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The Effectiveness of an Education Intervention Related to Knowledge Increase Among Adolescents Regarding Dietary Calcium and Prevention of Osteoporosis

Deborah K. Fast
Grand Valley State University

THE EFFECTIVENESS OF AN EDUCATIONAL INTERVENTION RELATED TO KNOWLEDGE INCREASE AMONG ADOLESCENTS REGARDING DIETARY CALCIUM AND PREVENTION OF OSTEOPOROSIS

By

Deborah K. Fast

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Thesis Committee Members:

