic et al., 1994; Mikhail, 1992). Exercise involving weight-bearing has been shown to both decrease bone loss and increase bone mass (Mikhail, 1992, Recker et al., 1992). If regular intensive effort is expended in a physical activity, it can maintain normal bones as sufficiently strong bones until very old age (Recker et al., 1992, Vuori, 1996).

During adolescent and young adult years most people are fairly active, however some choose not to be involved in physical activities and lead a sedentary lifestyle. Physical activity declines almost 50% during adolescence, with females becoming increasingly more sedentary than males (Garcia et al., 1995). Examples of weight-bearing activities include walking, running, jumping rope, aerobic exercises, weight-lifting, racquetball, tennis, handball, basketball, and volleyball. To be effective in building bone mass, the activity needs to be sustained for periods of 20 minutes or longer and performed

three or more times a week (Mikhail, 1992). Kasper et al. (1994) found that only 40% of the 114 women they surveyed reported getting adequate exercise per week. Sedlak & Doheny (1998) reported that 45% of 233 college students were not getting adequate exercise, however, 42% of them did not perceive themselves as being at risk for developing osteoporosis. While emphasis has been placed on the role of exercise in the prevention of heart disease, not enough young people have been informed of the importance it plays in the prevention of osteoporosis.

In a recent study (Sedlak, Doheny, & Jones, 1998) young college women who participated in an osteoporosis education program significantly increased their knowledge about osteoporosis. A major component of prevention is education, yet few researchers have evaluated what adolescents know about osteoporosis, their beliefs about the disease, and to what extent they practice preventive behaviors such as regular exercise. This study will build on the limited number of studies (Kasper et al., 1994; Recker et al, 1992; Sedlak et al, 1998; Taggart & Connor, 1995) about osteoporosis and knowledge. It is of concern that many adolescents are not aware of osteoporosis risk factors and may not engage in exercise activities. Knowledge influences behavior patterns developed in late childhood and adolescence and carries over into adulthood. Promoting positive health values and attitudes in adolescence is more likely to lead to a healthier adulthood (Sedlak, et al., 1998).

<u>Purpose of Study</u>

The purpose of this study is to assess the impact of an osteoporosis education intervention based on the Health Belief Model (Rosenstock, 1966) on knowledge of appropriate preventive physical activity. The information obtained from this study will be

important in assisting health care professionals in further developing educational programs for this age group.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Literature Review

The majority of osteoporosis research findings have been about postmenopausal or perimenopausal women, with few studies on prevention research for adolescents and young women. The literature review for this study is divided into three categories: 1) osteoporosis research in adolescents or young adults, 2) exercise research in adolescents, and 3) health education in adolescents.

Osteoporosis research in adolescents or young adults.

The literature pertaining to osteoporosis indicates that primary prevention entails maximizing peak bone mass and secondary prevention consists of preserving premenopausal bone mass. Several lifestyle factors may prevent or promote osteoporosis including physical activity, calcium intake, body weight, smoking and alcohol consumption. Some of the articles reviewed report results on more than one lifestyle factor, however, this review focuses on the evidence relating to physical activity and the participants' knowledge related to prevention of osteoporosis.

Recker et al. (1992) conducted research designed to explore whether bone mass continues to increase in healthy, nonpregnant white women during the young adult years following cessation of linear growth. This longitudinal prospective study of 156 college aged women for up to 5 years examined whether various self-chosen levels of physical

activity and nutrient intake or use of oral contraceptive might influence an increase in bone mass. The results showed that the rate of gain in bone density of the spine was positively correlated with physical activity and calcium intake ($r = .31$, $p = .01$). The authors concluded that changes in life-style involving relatively modest increases in physical activity and calcium intake may significantly reduce the risk of osteoporosis late in life.

Lysen and Walker (1997) indicate that adolescents are indeed at risk for osteoporosis and that this is an appropriate population to target for osteoporosis preventive education. The investigators compared gender differences in non-modifiable and modifiable osteoporosis risk factors in a group of 138 junior high student/parent pairs. Calcium intake, physical activity, sodium intake, body mass index and alcohol consumption were the modifiable risk factors identified in this study. Non-modifiable risk factors were gender, ethnic heritage, and family history. Both the parent and the student completed personal health history and demographic information regarding the student. Results indicated that many adolescents had several risk factors for osteoporosis. Approximately 10% of the sample had six or more risk factors; 26% had three or fewer. Of the sample, 86.7% of males and 73.2% of females indicated an adequate level of physical activity of three or more times per week for a minimum of 30 minutes. When gender was compared to each risk factor, significant differences were found for three of the risk factors. Males had significantly higher calcium intakes than females. This result was evident for both levels of calcium intake that were measured, at 1,200 mg ($p = .043$) and at 1,500 mg ($p =.023$). Males also had a significantly higher sodium intake than females ($p = .029$) with a reversed health benefit to their calcium intake. Body mass index

was the third area of significant gender difference. More males had low body weight for height than did females (p = .034). The authors concluded that the presence of many osteoporosis risk factors in adolescents emphasizes the need for bone health-related curricula and educational materials to be developed to address the needs of this population.

Sedlak and Doheny (1996) identified the prevalence of risk factors for osteoporosis and the need for more prevention education in a sample of 233 college women. The authors found that many young women do not participate in weight-bearing exercises or meet daily dietary calcium recommendations. Only 12% of the participants had an adequate calcium intake and 45% of the participants did not engage in weight-bearing exercise activities needed to facilitate promotion of peak bone mass. Despite these behaviors, 42% perceived themselves as not being at risk for developing osteoporosis.

Research regarding the participant's knowledge about osteoporosis prevention also supports the increased educational needs of this population. Sedlak, Doheny and Jones (1998) found that an osteoporosis program was effective in increasing awareness of osteoporosis prevention in women aged 18-26. The study assessed whether young women who participate in an osteoporosis prevention program based on the HBM (Rosenstock, 1966) and Self-Efficacy Models (Bandura, 1977) demonstrated higher levels of knowledge regarding osteoporosis prevention than young women who did not participate in the program. Thirty-one young college women were randomly assigned to an experimental group to receive an osteoporosis prevention program or to a control group. Subjects in both groups completed the Osteoporosis Knowledge Test, the Osteoporosis

Health Belief Scale, and the Osteoporosis Self-Efficacy Scale (Kim et al., 1991) two separate times; the experimental group received an osteoporosis prevention program before the second testing. The authors found that subjects in the experimental group had significantly higher knowledge ($p < .001$) and health belief scores ($p < .001$) after receiving the intervention while subjects in the control group had no change in scores. Limitations to this study include a high attrition rate without the researchers understanding as to any systematic pattern. Also, the fact that all the subjects had previously participated in a study on osteoporosis risk factors may have had an impact on their knowledge and attitudes toward osteoporosis.

Ailinger and Emerson (1998) conducted a descriptive study that examined womens' knowledge of osteoporosis risk factors and preventative behavior. This study included 247 women, ranged in age from 22 to 84 years, with an average age of 46. The subjects were recruited from various work sites, primary health care settings, and a health fair. The women completed The Facts on Osteoporosis Quiz (FOOQ) and a demographic sheet, some as a group (in the work site settings) and some individually (health fair and primary health care settings). The findings indicated that the majority of women had inadequate knowledge about osteoporosis and preventive behavior. The median score on the FOOQ was 16 out of a possible 25 (SD = 4.87; range = 1 to 25). This means that only half of the women responded correctly to 64% of the questions. The lowest number of correct responses were to items on risk factors of calcium need in young women, alcohol and high caffeine intake, populations at risk, and the availability of treatment. There was no correlation between years of education and scores on the knowledge test. The results revealed a significant difference between those who reported receiving previous

information on osteoporosis and those who did not (p = .000). The authors conclude that the message about this crippling disease is not getting to women and that education about osteoporosis was clearly indicated. The investigators suggest that further research on osteoporosis knowledge among younger women is imperative.

Taggart and Connor (1995) used the Health Belief Model to study the relationship of exercise habits of 113 female college students to their knowledge about osteoporosis and their health beliefs. This was a descriptive, correlational study using a convenience sample of 113 students with a mean age of 27 years. The Osteoporosis Health Belief Model Scale and the Osteoporosis Knowledge Test (Kim et al., 1991) were administered. The frequency and type of exercise were self-reported. There were no statistically significant relationships between frequency of exercise and either osteoporosis knowledge or health beliefs. However, students who were the most knowledgeable about osteoporosis were also most aware of the benefits of exercise (r = .25, p = .01). The younger participants exercised more often, however, they indicated that they did so for reasons such as increased muscle strength, weight control, improved appearance, and enhanced cardiovascular function, not for osteoporosis prevention. There was also a significant relationship between age and knowledge scores (r = .19, p = .04) and age and barriers to exercise (r =.94, p = .001). The older students were more knowledgeable. The authors speculated that this may be because they had read more about osteoporosis. The older participants believed that the barriers to exercise of lack of social support, difficulty in starting a new habit, and interference with routine were greater than the benefits of the exercise. The authors concluded that this strong relationship between age and perception of barriers to exercise indicates that exercise programs should begin early in life. A

limitation to the study is that participants were students enrolled in a basic health course. This may mean that the sample had a greater interest in health than the general public. Also exercise participation was self reported which may threaten the validity of the responses.

Another group of researchers (Kasper, et al., 1994) assessed college women's knowledge of osteoporosis, their beliefs about the disease, and to what extent they practice preventive behaviors. The researchers used a research design of a cross-sectional survey of 127 college women. The women were asked how much information about osteoporosis they had received and where they had received that information. Knowledge of risk factors was assessed by having the subjects categorize 13 common risk factors. Only 24% of the participants identified all four risk factors of low calcium intake, lack of physical activity, early menopause, and postmenopause. However, there was a significant relationship between receiving osteoporosis information and the ability to correctly identify risk factors ($p < .006$). The subjects believed that it was unlikely they would develop osteoporosis and that osteoporosis is less serious than other common causes of morbidity and morality in women. The majority of respondents listed television as a source of osteoporosis information (79.9%), followed by magazines (67.6%). Only 43% of the 114 women who had heard about osteoporosis had received information from a school or a teacher even though the subjects were all high school graduates currently enrolled in college. In addition, 57% had seen a physician for oral contraceptive use, yet only 43% listed receiving information from a clinic, doctor's office or health service. The authors suggest that health care providers and educational institutions have not taken the initiative to educate young women about osteoporosis or such information has not been

received and retained. One limitation of this study is that the subjects were volunteers enrolled in a health course at one state university.

One study (Edwards, 1998) assessed the current level of nutrition, exercise habits and knowledge about bone health in 180 girls who were 11 to 16 years old. Then in a combined community and school effort, a multi-disciplinary team designed a health promotion campaign to maximize peak bone mass in the girls of the community who were 11 to 16 years old. In the first phase, a questionnaire was sent to 256 girls from a higher socioeconomic group that were registered with one general practitioner, 180 responses were usable. The results of the questionnaire indicated that 20% did not eat breakfast, 43% had a daily intake of a quarter pint of milk or less, and only 53% of girls exercised daily. The study results also showed that school was the main source of nutritional information followed by parents. In phase two, a health promotion campaign was started that would included a much larger audience than those that responded to the questionnaire. The campaign included awareness of the project in the newspaper, leaflets designed by a dietitian on calcium-rich foods distributed to target schools and information packs relating to osteoporosis and healthy eating supplied by the health promotion department and advertised in the physician offices. Poster displays advertised the project and teachers were supported by the school nurses with material.

One year after the campaign started a modified questionnaire was sent to 102 of the respondents of the first questionnaire to assess the impact of the health promotion campaign. Only 54% reported having received some information concerning healthy eating and strong bones. Girls reduced their consumption of dairy products but there was a slight increase in exercise levels (from 53% to 59% did daily exercise) during the year

following the campaign. Self reporting is a limitation of the study that may reflect on the reliability of information reported and limit the validity of the study. The author noted that diet and lifestyle changes may be gradual and improvement may be noted in further study. It was concluded that knowledge of nutrition does not influence eating habits and suggested that health professionals and school teachers continue to promote positive health behaviors that promote peak bone mass.

In a study to predict osteoporosis-prevention behaviors, Ali (1996) used Pender's Health Promotion Model as a theoretical framework. The sample included 233 college women from a Midwestern university enrolled in non-health-related classes. The predictor variables were perceptions of benefits/barriers to calcium intake and to exercise participation, self-efficacy, control of health, importance of health, body image, knowledge of healthy behaviors, skipping meals, perceptions of current body weight, happiness with current body weight, demographics, and lifestyle characteristics. The data pertaining to calcium intake and exercise participation was assessed by self-report. The age range for the sample was 17-42 with a mean of 20.68 years; the majority of the sample were Caucasian and single.

Using stepwise multiple regression six independent variables were used to predict total calcium intake and four independent variables to predict exercise behaviors. The results were that perceptions of barriers to calcium intake, skipping meals, and knowledge of health behaviors together explained 36% of the variance of total calcium intake. Perceptions of internal control of health and barriers to exercise participation together explained 8% of the variance of exercise behaviors. In auxiliary findings, there was a significant difference ($p = < .01$) between single and married women in exercise

behaviors. Single women had a mean exercise time of 245 minutes per week, whereas married women had a mean of 151 minutes per week. The author concluded that the HPM variables were able to contribute significantly to explaining the difference on the criterion measures of osteoporosis prevention. Participants in this study tended to exercise more than the recommended 30-60 minutes three days a week. However their reasons for exercise were more related to burning calories, losing weight, or maintaining weight. The women were aware of the benefits of exercise for increased feelings of well being, maintaining weight, losing weight and reducing stress, however, none of the participants knew that exercise strengthens bones, prevents brittle bones, or increase peak bone mass.

The author points out that one contributing factor to lack of knowledge may be that the media tend to disperse information about the general benefits of exercise to targeted age groups. Exercise benefits in relation to osteoporosis prevention is typically directed to postmenopausal and elderly women. The author concluded that health education about exercise for young women should include information about the beneficial effects of weight bearing exercises and prevention of osteoporosis as women age.

In summary, few studies that have examined the knowledge of adolescents concerning osteoporosis prevention. The limited studies of young adults and osteoporosis knowledge have all implicated a low knowledge level (Ailinger & Emerson, 1998; Kasper et al., 1994; and Taggart & Conner, 1995). Because there are many adolescents with modifiable risk factors (Lysen and Walker, 1997) and because exercise, along with other health behaviors, increases bone mass (Recker et al., 1992) there is a need for

promoting preventive osteoporosis information. Only one study (Sedlak et al., 1998) tested the efficacy of an educational intervention. The findings demonstrated an increase in knowledge after an osteoporosis prevention program. This study will be the first to provide data regarding the effectiveness of incidental knowledge gain from an osteoporosis educational program in a group of adolescents.

Exercise Research in Adolescents

To get a better idea of typical adolescent exercise behavior it is important to review exercise research in the target population. Several studies have addressed the adolescent's perceptions, attitudes and beliefs about exercise. Garcia et al. (1995) examined gender and developmental differences in exercise beliefs and behaviors of 286 fifth, sixth, and eight grade students. Using Pender's Health Promotion Model, the study looks at three domains of influence on exercise: general background factors, health-related factors, and behavior-specific factors. The participants completed the Child/Adolescent Exercise Log for seven consecutive days, the Rosenberg Self-Esteem Scale, the Health Perceptions Questionnaire, the Children's Self-Efficacy Survey, the Children's Perceived Benefits/Barriers to Exercise Questionnaire, and the Social Support for Exercise Survey. The authors found that females reported less prior and current exercise ($p = .001$) compared to males. Females also reported significantly lower self-esteem ($p = .001$), poorer health status ($p = .0012$), and lower exercise self-schema ($p = .001$). Adolescents reported significantly less social support for exercise ($p = .01$), and fewer exercise role models ($p = .001$) than the pre-adolescents. Adolescent girls were less likely than the fifth/sixth grade girls to believe that the benefits of exercise outweighed the barriers to exercise, whereas the boys reported the opposite. The authors concluded

that the findings highlight girls as a high-risk group for inactivity and recommend exercise promotion counseling and exercise programs for pre-adolescents and adolescents. There were some limitations to this study. Several of the instruments were developed for this study and may prove to lack reliability and/or validity. The convenience sample of children and lack of opportunity to measure the effect of pubertal status on exercise were also limitations.

Birtwistle and Brodie (1991) conducted research that focused on the factors that might influence children's attitudes towards physical activity. A random sample of secondary (grades 7-11) and primary (grades 1-6) schools in the United Kingdom provided 291 secondary students and 315 primary students for this study. The sample consisted of a near equal number of boys and girls. To measure the children's perception of physical education (PE), they were asked to rank their school subjects in order of perceived importance. In addition, the children were asked open ended questions classified into categories of fitness, enjoyment, recreation, sports and other. A closed ended question that specified nine objectives, to be ranked in order of importance, followed the open ended questions. The children's attitudes towards physical activity was measured with the Children's Attitudes Towards Physical Activity (CATPA) inventory using total scores and the subdomain totals. Only the results of the secondary grades will be reported.

The authors found that when ranking subjects in order of perceived importance, PE was placed third when first choices only were considered. The open ended questionnaire items remained the same regardless of gender, socioeconomic status or as a total. Fitness was ranked as the first choice most often and was the objective cited by

nearly 75% of the respondents. When ranking the nine objectives, 42% of first choices were 'to become fit' followed by 36% that choose 'to learn why exercise is beneficial' as their first choice. Again, the same rank order was maintained when broken down by gender and socioeconomic status. There were significant differences between boys' and girls' CATPA subdomain scores in the social growth subdomain ($p = .01$) and the aesthetic subdomain ($p = .0005$) with girls' scores more positive in both. The authors conclude that both primary boys and girls perceive PE to be important for fitness and were aware of the need to learn about how to exercise to achieve and maintain fitness. They believe their research has shown that children do associate fitness with exercise, and fitness and exercise with PE. If school based PE is to be successful in promoting lifestyle changes, then it must be perceived by the students to be important and relevant.

Other exercise research examined and compared the perceptions and beliefs of specific populations. Desmond, Price, Lock, Smith and Stewart (1990) examined perceptions of exercise in 257 urban, inner-city, low socioeconomic black and white adolescents. The participants completed the modified Harvard Step Test and a 70-item questionnaire based on the HBM. The investigators then examined the actual fitness status by recording the subjects' pulse one minute after an exercise activity ended. The Physical Efficiency Index was used to classify the subjects' physical condition as good, average, or poor. The results in fitness status revealed that females were more likely than males to be in poor physical condition ($p = .001$) and that black students were more successful at self-classification than white students. There was a significant relationship between reported exercise practices and physical fitness status for black students ($p = .0001$) but not for the white students. White students were significantly more

knowledgeable than black students on the exercise knowledge subscale, however, there were no other differences on any other HBM subscales when comparing race. When comparing those in good physical condition versus poor physical condition, significant differences were found on all subscales except perceived benefits. Based on their findings, the authors suggest the use of different strategies for attempts to encourage physical activity and exercise in black and white adolescents. In addition, providing increased motivation to become an exerciser would likely increase the frequency of exercise among this population.

Bonheur and Young (1991) examined differences between 57 exercisers and 48 nonexercisers in self-esteem, perceived benefits of exercise and perceived barriers to exercise. Self Esteem and The Health Promotion Model provided the frameworks for this exploratory study. College students were assigned to the exerciser group if they reported exercising at least three times per week for at least 20 minutes at moderate intensity, students not meeting those criteria were put into the nonexerciser group. Both groups completed the Borg Scale, the Exercise Benefits/Barriers Scale, and the Coopersmith Self Esteem Inventory. Results showed that exercisers had a significantly higher self-esteem score ($p = .01$), higher perceived benefits of regular exercise score ($p = .01$), and lower perceived barriers of regular exercise score ($p = .01$) than nonexercisers. Small sample size and nonrandom selection are limitations to this study.

The Health Belief Model was used by O'Connell, Price, Roberts, Jurs, and McKinley (1985) to determine which of the model's variables predict dieting and exercising behavior of obese and non-obese adolescents. This study examined knowledge about obesity as well as knowledge about the proper means of losing weight by dieting

and exercising. An elicitation questionnaire was used to determine salient beliefs about dieting, exercising, and obesity for each of the major components of the HBM. The Health Belief Model questionnaire, developed from the elicited salient beliefs, contained items employed to measure attitudes towards obesity and exercise, knowledge of obesity and exercise, weight locus of control, and beliefs and evaluations about obesity and exercise. High school freshmen and sophomores were classified as obese or non-obese based on tricep skinfold measurements. Of the 341 students classified, 39 females and 30 males were obese; 50 males and 50 females were randomly selected from the remaining 272 students to constitute the non-obese sample. The results regarding exercise only are given.

Using discriminate analysis, present exercising behavior was able to correctly classify 75% of both the exercising and nonexercising obese adolescents and 77% of the exercising non-obese adolescents. The significant variables in predicting exercising behavior of obese adolescents included cues to exercising and social approval for dieting. Cues to exercising included the external cue of peer pressure and the internal cues of poor health and poor muscle tone. There were no significant model variables in regard to exercising behavior of the non-obese adolescents. The authors conclude that utilization of the HBM in predicting dieting and exercising behavior of obese and non-obese adolescents is limited. Although no variables were significant in predicting exercising behavior of the non-obese adolescents, weight control programs for obese adolescents should emphasize internal and external cues to exercising to encourage participation in aerobic exercise.

A longitudinal study over seven years evaluated the long term outcomes of the Minnesota Heart Health Program (MHHP) and the Class of 1989 Study. Kelder, Perry and Klepp (1993) used the data set from these two studies to see if physical activity outcomes were greater in school age children who were exposed to both the Class of 1989 and MHHP interventions compared to children in a control group. The MHHP is a population-wide, community-based cardiovascular prevention program funded by the National Heart, Lung and Blood Institute over a 13 year period. A total of six cities in North Central United States were selected to participate in this study. Three were designated as communities that would receive a five year educational program encouraging health changes in eating habits, physical activity, smoking, and high blood pressure control; three similar cities served as reference communities. The Class of 1989 Study is an ancillary study of the MHHP that tested two of six MHHP communities. Beginning in sixth grade, seven annual measurements were taken from students in one of the MHHP intervention communities and its matched pair (N = 2,376). Self reported data were collected every April related to hours of exercise engaged in per week outside of class and duration and intensity of regular physical activity. Self reported measures may not adequately assess physical activity and are a limitation of this study.

Cohort data were analyzed to examine differences between communities on exercise variables for each year. There were no significant differences between schools at baseline (sixth grade), however there were significant differences by gender. Physical activity levels were significantly higher in the intervention community for females. Male averages were higher in the intervention group but were not statistically significant. The authors suggest the higher physical activity level of females from the intervention group

may mean they will have higher levels of activity as adults. In addition, they conclude that multiple education interventions, such as school based programs in combination with community led programs, can produce improvement in adolescent physical activity, particularly with female students.

In a later study, Kelder, Perry, Peters, Lytle and Klepp (1995) examined the gender differences in the Class of 1989 Study, the school component of the Minnesota Heart Health Program (MHHP). Students in the education community participated in MHHP-sponsored behavioral health education programs in school from sixth to twelfth grade. Beginning in 1983, seven annual measurements were taken from students in one of the MHHP intervention communities and its matched pair (baseline n = 2,376). The Slice of Life Program was implemented and focused on skills to improve eating and exercise patterns within the context of adolescents lives. Outcome evaluation for exercise included a self-reported hours of exercise per week outside of gym class. The students were also asked to rate the importance of various reasons for engaging in exercise on a scale of 1 (very important) to 5 (not very important).

In the results of this study, males reported significantly greater numbers of hours of exercise per week than females at all annual measurements ($p < .001$). However, there were no significant gender differences between intervention and control groups except in ninth grade ($p = .01$). Females in the intervention group reported significantly greater hours of exercise per week as compared with the females in the control group at all but the eleventh grade follow-up points. Males in the intervention group also reported exercising more frequently than the control group, but this was significant only when

they were in the seventh and eleventh grades. The authors conclude that females may be more receptive than boys to health education.

Limited research was found that related to adolescents' knowledge of exercise alone. However, there have been studies that included exercise knowledge as one of the variables studied. A survey about children's attitudes about food and physical activity was reported by Borra, Schwartz, Spain, & Natchipolsky (1995). The Gallup Organization conducted telephone interviews with a national sample of 410 children between the ages of 9 and 15, using a survey developed by The American Dietetic Association (ADA) and the International Food Information Council (IFIC) in cooperation with the President's Council on Physical Fitness and Sports. It was found that children recognize the value of physical activity. Although virtually all of the respondents agreed that regular physical activity is important for good health, the most important reason cited was because "it's fun" and "they enjoy it". Almost half (45%) of those surveyed said they were not physically fit, and 80% said they want to be more physically active. Schools and teachers were mentioned as sources of encouragement by 43% of children. Also, only 33% of the children surveyed reported taking physical education at school five days a week. The authors conclude that efforts must focus on getting daily physical education back into the school curriculum and that the program should include upbeat messages about physical activity.

Ferguson, Yesalis, Pomrehn, and Kirkpatrick (1989) used the Health Belief Model to investigate whether the variables of the model could be predictors of exercise intent and behavior in schoolchildren. Students in two rural communities were surveyed. A 45-question survey was given, by classroom teachers, to students in grade six through eight

(n = 603) during their physical education class. The six questions which assessed the subject's knowledge about exercise were developed from the health education curriculum used in one of the schools.

The authors found that students perceived exercise as beneficial (mean of 1.8, with 1.0 as most beneficial) and were knowledgeable about exercise (mean of 3.9, with 5.0 as most knowledgeable). However, of all the predictor variables analyzed, only knowledge about exercise failed to correlate significantly with either exercise intent or current exercise behavior. Perceived benefits of exercise, self-esteem, perceived athletic ability, attitudes about physical education, and belief in one's ability to maintain commitments all correlated significantly and positively with exercise intent. The authors concluded that physical education programs that explain benefits of exercise can influence exercise intent and enhance the student's sense of self-esteem. Early development of positive attitudes toward exercise may increase an individual's desire to maintain an active lifestyle throughout their lifetime.

The exercise research reviewed leads one to conclude that adolescent exercise behavior is dependent on a complex array of factors that influence individual beliefs and perceptions. Several studies had significant results indicating that perceived benefits of exercise has a positive correlation with increased exercise behavior or the intent to exercise (Bonheur & Young, 1991; Britwistle & Brodie, 1991; Ferguson et al., 1989; & Garcia et. al, 1995). While Ferguson et al. (1989) found that students were knowledgeable about exercise, Birtwhistle & Brodie found that girls were aware of the need to learn about how to exercise.

All but two of the studies reported significant gender differences with females being indicated as a high risk group for sedentary behavior. Generally, females exercised less than males (Garcia et al., 1995; Kelder et al., 1993 and 1995) and were more likely to be in poor physical condition (Garcia et al., 1995; and Desmond et al, 1990). However, Kelder et al. (1993, 1995) found that females had significantly higher activity levels than males after a health promotion intervention and Birtwistle & Brodie found that females had a significantly more positive attitude than boys about social and aesthetic benefits of exercise. This may indicate that females are more receptive than boys to health education.

Health Education in Adolescents

Learning health-promoting behaviors can empower older children and adolescents to assume responsibility for health promotion (Mickalide, 1986). School-based health education programs are one strategy for educating young people about health behaviors. No research articles were found investigating health education about osteoporosis with adolescents. However, there have been several studies regarding the effectiveness of an educational intervention for other health concerns.

MacDonald (1995) conducted a study to assess the influence of the Cardiovasuclar Health Education Program (CHEP) on adolescents' cardiovascular health knowledge. The CHEP provides a ready-to-use health educator guide that contains seven detailed modules with five educational sessions. The first and last modules are designed to administer the pretest and posttest. The main education strategies of the CHEP included lectures, peer group discussion, exercises, and games. Forty-four junior high school adolescents from two health education classes participated in the study. One class of 12 students was randomly assigned to the control group while the other class of 22

adolescents was assigned to the experimental group which would receive the CHEP. Pretest results indicated that the level of knowledge demonstrated by both groups was similar. There was a significant improvement in the experimental group's posttest cardiovascular health knowledge scores ($p = .01$). In comparison, the control group did not show a significant difference between pretest and posttest knowledge scores. The authors concluded that improved knowledge may help adolescents make informed decisions regarding their cardiovascular health now and in the future.

In 1999, MacDonald used the same design in a second study to assess the CHEP impact on rural and urban adolescents' health knowledge. A total of 146 eighth grade students participated, with 88 in the experimental group and 58 in the control group. The sample consisted of two health classes in a rural setting and four in the urban setting. The experimental group received CHEP and the control group received the regular health education curriculum.

In MacDonald's study, cardiovascular knowledge scores were similar between rural and urban residents at pretest. After the five health education classes, a posttest was administered which revealed a significant improvement in mean scores for the rural experimental group. The control group means did not change significantly. The urban experimental group did not have a significant improvement in their knowledge mean scores, therefore, the findings only partially supported the hypothesis that adolescents participating in the CHEP would have a significant improvement in knowledge scores compared to adolescents who did not participate. One of the limitations discussed is the possibility of variation in the training and expertise of the health educators who administered the education program. Another factor that may have contributed to the

difference between rural and urban knowledge gain is class size. In the urban setting the class size was 36, whereas, the rural class size was 22. A smaller class size could make it easier to implement experimental learning. The investigator concluded that school-based health education programs are one of the most appropriate strategies for educating young people about cardiovascular health.

Meagher and Mann (1990) studied the effect of an educational program on knowledge and attitudes about blood pressure as part of a cardiovascular health promotion. The sample included 369 seventh, eighth and ninth grade students in two urban cities in eastern Canada. This study used an experimental group and a control group in a randomized two group pretest, posttest and delayed posttest design. The experimental group received a 40 minute education session on blood pressure which was comprised of a 10 minute video presentation and discussion by the teacher. The control group received no health information on blood pressure during their health education class and took the pretest at the same time as the experimental group.

The program was effective in improving students' knowledge of blood pressure at one week posttest ($p < .004$); however, the improvement did not persist at the three month posttest. The difference in scores at three months between the experimental group and control group was not significant. The teachers who provided the educational intervention suggested that more than one 40-minute lesson be incorporated into the health curriculum. One limitation of the study was reliability of the instrument. Reliability of the test questionnaire was low at .42 which may reflect on its internal consistency. The authors point out that behavior change is less likely to occur without the appropriate

knowledge, and conclude that the educational program was a viable tool that could affect knowledge gain and be used as an effective and useful resource for teachers and students.

Munodawafa, Marty and Gwede (1995) investigated the effectiveness of health instruction provided by student nurses in rural Zimbabwe. A quasi-experimental, non-equivalent control group design was used and consisted of 141 adolescents in the intervention group and 144 in the control group. The curriculum included information on prevention of STDs, HIV/AIDS, and drugs. Twelve student nurses underwent training for 12 days over a period of six weeks covering implementation and instruction of the health education curriculum. Health knowledge significantly increased on the posttest in 24 of the 27 health knowledge items within the group that received health instruction, compared to a gain in two items reported in the control group ($p = .01$). Also, 70% of the pupils who received health instruction from student nurses gave a high approval rating of student nurses' performance. The authors concluded that health instruction by nurses was feasible in school classes and effective in raising health knowledge levels. The study is limited in its generalizability to students in developed countries; however, it lends to the review in that knowledge gain after an educational program crosses cultural and socioeconomic lines.

Some of the education research has also included outcomes in their variables. These studies not only looked at increases in knowledge and attitudes but assessed how those two variables affected behavior or physical responses. Once such study (Hern and Gates, 1998) evaluated the effects of an educational program on the participant's cholesterol, but did not assess gains in knowledge. Twenty-three high school biology students were recruited to participate in an educational program about cholesterol,

nutrition, and exercise and their total effects on cholesterol. The experimental group consisted of thirteen students who received the education intervention, the remaining ten students received no program intervention and served as the control group. The content of the education intervention was taught over a 20 to 30 minute period in three curricular sections. The total serum cholesterol levels were screened in all participants in January, May and October. Although not significant, seven students' cholesterol levels decreased at follow-up after receiving the education, and four students' levels dropped without their participating in the education. The authors conclude that an adolescent population of high school biology students can be receptive to education about their health behaviors. A small sample size and tools that use self-report methods are two limitations of this study.

Another study that assessed the effectiveness of a education program was conducted by Bredbenner, O'Connell, Shannon and Eddy (1984). The purpose of this study was to determine the effect of nutrition instruction on adolescent knowledge, attitudes, and dietary behaviors. The study included junior and senior health education classes taught by health educators from 11 secondary schools in Pennsylvania and Ohio. An experimental group and two control groups were within both the eight junior high classes and the six senior classes that were participants of the study. The experimental group was pretested, taught the nutrition curriculum, and posttested; the two control groups were not taught nutrition until after the study ended. One control group was pretested and posttested and the other control group was posttested only to assess the effect of pretesting on posttest scores. The pretest and posttest included a knowledge test, a food/nutrition attitude instrument, and a food frequency form.

Analysis from this study revealed that pretesting did not affect posttest scores and that the experimental group achieved significantly higher knowledge scores ($p < .001$) at both the junior high and senior high levels after the classes. The senior experimental group had significantly higher attitude posttest scores than the scores of control groups, however, there was little difference in the junior high experimental and control groups posttest scores. No consistent relationship existed between dietary behavior scores and either nutrition knowledge or attitude scores. It was concluded that Nutrition In a Changing World was an curriculum that improved the nutrition knowledge of junior high and senior high students. The investigators suggest that the knowledge gain and attitude improvement may impact the students behavior in the future when they had more control over their diet.

Marcus, Wheeler, Cullen and Crane (1987) examined the impact of the Know Your Body (KYB) program on schoolchildren's knowledge, beliefs and self-reported health behaviors. KYB was implemented in the Los Angeles and Santa Monica Unified School Districts. There was a total of 1,400 subjects, age 9 to 11, from 18 schools who were assigned to one of four comparison groups: (a) Know Your Body curriculum and health screening (n = 688); (b) Know Your Body health screening only (n = 333); (c) Know Your Body curriculum only (n = 253); and (d) the control group (n = 234). Homeroom teachers implemented the KYB curriculum in 13 schools; a public health nurse taught the curriculum at the other two intervention schools. The curriculum included self esteem development, clinical assessment description, principles of prevention, framework of health decisions, physical fitness and exercise, nutrition,

substance use, circulation, and respiration. For 18 weeks, a minimum of 45 minutes each week were spent on the KYB curriculum.

Three questionnaires, covering health knowledge, health beliefs, and self-reported health behaviors, were administered as a pretest and again as a posttest. Using linear multiple regression, a significant relationship between treatment and control groups were found for each of the six knowledge tests. The KYB curriculum only group scored higher than the control group on knowledge of cardiovascular health ($p < .001$), physical fitness ($p < .001$), first aid ($p < .01$), smoking ($p < .001$), and nutrition ($p < .01$). The curriculum and screening group scored higher than the control group on cardiovascular health, physical fitness, first-aid, and preventive health behavior. The screening only group did not score higher than the control group on any of the knowledge indices. In addition, no significant gender differences were found for any of the knowledge categories. The results of the self-reported health behavior questionnaire showed no differences between any of the groups in self-reported behaviors pertaining to nutrition habits. There was a modest difference ($p < .05$) in self-reports of aerobic exercise between the curriculum and screening group and the control group. This was not replicated in the curriculum only group. Also, girls were less likely than boys ($p < .001$) to report aerobic exercise. The authors conclude that the KYB curriculum had a significant effect on health knowledge. The limitations of the study include a high attrition rate and the lack of project resources to supervise closely and reinforce teacher adherence to the KYB curriculum.

The Know Your Body curriculum was also studied in New York's inner-city with students from grades 1-4. A total of 1,209 students were tracked for 2-1/2 years through grades 3-6. Three New York elementary schools received the KYB program, a fourth

served as a comparison school. One equivalent elementary school in Texas served as another comparison school. The comparison schools (n = 3,045) received a posttest only. Teachers were asked to utilize the KYB curriculum as least once a week for 30-45 minutes during the entire school year. The program was implemented for 2-1/2 years. In addition, school-wide activities were facilitated by the one full-time project coordinator for all three schools. These activities included peer leader training, student health committees, food tasting parties, poster and essay contests, student aerobics, and special health lectures. Physical measurements included total cholesterol, height, weight and body mass index, and blood pressure.

Health knowledge was assessed with separate age-appropriate instruments for grades 1-2, grade 3, and grades 4-6. In grades 4-6 only, health attitude and self-efficacy scales were also administered. The results for the three year longitudinal cohort showed a significantly ($p < .05$) lower total cholesterol and systolic blood pressure values than the comparison group. Unexpected by the authors, the mean health knowledge was significantly higher in the comparison group than in all the intervention groups combined ($F = 9.1$; $p < .01$). One reason the authors give for a higher health knowledge in the comparison school is that only 12% of the intervention schools had what could be classified as high exposure to the KYB program. The authors state that the treatment schools' longitudinal cohort were not representative of the entire school population. The mean posttest health knowledge score of the treatment schools' longitudinal cohort was significantly ($p < .001$) lower than the mean of remaining students.

The impact of the Nutrition for Life (NFL) program was investigated by Devine, Olson and Frongillo, Jr. (1992). This study evaluated the impact of a school-based

nutrition teaching program on nutrition knowledge, attitudes, and self-reported behavior of seventh and eighth grade students. A total of 1,863 students in 103 randomly selected classes were tested. Classes were either a health class or a home and career skills class and they had a range of nutrition teaching time between 2 and 50 hours with a median of 10. Twenty six classes had no nutrition taught, 37 classes had nutrition taught but NFL was not used, and 35 classes had nutrition taught using NFL. In the classes that used NFL there were significantly higher nutrition knowledge and attitude scores when compared to classes that received no nutritional teaching. There were no significant differences in variables between the classes taught using NFL and classes using other teaching material. No significant differences were found in nutrition behaviors scores between any of the groups.

In summary, in all but one of the studies reviewed, participants showed a knowledge gain after they received some form of education about a health behavior. Although Resnicow et al. (1992) found that a health curriculum in grades 1-4 did not increase knowledge in grades 4-6, they felt there was a low implementation rate by the classroom teachers. However, several studies demonstrated an increase in knowledge after an educational intervention (Byrd-Bredbenner et al., 1984; Devine et al., 1992; Meagher, 1990; MacDonald, 1995 and 1999; and Munodawafa et al., 1995). In one, (Meagher, 1990) the researchers found that the increase in knowledge did not persist over time; however, the teachers strongly supported the program and suggested that repeated exposure would increase long term knowledge acquisition.

Summary and Implications for Study

While the osteoporosis research revealed the lack of knowledge about the preventive role of exercise in osteoporosis, the exercise research confirmed that a person's perception, beliefs, and attitudes could influence their exercise behavior or intent to exercise. Similarly, education research led one to believe that knowledge generally does increase with a health education intervention. In addition, exercise research literature is in agreement that females are particularly at risk because they exercise less than males and are in poorer physical condition. This study examined the gender differences in knowledge of osteoporosis and preventive physical activity. In this study, an educational intervention, based primarily on nutrition, included minimal amounts of exercise information. It is the first study to assess incidental knowledge gain about exercise as a preventive health behavior in adolescents.

The role of the nurse educator, in promoting healthy bones through physical activity, centers on strategies that influence positive beliefs and feelings about physical activity. This relies on communicating the seriousness of the disease and a person's susceptibility to osteoporosis in an effort to effect the behavior change of participating in appropriate osteoporosis preventive exercise. Nursing has historically assumed a major role in health education, often with the uneasy awareness that persons may not utilize the information. Although knowledge alone does not always change behavior, it is necessary if a person is to change their health patterns. Young people can only choose to participate in activities that promote healthy bones if they have the knowledge about what preventive activities include.

Conceptual Framework

Several models and theories have been developed to explain and predict human behavior. These models include a number of variables that are expected to influence behavior. Models based on cognitive-behavioral aspects and grounded in Social Cognitive Theory focus on knowledge and skill, beliefs, motivation and decision-making regarding what action to take. These models also assume that people have rational decision-making abilities. The Health Belief Model (HBM), developed in the 1950s by a group of social psychologists, is one such model and provided the conceptual framework for this study.

The basic components of the HBM are derived from a psychological and behavioral theory that hypothesizes that behavior depends mainly upon the value an individual places on a particular goal and the individual's estimate of the likelihood that a given action will achieve that goal (Kirscht, 1983). Translated into the context of health-related behavior, it depends on the individual's estimate of the threat of illness and of the likelihood of being able, through personal action, to reduce that threat. Health behaviors are more likely to occur if an individual believes in personal susceptibility to the condition and, at the same time, perceives that having the condition would have serious consequences. Originally the model included the key variables of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, demographic and sociopsychological variables, and cues to action; in 1988 self-efficacy was also added to increase its explanatory power (Rosenstock, 1990).

Perceived susceptibility is one's beliefs about personal vulnerability to a condition. In the case of a medically established illness, the dimension includes

acceptance of the diagnosis, personal estimates of re-susceptibility, and susceptibility to illness in general (Janz & Becker, 1984). Perceived severity is the belief concerning the seriousness of contracting an illness or leaving it untreated. It includes evaluation of medical, clinical, and social consequences such as death, disability, pain, and the effects on work life, family life and social relations (Janz & Becker, 1984). Rosenstock (1990) notes that it is useful to label the combination of susceptibility and severity as "perceived threat" (p. 43).

Perceived benefits are the person's beliefs regarding the effectiveness of the various actions available in reducing the disease threat, or the perceived benefits of taking health action. Perceived barriers are the potential negative aspects of a particular health action and may act as impediments to undertaking the recommended behavior. The individual weighs an action's effectiveness against perceptions that it may be expensive, dangerous, unpleasant, inconvenient, or time consuming (Janz & Becker, 1984). In a summary of results from a decade of research using the HBM, perceived barriers was the most powerful single predictor of the HBM dimensions across all studies, and perceived susceptibility was a stronger predictor than perceived benefits in preventive health behaviors. The combined levels of susceptibility and severity provide the energy or force to act, and the perception of benefits, fewer barriers, provide a preferred path of action (Rosenstock, 1990).

Demographic and sociopsychological variables and cues to action affect the individual's perception and thus indirectly influence health related behavior (Rosenstock, 1990). Demographic variables include age, race, sex, etc. Rosenstock (1990) specifically mentions the sociopsychological factor of educational attainment as having an indirect

effect on behavior by influencing all the other variables. Cues to action, on the other hand influence the perceived threat of the disease. These cues can be internal, such as symptoms, or external, such as advice from others (Janz & Becker, 1984).

The final variable in the HBM was included from Bandura's work on the concept of self-efficacy (Rosenstock, 1990). Self-efficacy is the conviction that one can successfully execute the behavior required to produce the outcome. A person must believe that the behavior will benefit their health and also that they are capable of performing the behavior effectively (Rosenstock, 1990).

The HBM provides a logical framework in exploring osteoporosis preventive health knowledge and includes variables which are amenable to nursing interventions. If significant gains in knowledge occur concerning osteoporosis prevention through exercise, nursing interventions can be tailored to alter beliefs and modify behavior. When applying the HBM (Janz & Becker, 1984) to exercise behavior in adolescents, the young person must be convinced that he/she is susceptible to osteoporosis and that it is a serious disease in order to motivate them to act. He/she must also perceive that the benefit of preventing osteoporosis outweighs the barriers to performing weight-bearing exercise regularly. Finally, he/she must believe that they are able to perform the exercises required for prevention of osteoporosis.

The use of the Health Belief Model in the adolescent population has been criticized for its lack of predictability in their intentions and behaviors. It does not incorporate peer group influence, emotional factors, or the cognitive level of adolescents which can impair the adolescent's ability to evaluate personal risks objectively (Hiltabiddle, 1996). The adolescent's preoccupation with the immediate consequences of

his or her actions hinders the rational decision-making skills on which this model is based (Brown et al., 1991). However, the HBM is useful in obtaining important information about knowledge and beliefs that can help guide health professionals in the development of educational programs. Adolescents do not perceive themselves as being at risk for osteoporosis because it is erroneously believed to be a disease which afflicts only older people (Portsmouth et al., 1994). However, one modifying factor that could change their perception is educational attainment. Health promotion campaigns need to focus on helping adolescents recognize their actual risk of osteoporosis.

In addition to knowledge about the disease itself, adolescents need to be given information about recent findings on the incidence of bone loss in young women and men along with the several reasons why young people may be at risk for osteoporosis. Smoking, consuming too much alcohol, taking an inadequate amount of calcium, or getting little or no weight bearing exercise increases the chances of developing osteoporosis. Since being a woman is a key risk factor, results of recent studies unique to adolescent girls also need to be shared. Things that should be shared include the information that females become increasingly more sedentary than males during adolescence, that the tendency to exclude high calcium foods from their diet to avoid gaining weight also puts them at risk, and that there is an increase in bone loss when using Depo-provera for birth control.

According to the HBM (Janz & Becker, 1984), knowledge through education would indirectly influence the likelihood of performing exercise by affecting the person's perception of their own susceptibility, the severity of the disease, and the perceived benefits of a regular exercise program. If adolescents believe they are vulnerable to

osteoporosis, and that it is a severe disease, it will provide the energy or force to act. If they believe the benefits of exercise outweigh the barriers of energy exertion, time needed to perform activity, and access to exercise facilities, they will chose exercise as one path of action to prevent osteoporosis.

Research Questions

The following questions were tested in this study:

(1) Is there a statistically significant increase in knowledge regarding osteoporosis prevention through exercise in both adolescent males and females after receiving an osteoporosis education intervention?

(2) Is there a difference between knowledge change scores in adolescent boys and adolescent girls after receiving an osteoporosis education intervention?

Definition of Terms

In this study the modifying factor investigated was educational attainment which is within the sociopsychological variables in the HBM. The variables that knowledge, through educational attainment, would directly affect include perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, and perceived threat, which have all been defined in the section on conceptual framework.

Knowledge: "The sum or range of what has been perceived, discovered, or learned" (American Heritage Dictionary, 1994).

Adolescent: Males and Females in grades 6 through 10.

Exercise: "any action, skill, or maneuver that causes muscle exertion and is performed repeatedly to develop or strengthen the body or any of its parts" (Anderson, Anderson & Glanze, 1998, p. 598).

Prevention: "any action directed to preventing illness and promoting health to eliminate the need for secondary or tertiary health care" (Anderson, Anderson & Glanze, 1998, p. 1320).

Health Education: "...providing instruction and learning experiences to facilitate voluntary adaptation of behavior conducive to health in individuals" (Anderson, Anderson & Glanze, 1998, p. 733).

Osteoporosis: "..a condition characterised by reduced amount of bone, which leads to diminished physical strength of the skeleton and an increased susceptibility to fracture" (Riis, 1996, p. 9).

CHAPTER THREE

METHODS

Research Design

This was a secondary analysis of data from a study that used a preexperimental pretest-posttest, no control group design to assess the impact of an educational intervention. The purpose of this study was to assess the impact of an educational intervention on adolescent knowledge about exercise and prevention of osteoporosis. Questionnaires were used to collect data from adolescent boys and girls in a small Midwestern charter school. The Healthy Bones Knowledge Questionnaire was administered to all participants before an education intervention and again after the intervention. The independent variable was the education intervention. The difference between pretest knowledge and posttest knowledge served as the dependent variable. The difference between female and male knowledge gain served as an additional dependent variable.

The data were collected only in the student's science classroom at the beginning of the period. Another way of maintaining external conditions was that a script was used for the educational intervention to ensure constancy of communication. Intrinsic factors were controlled using homogeneity. Homogeneity is when only subjects who are homogeneous, with respect to the variables, are included in the sample (Polit & Hungler,

1999). This study limited the subject pool to those in a specific age range because the subjects' age was considered an important variable in osteoporosis knowledge.

In this study, a secondary analysis was done on the exercise knowledge component from an investigation that included the additional components of calcium knowledge, risk factors and self reports on current diet and exercise activities. The original study was conducted in the Spring of 1999. The data from that study have not been analyzed yet. In this study, variables have been examined comparing the knowledge scores concerning exercise and osteoporosis before and after an educational intervention.

Sample and Setting

A convenience sample of 184 adolescents was used for this study. Data collection took place in a small public charter school in western Michigan. The sample subjects created a multiethnic group, however, they were primarily Caucasian. All students enrolled in sixth through eleventh grade participated in the study.

Instrument

This study used The Healthy Bones Knowledge Questionnaire to measure student knowledge regarding osteoporosis. The Osteoporosis Knowledge Test was developed by Kim et al. (1991) for the adult population. Using this instrument as a guide, a new research team at Grand Valley State University (Martin, Coviak, Mellen, Gendler, Kim, & Rodrigues-Fisher) developed the adolescent version with a lower reading level and other age appropriate changes.

Initial testing of the adolescent versions for females was begun in the Spring of 1998. All female students in a small charter school (grades 7-12; N = 100) took the HBKQ. Two weeks later, a retest was completed with 50 girls randomly selected from the

girls who originally took the test. Three groups of five to six girls each were selected, from the 50 subjects, to participate in focus groups immediately following the retest administration. This was done to further evaluate the clarity of the questions and directions on the HBKQ. No further modifications of the test were made from the original as a result of this procedure. The correlation between original test scores and retest scores yielded a test-retest stability coefficient of greater than .65; the reliability coefficient for internal consistency (KR 20) is .67.

The HBKQ was modified by making two gender-specific versions. The female version (Appendix A) is the original test as it was administered to the female population mentioned above. The male version (Appendix B) was developed to make the instrument more gender sensitive by excluding questions related to menstruation and adding male risk factors. Attached to the front of each version of the HBKQ was a demographic data page (Appendix C) that also served as an identification number to match student's pretest and posttest scores.

The HBKQ has two subscales: Calcium (items 1-17, items 25-33 on female version; 1-18, 27-35 on male version) and Exercise (items 1-24, female version; 1-26, male version). Items 1-17 (1-18 male version) are common to both the Calcium and Exercise subscales. This study examined the variables in the exercise subscale. The common items that reference nutrition activities were excluded. In the female version, the items that were examined are 1,2 5-16, and 18-24. The male version included items 1-3, 6-17, and 19-26. Items 1-17 (1-18 on male version) each have the same four choices (more likely, less likely, nothing to do with, and not sure). Correct answers were coded as 1, incorrect as 0. Items 18 through 24 (19-26 on male version) are multiple choice

questions, each with four possible answers; one answer is correct. Items are evaluated as right or wrong with a possible score of zero through 21 for the female version (zero to 23 for the male version). For analyses in this study, the percentages correct were calculated and used for statistical comparisons.

Procedure

Permission was obtained from Grand Valley State University Human Research Committee for the original study prior to collection of the data (Appendix D) and for the secondary analysis of this study prior to analysis of data (Appendix E). In addition, students in a small public charter school were recruited with permission from the school administration (Appendix F) and passive parental consent (Appendix G). Permission was obtained to use the instrument developed by investigators of the original study (Appendix H). The Healthy Bones Knowledge Questionnaire (HBKQ) was administered as a pretest and again as a posttest after an educational intervention. All students completed the HBKQ as a pretest measure of knowledge in March 1999. Administers of the test were six professors and five Master's Degree students from a local university. Two administers went into every science classroom, introduced themselves and requested the students take a paper and pencil test. Students were assured that the test would not be scored nor count toward their grade. To protect confidentiality, the students were instructed not to put their names on the instrument. Immediately after the pretest, an education intervention was administered by three doctoral prepared nurses and a dietitian who holds a master's degree. The intervention had a script (Appendix I) with prescribed content that included oral and interactive sessions about what osteoporosis is, how bones grow, and what helps them grow. The education primarily addressed nutrition, but did cover some content on

physical activity and exercise. The intervention ended with a game entitled "The Calcium is Right" that was patterned after the television game show "The Price is Right". In April of 1999 the same students completed the HBKQ again to measure any knowledge gain. The posttest was administered with the same procedure as the pretest.

CHAPTER FOUR

RESULTS

Eighty-two boys and 102 girls completed both the pretest and posttest. Each item on the test was assigned a numerical value for purposes of computer analysis. Analysis of the data collected was completed using the Statistical Package for the Social Sciences (SPSS). Data analysis was performed to describe the demographic characteristics of the sample and to answer the research questions. All pretest and posttest scores for both groups were compared to a normal histogram. The data fell within the normal curve, therefore, parametric tests were used. Because the girls' test had two fewer questions than the boys', percentage of correct answers were used for statistical comparisons. All data was tested using a 95% confidence level, thus a p value of $< .05$ is considered to be significant.

Characteristics of the sample

Table 1 summarizes the number of participants at each grade level in both groups. The boys group was smaller in number ($n = 82$) than the girls ($n = 102$). The mean age was 13.4 (SD $\pm$ 1.3) for the boys group and 13.5 (SD $\pm$ 1.3) for the girls group with a range from 11 to 17 years old. Students from grades 6 through 11 were represented between both groups with the 8^{th} grade being the mode in each group.

Table 1

Number of Male and Female Participants in Each Grade Level

Grade	Boys (n = 82)	Girls (n = 102)
6th grade	10	11
7th grade	26	24
8th grade	27	38
9th grade	18	27
10th grade	1	0
11th grade	0	2

Research Questions One

The first question of this study asked "Is there a statistically significant increase in knowledge regarding osteoporosis prevention through exercise in adolescent males and females after receiving an osteoporosis education intervention?" To answer this question, a paired t-test was used to analyze the difference between pretest and posttest mean percent correct scores, for the exercise items, in both groups. Table 2 summaries the percentage correct of exercise knowledge items at pretest and posttest. The results of the paired t-tests comparing the pretest and posttest means for the girls ($t = .83$, $p = .40$) and boys ($t = -.23$, $p = .82$) showed that neither group had a significant increase in knowledge regarding osteoporosis prevention through exercise after the education intervention.

Table 2

Percentage Correct of Exercise Knowledge Items at Pretest and Posttest for All Grade Levels

Test Statistics	Boys (n = 82)	Girls (n = 102)
Pretest		
Minimum percentage correct	00.0	00.0
Maximum percentage correct	69.6	81.0
Mean percentage correct	36.6	38.3
Standard deviation	16.5	17.3
Posttest		
Minimum percentage correct	00.0	9.5
Maximum percentage correct	69.6	81.0
Mean percentage correct	37.2	40.3
Standard deviation	18.6	17.0

The raw score data showed that the girls' scores ranged from 0 to 17 (out of a possible 21) and boys ranged from 0 to 16 (out of a possible 23) on the pretest. The mean number of questions answered correctly in the girls group was 8.0 (SD ± 3.6) and the mean in the boys group was 8.4 (SD ± 3.8). On posttest, the girls' raw scores ranged from 2 to 17 (M = 8.3, SD ± 3.6) and boys' scores ranged 0 to 16 (M = 8.7, SD ± 4.3)

The mean percentage of correct answers in the girls group on the pretest was approximately 38% (SD ± 17.3), the posttest mean was 40% (SD ± 17). The boys mean percentage correct on pretest was approximately 37% (SD ± 16.5) and remained at 37% (SD ± 18.6) on posttest.

Research Question Two

The second question of this study asked "Is there a difference between knowledge change scores in boys and girls after receiving an osteoporosis education intervention?" The results of an independent t-test showed there was no significant difference between the groups in the amount of knowledge gain after the osteoporosis educational intervention ($t = .41$, $p = .69$). The mean percentage change between pretest and posttest was .6 (SD ± 22.3) in the boys group and 2.0 (SD ± 24.4) in the girls group. Table 3 summaries the changes in pretest and posttest percentages correct in each group.

Table 3

Change in Percentage Correct Between Pretest and Posttest Scores

Test Statistics	Boys (n = 82)	Girls (n = 102)
Minimum percentage change	-60.9	-61.9
Maximum percentage change	56.5	76.2
Mean percentage change	.6	2.0
Standard deviation	22.3	24.4

Findings of Interest

Even though the overall testing showed no significant increase in knowledge, it is of interest to find that a large percentage of the students had the correct answer to a few basic exercise questions on the pretest. Table 4 summarizes the results of specific questions.

Table 4

Correct Responses (Percentages) to Select Questions on the Healthy Bones Knowledge Questionnaire Administered During the Pretest

Questions	Boys (n = 82)	Girls (n = 102)
Exercising 3-4 times/wk for 20-30 min - less likely to get osteoporosis	63.0	74.5
Least amount of exercise time that will strengthen bones	51.2	58.4
How many days a week should a person exercise?	80.2	78.2
Best way to reduce chance of getting osteoporosis - Dancing	59.3	64.0
Best way to reduce chance of getting osteoporosis - Jog/Run	54.3	73.7

It is of interest to note that more than 50% of the students had knowledge that exercise is important in preventing osteoporosis on the pretest. In addition, they knew that they should exercise three or more days a week for at least 20-30 minutes and could identify what exercises are best to reduce their chance of getting osteoporosis.

CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Discussion

The purpose of this research study was to assess the impact of an osteoporosis educational intervention on the knowledge of appropriate preventive physical activity. In discussing the results below, it must be noted that the educational intervention focused mainly on calcium intake and prevention of osteoporosis. The script used for the education intervention contained minimal information on the relationship of exercise to osteoporosis prevention.

The first research question was asked to determine if adolescents would show an increase in their knowledge of the relationship between exercise and prevention of osteoporosis if they were given information about osteoporosis prevention. Based on the literature review, the investigator expected to find a significant increase in both boys' and girls' knowledge scores on the posttest. However, there was no significant difference in the participant's pretest and posttest scores in either group. Since the education intervention only included minimal information about the tested exercise questions, this study varied from the those reviewed earlier.

The findings of this study are inconsistent with those of Sedlak et al. (1998), who found that there was an increase in knowledge after an osteoporosis prevention program. Those investigators used college students as participants and designed a program that specifically addressed many of the questions on the Osteoporosis

Knowledge Test (Kim, et al., 1991). The difference may be that college students are more motivated to learn material outside of their required class studies than students in grades 6 through 11, and that the information the college students received was not incidental to the tested subject (which for the current project was calcium intake).

The findings of the current investigation are also inconsistent with most of the studies about health education in the adolescent population, which found there was a significant increase in knowledge after an education intervention (Byrd-Bredbenner et al., 1984; Devine et al., 1992; MacDonald, 1995 and 1999; Meagher, 1990; and Munodawafa et al., 1995). However, the findings are consistent with the Resnicow et al. (1992) study in which there was not an increase in health knowledge after the participants received a health curriculum during classroom time. Resnicow et al. (1992) suggested that there was a low implementation rate by the classroom teachers. This would indicate that the participants of their study were also tested on incidental knowledge gain as were the participants of this study. The students in both studies received little information regarding the specific subject and is possibly why they did not have a significant knowledge gain.

The second research question explored whether there was a difference between boys' knowledge gain and girls' knowledge gain after an education intervention. This question was asked because to date all but one of the studies (Lysen and Walker, 1997) pertaining to osteoporosis knowledge included only female participants. This researcher wondered if males would lack motivation to learn about a predominantly female disease because they believed they were not susceptible. One study reviewed (Birtwistle and Brodie, 1991) indicated that females had significantly more positive attitude than boys

about the benefits of exercise indicating they were more receptive to health education. However, the results of this study showed that there was not a significant difference in knowledge gain between boys and girls. The boys' percentage of right answers did not increase, whereas the girls percentage increased by 2%. Again, this may be the result of limited information received during the education intervention, however, it appears in this study that both girls and boys learn equally when receiving information on health issues.

The findings of interest in this study were the knowledge levels of the youth on the pretest before the education intervention. Approximately 63% of boys and 75% of girls were knowledgeable that exercise would help a person be less likely to get osteoporosis. Over 78% of the youth knew how many times a week they needed to exercise to receive that benefit and greater than 50% knew how long the exercise session should be and what exercises would be best to reduce their chance of getting osteoporosis. This may seem somewhat inconsistent with many of the studies that have implicated a low osteoporosis knowledge level (Ailinger and Emerson, 1998; Kasper et al., 1994; and Taggart & Conner, 1995), however, these studies have included all osteoporosis knowledge (calcium intake, exercise, risk factors, and knowledge about the disease process) in their results. When examining the testing in greater detail, each study had a high percentage of participants who correctly identified exercise as a preventive factor in getting osteoporosis.

This information is consistent with a study conducted by Borra et al. (1995) that reported children recognized the value of physical activity. It also is consistent with results from the Ferguson et al. (1989) study in which children were knowledgeable about exercise. This researcher speculates that this may be the result of the large campaign to

inform the public about cardiovascular health. The amount of time needed to exercise and the number of days needed per week are the same for cardiovascular health as they are for osteoporosis prevention. The types of exercise needed for osteoporosis prevention are somewhat different than those needed for cardiovascular health and the participants in this study demonstrated some confusion on this issue. For example, bicycling, jogging/running, and swimming are all excellent cardiovascular exercise, however bicycling and swimming have a limited osteoporosis prevention effect because they generally are not weight bearing. One particular question regarding the best exercise included both bicycling and jogging or running. Nearly 74% of the girls and 55% of the boys choose the correct exercise on the pretest. On the other hand, in a question that included swimming and walking (choice on the girls test) or jogging (choice on the boys test), only 25% of the girls chose walking (45% chose swimming), and only 27% of the boys chose jogging (34% chose swimming). This would indicate that there is some confusion about the types of exercise that would be beneficial for osteoporosis prevention. Since the type of exercise that is beneficial was not covered during the teaching intervention, it would not be useful to look at posttest scores on these questions.

Relationship of Findings to Theoretical Framework

The HBM provides an appropriate framework to assess adolescent knowledge and beliefs. Although previous studies (Hiltabiddle, 1996; Burak & Meyer, 1996) suggest that the HBM is not very useful in predicting adolescent intentions and behaviors, they agree that it's structure results in important information gathering about knowledge and beliefs and that it can help guide health professionals in the development of educational programs.

The HBM examines individual perceptions as motivators of health related behaviors which include perceived susceptibility to the disease, perceived severity to the disease, and the perceived benefits minus barriers to the preventive behavior. Because this study did not examine relationships between health knowledge and outcome behavior, it is difficult to relate the results of this study to other studies that used the HBM with adolescents.

Demographic and sociopsychological variables and cues to action affect the adolescent's perception and thus indirectly influences health related behavior. The demographic factor in this study is age and the sociopsychological variable is educational attainment. The findings in this study are that an education intervention with minimal exercise information did not increase the knowledge of adolescents. Therefore, it could not influence beliefs. Using the model we could then hypothesize that it will not influence behavior modification.

Limitations

One major limitation of this study was that the independent variable (education intervention) did not cover most of the knowledge measured by dependent variable (mean knowledge scores). A disadvantage to a secondary analysis is the inability to obtain the exact data one intended to examine (Polit & Hungler, 1999). In this study, there was not a chance to assess knowledge gain after a more intense exercise education intervention. However, the primary objectives of the researchers in the larger study centered on "repaying" the participants through classes, for assistance in the earlier instrument development study.

Another limitation to this study may have been the effect a pretest can have on the posttest. Collecting data from people changes them. This is especially evident in studies dealing with opinions and attitudes (Polit & Hungler, 1999). Testing threats are much more likely to occur when the pretest involves information the subjects provide in a self-report format. Although this study was not concerned with opinion or attitudes it was administered in a self-report format. Since a comparison group was not used, this must be considered when interpreting the data.

A threat to the internal validity in this study is instrumentation. Instrumentation effects can occur even if the same measure is used (Polit & Hungler, 1999). In this study, different test administrators were used during pretest and posttest collection of data, some of them more experienced in data collection than others. This could have yielded more or less accurate measures on one administration of the test even though the same instrument was used for both.

Another limitation involving the instrumentation was that several of the female subjects previously participated in a study testing the instrument used in this study. No data were collected to determine how many of those subjects were still attending the school during data collection for this study. The impact may be that participation in the first study increased the knowledge of the female population about osteoporosis and therefore deflated the results of the knowledge score differences between boys and girls. The mean percentage correct score for the female group was approximately 2% higher on the pretest than then males mean percentage correct score. If females had an increased pretest knowledge because of their previous exposure to osteoporosis during instrument

testing, the difference between pretest and posttest knowledge may not have showed the true difference in female knowledge gain as compared to male knowledge gain.

A final limitation to the study that must be considered is the convenience sample of adolescents. First, the majority of the students were Caucasian and this limits generalizibility of the findings to all groups of adolescents. Second, the sample included all children attending a school that was willing to have this study conducted and it may not be assumed that the subjects were interested in participating in the study. Even though the students were not required to participate, they may not have felt comfortable declining to participate in something they believed their teacher wanted them to complete. This may have had an effect on the effort they used to complete the test accurately.

Implications and Recommendations

One implication of this study is that education containing only incidental knowledge does not significantly affect adolescent knowledge. Nurse educators need to realize that adolescents do not learn from this type of teaching plan. Further research needs to be done to assess the knowledge gain after a carefully designed educational intervention is directed to include more specific information regarding the subject. Adolescents, if effectively educated about osteoporosis and the several factors affecting onset, may choose to protect themselves from some of the worst outcomes of osteoporosis by practicing preventive behaviors.

Implications regarding nursing practice are difficult to assess from the data results of this study. Since the study results were not significant, it can be implied that adolescents do not learn when small amounts of information are presented. It may also imply that a one-time exposure to the information may not be enough to increase

knowledge. When addressing adolescents concerning osteoporosis and exercise, it may be more effective to specifically detail the information related to exercise and osteoporosis prevention and to present the information more than once, if possible. Other research findings that involve health teaching with adolescents support this speculation. The findings of interest in this study indicate that many of the adolescents were knowledgeable about exercise before the intervention. The high pretest knowledge may have precluded the potential for increasing that knowledge. The obvious next step in osteoporosis research would be to study adolescent behaviors resulting from changes in osteoporosis knowledge.

In future research, the HBM may not be the best fit for the adolescent population. The constructs of the HBM were not directly tested during this study, however, its use with adolescents has been criticized. Adolescent egocentrism causes them to believe they are excluded from the realm of natural laws (Burak & Meyer, 1997), therefore, they feel less susceptible to disease. The importance of peer group influence, and the knowledge that adolescents' health-seeking behaviors are not driven by a desire to avoid disease also weaken the validity of using the HBM to tests adolescent behaviors in regards to osteoporosis prevention.

Summary

In conclusion, the main purpose of this study was to assess the impact of an educational intervention on adolescent knowledge concerning exercise as a osteoporosis preventive behavior. The education intervention mainly focused on calcium intake as a preventive measure, however, it did contain some information on exercise as well. The findings indicate that there was no incidental knowledge gain about exercise after an

intervention with minimal information regarding that subject. However, findings also point to the fact that many adolescents were knowledgeable about exercise on the pretest which means that they obtained the information prior to the education intervention in this study. Further study needs to be done to assess the impact of education with emphasis on the tested subject. Also, because of the controversy about using the HBM with adolescents, further study needs to be done to address the relationship of knowledge attainment and health behaviors in the adolescent population.

APPENDICES

APPENDIX A

HEALTHY BONES KNOWLEDGE QUESTIONNAIRE: GIRLS

Osteoporosis (os-tee-o-po-ro-sis) is a condition in which the bones become very brittle and weak so that they break easily.

Below is a list of things which may or may not affect a person's chance of getting osteoporosis. We wish to learn what you know or may not know about osteoporosis risk factors. It helps us to know if you're not sure about some factors. Please read each statement, then place a check in the box to show if you think that a person is:

MORE LIKELY TO GET OSTEOPOROSIS, or

LESS LIKELY TO GET OSTEOPOROSIS, or the statement

HAS NOTHING TO DO WITH GETTING OSTEOPOROSIS, or

You are NOT SURE.

For office use only	Statement				
0 1	1. Having big bones	More Likely	Less Likely	Nothing to do with	Not sure
0 1	2. Stopping periods for more than 6 months	More Likely	Less Likely	Nothing to do with	Not sure
0 1	3. Not eating or drinking milk products each day	More Likely	Less Likely	Nothing to do with	Not sure
0 1	4. Eating a diet high in dark green vegetables like broccoli or collard greens	More Likely	Less Likely	Nothing to do with	Not sure
0 1	5. Having a mother who is not as tall as she used to be	More Likely	Less Likely	Nothing to do with	Not sure
0 1	6. Having a grandmother who has a hunchback	More Likely	Less Likely	Nothing to do with	Not sure
0 1	7. Being a woman	More Likely	Less Likely	Nothing to do with	Not sure
0 1	8. Being a man	More Likely	Less Likely	Nothing to do with	Not sure

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ID NO. ___________

			More Likely	Less Likely	Nothing to do with	Not sure
0 1	9.	Being an African-American woman.	More Likely	Less Likely	Nothing to do with	Not sure
0 1	10.	Having ovaries surgically removed	More Likely	Less Likely	Nothing to do with	Not sure
0 1	11.	Taking cortisone (steroids) pills or shots for a long time	More Likely	Less Likely	Nothing to do with	Not sure
0 1	12.	Exercising 3-4 times a week for 20-30 minutes at a time	More Likely	Less Likely	Nothing to do with	Not sure
0 1	13.	Having poor posture	More Likely	Less Likely	Nothing to do with	Not sure
0 1	14.	Being underweight	More Likely	Less Likely	Nothing to do with	Not sure
0 1	15.	Being overweight	More Likely	Less Likely	Nothing to do with	Not sure
0 1	16.	Being anorexic	More Likely	Less Likely	Nothing to do with	Not sure
0 1	17.	Being on a diet (but not anorexic)	More Likely	Less Likely	Nothing to do with	Not sure

For the next group of questions, choose one answer from several choices. Be sure to choose only one answer. If you think there is more than one correct answer, choose the best answer. If you are not sure, just choose "Not sure".

For office use only

0 1 18. Which of the following exercises is the best way to reduce a person's chance of getting osteoporosis?

A. Swimming
B. Walking briskly
C. Doing kitchen chores, such as washing dishes or cooking
D. Not sure

2/12/99

For office
use only

01

19. Which of the following exercises is the best way to reduce a person's chance of getting osteoporosis?

A. Bicycling
B. Yoga
C. Housecleaning
01 D. Not sure

20. How many days a week do you think a person should exercise to strengthen the bones?

A. I day a week
B. 2days a week
01 C. 3 or more days a week
D. Not sure

21. What is the LEAST AMOUNT OF TIME a person should exercise on each occasion to strengthen the bones?

A. Less than 15 minutes
B. 20 to 30 minutes
01 C. More than 45 minutes
D. Not sure

22. Exercise makes bones strong, but it must be hard enough to make breathing:

A. Just a little faster than normal
01 B. So fast that talking is not possible
C. Much faster but talking is possible
D. Not sure

23. Which of the following exercises is the best way to reduce a person's chance of getting osteoporosis?

A. Jogging or running for exercise
B. Bicycling
C. Bowling
D. Not sure

2/12/9

For Office use only

0 1 24. Which of the following activities is the <u>best way</u> to reduce a person's
chance of getting osteoporosis?

A. Cleaning upa room
B. Dancing
C. Playing a musical instrument
D. Not sure

0 1 25. Which of these foods gives a person <u>the most</u> calcium?

A. Apple
B. Cheese
C. Cucumber
D. Not sure

0 1 26. Which of these foods gives a person <u>the most</u> calcium?

A. Watermelon
B. Corn
C. Canned Sardines
D. Not sure

0 1 27. Which of these foods gives a person <u>the most</u> calcium?

A. Chicken
B. Baked or refried beans
C. Grapes
D. Not sure

0 1 28. Which of these foods gives a person <u>the most</u> calcium?

A. Strawberries
B. Cabbage
C. Yogurt
D. Not sure

0 1 29. Which of these foods gives a person <u>the most</u> calcium?

A. Grapefruit
B. Ice cream
C. Radishes
D. Not sure

2/12/99

ID NO.__________

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0 1 30. Which of the following is the recommended amount of calcium intake for a teenage girl?

A. 600 mg daily
B. 1300 mg daily
C. 2500 mg daily
D. Not sure

0 1 31. How many 8 ounce glasses of milk (the amount in a school lunch milk carton) must a teenage girl drink each day to meet the recommended amount of calcium?

A. 2-3
B. 4-5
C. 6 or more
D. Not sure

0 1 32. Which of the following is the <u>best</u> reason for taking a calcium supplement?

A. If a person skips breakfast
B. If a person does not get enough calcium from diet
C. If a person drinks only skim milk or non-fat milk
D. Not sure

0 1 33. Which vitamin is <u>necessary</u> for calcium absorption by the body?

A. Vitamin A
B. Vitamin C
C. Vitamin D
D. Not sure

Kim, Horan, & Gendler, modified Kim, Gendler, Mellen, Martin, Coviak, Rodrigues-Fisher

2/12/99

APPENDIX B

HEALTHY BONES KNOWLEDGE QUESTIONNAIRE: BOYS

Osteoporosis (os-tee-o-po-ro-sis) is a condition in which the bones become very brittle and weak so that they break easily.

Below is a list of things which may or may not affect a person's chance of getting osteoporosis. We wish to learn what you know or may not know about osteoporosis risk factors. <u>It helps us to know if you're not sure</u> about some factors. Please read each statement, then place a check in the box to show if you think that a person is:

MORE LIKELY TO GET OSTEOPOROSIS, or

LESS LIKELY TO GET OSTEOPOROSIS, or the statement

HAS NOTHING TO DO WITH GETTING OSTEOPOROSIS, or

You are NOT SURE.

For office use only						
0 1	1.	Having big bones	More Likely	Less Likely	Nothing to do with	Not sure
0 1	2.	Being tall.	More Likely	Less Likely	Nothing to do with	Not sure
0 1	3.	Being short.	More Likely	Less Likely	Nothing to do with	Not sure
0 1	4.	Not eating or drinking milk products each day	More Likely	Less Likely	Nothing to do with	Not sure
0 1	5.	Eating a diet high in dark green vegetables like broccoli or collard greens	More Likely	Less Likely	Nothing to do with	Not sure
0 1	6.	Having a father who is not as tall as he used to be	More Likely	Less Likely	Nothing to do with	Not sure
0 1	7.	Having a grandfather who has a hunchback	More Likely	Less Likely	Nothing to do with	Not sure
0 1	8.	Being a woman	More Likely	Less Likely	Nothing to do with	Not sure
0 1	9.	Being a man	More	Less	Nothing	Not sure

2/12/99

ID NO. ___________

		Likely	Likely	to do with	
0 1	10. Being an African-American	More Likely	Less Likely	Nothing to do with	Not sure
0 1	11. Having low male hormones	More Likely	Less Likely	Nothing to do with	Not sure
0 1	12. Taking cortisone (steroids) pills or shots for a <u>long time</u>	More Likely	Less Likely	Nothing to do with	Not sure
0 1	13. Exercising 3-4 times a week for 20-30 minutes at a time	More Likely	Less Likely	Nothing to do with	Not sure
0 1	14. Having poor posture	More Likely	Less Likely	Nothing to do with	Not sure
0 1	15. Being underweight	More Likely	Less Likely	Nothing to do with	Not sure
0 1	16. Being overweight	More Likely	Less Likely	Nothing to do with	Not sure
0 1	17. Being anorexic	More Likely	Less Likely	Nothing to do with	Not sure
0 1	18. Being on a diet (but not anorexic)	More Likely	Less Likely	Nothing to do with	Not sure

For the next group of questions, choose one answer from several choices. Be sure to choose <u>only one</u> answer. If you think there is more than one correct answer, choose the best answer. If you are not sure, just choose "Not sure".

For office use only

0 1 — 19. Which of the following exercises is the <u>best way</u> to reduce a person's chance of getting osteoporosis?

A. Swimming
B. Doing yard work
C. Jogging
D. Not sure

2/12/99

ID NO. ____________

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0 1 20. Which of the following exercises is the best way to reduce a person's chance of getting osteoporosis?.

A. Bicycling
B. Doing warm-up stretches
C. Changing the oil on a car
D. Not sure

0 1 21. Which of the following exercises is least likely to reduce a person's chance of getting osteoporosis?

A. Computer games
B. Soccer
C. Basketball
D. Not sure

0 1 22. How many days a week do you think a person should exercise to strengthen the bones?

A. 1 day a week
B. 2 days a week
C. 3 or more days a week
D. Not sure

0 1 23. What is the LEAST AMOUNT OF TIME a person should exercise on each occasion to strengthen the bones?

A. Less than 15 minutes
B. 20 to 30 minutes
C. More than 45 minutes
D. Not sure

0 1 24. Exercise makes bones strong, but it must be hard enough to make breathing:

A. Just a little faster than normal
B. So fast that talking is not possible
C. Much faster, but talking is possible
D. Not sure

2/12/99

ID NO. ___________

For office use only

0 1 25. Which of the following exercises is the best way to reduce a person's chance of getting osteoporosis?

A. Jogging or running for exercise
B. Bicycling
C. Bowling
D. Not sure

0 1 26. Which of the following activities is the best way to reduce a person's chance of getting osteoporosis?

A. Cleaning up a room
B. Dancing
C. Playing a musical instrument
D. Not sure

0 1 27. Which of these foods gives a person the most calcium?

A. Apple
B. Cheese
C. Cucumber
D. Not sure

0 1 28. Which of these foods gives a person the most calcium?

A. Watermelon
B. Corn
C. Canned Sardines
D. Not sure

0 1 29. Which of these foods gives a person the most calcium?

A. Chicken
B. Baked or refried beans
C. Grapes
D. Not sure

0 1 30. Which of these foods gives a person the most calcium?

A. Strawberries
B. Cabbage
C. Yogurt
D. Not sure

2/12/99

ID NO. ____________

For office use only

0 1 | 31. Which of these foods gives a person <u>the most</u> calcium?

A. Grapefruit
B. Ice cream
C. Radishes
D. Not sure

0 1 | 32. Which of the following is the recommended amount of calcium intake for a teenage boy?

A. 600 mg daily
B. 1300 mg daily
C. 2500 mg daily
D. Not sure

0 1 | 33. How many 8 ounce glasses of milk (the amount in a school lunch milk carton) must a teenage boy drink each day to meet the recommended amount of calcium?

A. 2-3
B. 4-5
C. 6 or more
D. Not sure

0 1 | 34. Which of the following is the <u>best</u> reason for taking a calcium supplement?

A. If a person skips breakfast
B. If a person does not get enough calcium from diet
C. If a person drinks only skim milk or non-fat milk
D. Not sure

0 1 | 35. Which vitamin is <u>necessary</u> for calcium absorption by the body?

A. Vitamin A
B. Vitamin C
C. Vitamin D
D. Not sure

Kim, Horan, & Gendler, modified Kim, Gendler, Mellen, Martin, Coviak, Rodrigues-Fisher
2/12/99

APPENDIX C

DEMOGRAPHIC DATA

1. What year were you born? _______________

2. When is your birthday? _______________

3. How many birth sisters do you have? _______________

4. How many stepsisters do you have? _______________

5. How many birth brothers do you have? _______________

6. How many stepbrothers do you have? _______________

7. What grade are you in? _______________

APPENDIX D

GRAND VALLEY STATE UNIVERSITY

1 CAMPUS DRIVE • ALLENDALE, MICHIGAN 49401-9403 • 616/895-6611

February 18, 1999

Jean Martin
Kirkhof School of Nursing
232 HRY

Dear Jean:

Your proposed project entitled "***Healthy Bones Education: An Adolescent Osteoporosis Prevention Project***" has been reviewed. It has been approved as a study which is exempt from the regulations by section 46.101 of the Federal Register 46(16):8336, January 26, 1981.

Sincerely,

[redacted]

Paul Huizenga, Chair
Human Research Review Committee

APPENDIX E

GRAND VALLEY
STATE UNIVERSITY

1 CAMPUS DRIVE • ALLENDALE, MICHIGAN 49401-9403 • 616/895-6611

December 13, 1999

Alice Padilla
4557 Loggers Run
Grand Rapids, MI 49525

Dear Alice:

Your proposed project entitled **Adolescent Knowledge About the Relationship Between Exercise and Prevention of Osteoporosis** has been reviewed. It has been approved as a study which is exempt from the regulations by section 46.101 of the Federal Register 46(16):8336, January 26, 1981.

Sincerely,

[redacted]

Paul A. Huizenga, Chair
Human Research Review Committee

APPENDIX F

BLACK RIVER
PUBLIC SCHOOL

January 26, 1999

To Whom It May Concern:

It is our pleasure to participate in the *Healthy Bones for Teens* study being conducted by Grand Valley State University.

We will involve our entire student body. This includes 6th through 11th grade boys and girls.

If you have any further questions, please feel free to call me at 355-0055, ext. 119.

Sincerely,

[redacted]

Claudia U. Ruf
Deputy Fhead of School

APPENDIX G

Dear Parent/Guardian,

The Health Curriculum at Black River includes a unit on nutrition. This year the nutrition unit for grades 6-9, with an emphasis on bone health, will be taught by faculty from the Kirkhof School of Nursing at Grand Valley State University and a dietitian from the United Dairy Industry of Michigan during the week of March 8. As part of this module, students will be asked to complete questionnaires about osteoporosis, calcium intake, and exercise patterns. They will be asked to repeat the exercise questionnaire an additional 2 times within the next week. Approximately 6 weeks after the class students will be asked to complete all questionnaires a second time.

The purpose of the study is to implement and evaluate a nutrition education program for healthy bones, and to evaluate the questionnaires related to knowledge, calcium intake and exercise patterns. The study is part of a research project to help develop an osteoporosis prevention program for adolescents.

This study has been approved by the Human Research Review committee at Grand Valley State University. Permission to administer the questionnaires has been given by Claudia Ruf, Dean of Students at Black River.

Participating in the study is voluntary and will not affect student's grades in any way. All answers will be confidential and summarized with those of other students. The school will not be identified in any of the data analysis. If you do not wish your student to participate in completing the questionnaires please return the form below to the school office by (March 5, 1999). All students will receive the nutrition content as part of the standard health curriculum.

Thank you for allowing your student to participate. The information gathered from this study will contribute to developing a comprehensive osteoporosis prevention program for adolescents.

Any questions about the study can be directed to Jean Martin, Assistant Professor of Nursing (616) 895-3143. Questions about your child's rights can be directed to Paul Huizenga, Associate Professor of Biology and Chair of the Human Research Review Committee (616) 895-2472.

Sincerely,

Jean Martin, DNSc, RN-C, PNP
Assistant Professor of Nursing

Grand Valley State University Healthy Bones Education Study

Please **EXCUSE** my student ___________________________ from participating in the Healthy Bones Education study. I prefer that my student **NOT** participate.

I understand my student will still receive the nutrition content as part of the standard health curriculum.

Parent/guardian signature _______________________________ Date: ______________

APPENDIX H

GRAND VALLEY
STATE UNIVERSITY

1 CAMPUS DRIVE • ALLENDALE, MICHIGAN 49401-9403 • 616/895-6611

October 1, 1999

Alice Padilla
4557 Loggers Run N.E.
Grand Rapids, MI 40525

Dear Alice,

As co-investigator of the Healthy Bones Adolescent Osteoporosis Prevention Project I am pleased to grant you permission to access the data from the Black River project conducted during the spring of 1999 for use for your master's thesis. You also have permission to reproduce the instruments in your study if appropriate. We look forward to the completion of your project and your contribution to the larger study.

Sincerely,

[redacted]

Jean T. Martin, DNSc, RN-C
Assistant Professor, Kirkhof School of Nursing

APPENDIX I

Script

Introduction

(Introduce yourself)

"Today we are talking about how to make healthy eating easier."

"Speaking of easier, how many of you have eaten at a fast food restaurant in the past week?"

"Many times we face a choice.... fast food or no food."

"You might think fast food can't be healthy, but today you will hear about a tool that helps you eat well in any situation."

Fast food activity sheet:

"You have a sheet titled 'Fantastic *Fast* Foods'. On this sheet are many of the foods you can find at fast food restaurants. Circle all the foods you like or might order at a fast food restaurant."

(Allow work time. Explain and demonstrate the folding process. Have students fold their papers.)

"Now unfold your sheets. The fold lines divide the fast foods into the five basic food groups and the others foods. The food groups are the parts of that tool I mentioned earlier. By noticing the food groups you can eat well anywhere."

Pyramid and the Five Food Groups:

(Point to the pyramid poster.)

"You have prbably seen the food groups as a pyramid."

"Each food group in the pyramid makes a unique contribution to your health. the pyramid is dividied into 5 food groups plus the tip of the pyramid."

(Call attention to the display of comparison cards.)

"These cards are arranged by food groups. Each row is a different group. The colored bars on the graph show how much of certain nutrients are in each food."

"Look at the cards. What do you notice?.."

(Let them point out thinks like:
- the groups look different
- the foods within a group are similar
- Fruits and Vegetables look a lot alike.

You can prompt them with the following questions if they don't seem to get these points.

"When you look aecross the row of milk group foods what do you notice?"
"How are they alike?"
"How are they different?'

"When you look at the first food in each row what do you notice?"

Finish this activity by looking at the key nutrients in each food group.)

The spine can keep crushing until the vertebrae start to bend forward. That is when you see the humped back some older people get." (Point out graphic of changes in spine at different ages.) **"Do any of you remember seeing someone with this hump in their back?**

"Can you protect your bones from this problem? YES!!! How?"

"There are two main things everyone can do.

1. **Exercise – Physical activity sends a message to your bones build up their strength.**
2. **East and drink foods with calcium – You need about four servings a day of high calcium foods.**

We have a game to let you figure out what foods are high in calcium."

(Play the game.)

(After the game, ask students to brainstorm a list of reasons teens might not get enough calcium-rich foods.

The reasons listed below are some common ones. Beside each item is a quick way to give ideas that help overcome the reasons.

1. Too much fat in dairy foods: Show comparison cards of skim and whole milk. The calcium is the same, only the fat and calories are different.
2. Too many calories: See idea above.
3. Lactose intolerance: Share tip sheet/handout.
4. Doesn't taste good: Share smoothie recipes or point out that chocolate milk still has all the calcium in white milk

"You have prbably seen the food groups as a pyramid."

"Each food group in the pyramid makes a unique contribution to your health. the pyramid is dividied into 5 food groups plus the tip of the pyramid."

(Call attention to the display of comparison cards.)

"These cards are arranged by food groups. Each row is a different group. The colored bars on the graph show how much of certain nutrients are in each food."

"Look at the cards. What do you notice?.."

(Let them point out thinks like:
• the groups look different
• the foods within a group are similar
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"When you look aecross the row of milk group foods what do you notice?"
"How are they alike?"
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"When you look at the first food in each row what do you notice?"

Finish this activity by looking at the key nutrients in each food group.)

"These foods in the milk group all have a tall green bar. That bar shows how much calcium is in a food. Why do you need calcium?" (Let them answer for strong bones and teeth.) **"Milk group foods also have protein to help build strong muscles. You see that in this red bar."**

"Meat, eggs, and beaus are the group of foods that supply most of our protein and iron for building muscles." (Point to the bars on the comparison cards.)

"Vegetable and fruit group foods both supply vitamins A & C. Vitamin A is critical for good vision and skin health. Vitamin C helps heal cuts. Both of these vitamins help protect your body from illness." (Point to the bars-on the comparison cards.) **"Some fruits and vegatables are good for one of these vitamins and others have a lot of both."** (Point out examples.).

"Grain foods supply energy to keep your body moving. The most usable energy for your body isn't gasoline. It is carbohydrates and grain foods are the best source of these." (There isn't a carbohydrate bar on the comparison cards. You can mention that the grain foods are also good sources of B vitamins.)

Mystery cards
(If time permits you can play mystery cards here.)
(Game directions:

1. Divide the class into three teams.
2. Give each team four mystery cards (Comparison cards with the food name cut off) in a folder.
3. Have them keep the folder closed until you say go.
4. When you say go, they can open the folder and try to figure out which food group is represented by each of their cards.

5. When a team thinks they know the group for all their cards, they shout stop. The other two teams put their cards back in their folders.
6. The team wins if they can accurately tell you which food groups are on their cards. (Answer key is coded by numbers on the cards.)
7. If they get a wrong answer the remaining two teams can restart and try to figure out their cards.
8. The winning team can have milk mustache pictures.

Distribute pyramid handouts to everyone.)

"Getting enough from each food group is the tool you can use everyday to make sure you feed your body the nutrients it needs."

(Review the number of servings needed from each food group. Note that people their age need 4 servings from the milk group.)

"That sounds easy, but most people are not getting all that they need from the basic food groups."

"We haven't talked much about the tip of the pyramid. These foods have energy, but not many other nutrients. That is why we don't make them one of the five food groups."

(Point out this row on the display of comparison cards.)

"Does that mean you never eat these foods? NO! They just don't replace the other food groups. For example, a milk chocolate candy bar does not replace a serving of milk."

<u>Calcium Education</u>

"Milk and other dairy foods are one of the most commonly missed food groups. This means your bones could be missing calcium and protein for strength"

"During the years when your bones are growing longer and you are getting taller you need extra calcium." (Point to the poster of bone development.) **"At this stage you need four cups of milk a day."** (Show food models of four cups of milk.)

"Why is milk so important? It is a complete package of nutrients. It has the calcium and proteins your bones need, plus it has another critical nutrient..... Vitamin D."

"Vitamin D helps your body absorb calcium from your food. Without vitamin D, your body would absorb much less calcium. In fact you would get only 1/3 of the calcium your body absorbs normally. Without Vitamin D you would need three times as much milk!! Instead of four cups you would have to have twelve cups or three quarts each day!!" (Add extra models to the *four* cups on display.)

"There are only two major sources of Vitamin D for your body... sunshine and milk. Sunshine lets your body make it's own vitamin D. However, much of the year Michigan doesn't have enough sunshine, so we depend on our milk."

(Explain the poster/map of vitamin production. Note that Michigan *is* low in sunshine from November through February. That's one third of the year.)

"Bone building doesn't stop after you stop getting taller. When it comes to bones, length building starts first, but strength building lasts longer."

"Your bones look pretty solid, but they actually have lots of small holes that get partially filled in with calcium and other minerals. It is like adding paper mache to a piece of netting. Without the paper mache the netting is very soft and not strong. It is like the soft cartilage in the end of your nose or your earlobe. When you add the paper mache the holes fill in a little and the netting becomes stiffer and holds its shape.

(Show the netting pieces.)

"Filling in the netting... I mean your bones is what we call increasing your bone density. When bones are more dense, they break less easily."

(Demonstrate breaking the chocolate bars with and without rice krispes. You might want to have a student volunteer break the 'bones'.)

"Once your bones are filled with calcium, they don't always stay that way. Most of the calcium in your body is in your bones, but a small amount is used for other important body functions. For example, calcium helps your muscles contract. When your body needs calcium for your muscles, it gets it either from the food you eat or it borrows calcium from your bones. If you don't eat enough calcium, your body keeps borrowing from your bones. After many years, your bones can loose so much calcium that they are weak and just break."

"That is what we call osteoporosis. The word osteoporosis means 'porous bone' or bones with many holes in them. Here is a picture of a normal vertebrae in your spine and here is one with osteoporosis." (Point out the vertebrae poster.) **"You can see how many more holes are in the osteoporotic bone. The other thing you can see is the vertebrae looks squashed. It is. The weak bones in the spine of someone with osteoporosis actually have many small breaks and they crush together. If you hear someone say they are getting shorter it might be osteoporosis.**

The spine can keep crushing until the vertebrae start to bend forward. That is when you see the humped back some older people get." (Point out graphic of changes in spine at different ages.) **"Do any of you remember seeing someone with this hump in their back?**

"Can you protect your bones from this problem? YES!!! How?"

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THE CALCIUM IS RIGHT!

A GAME FOR LEARNING THE CALCIUM LEVELS IN FOODS

Rules of the Game

1. Students should be assigned to three teams, and should be given a set of 8 numbers, all of the same colored backing (red, blue, or yellow).

2. On the left side of the game board, pictures of foods, all taken from the <u>same</u> plastic bag, should be placed on the velcro strips near the numbers in a random order.

3. Students in teams are to look at all of the pictures and determine which of the foods gives the highest percentage of required calcium, the next largest amount, and so on, until decisions on calcium ranking of all 8 foods have been made. Initially, allow 10 minutes for this teamwork, but shorten to lesser amounts of time if you see that it doesn't take the teams very long.

4. A team representative then puts the team's ranking numbers on the food board under their team's column in order of the foods ranking for calcium. Put the foods' numbers in order of rank of calcium.

5. After all teams have placed their numbers, each team should be given one more opportunity to change the rankings, if they wish.

6. When all teams have decided on their final rankings, begin removing the food pictures off the board one-by-one, and revealing their true rank amount the foods in the current display (written in ink on the back, with a circle surrounding the number indicating its rank). Teams that have correctly assigned the rank of this food item are given one point.

7. Continue revealing the calcium ranking of the other items on the food board, awarding points for the teams that are correct. The team that has had the most points for correct rankings wins. If there is a tie, use a tie-breaker questions that teams can decide the answer to in the group.

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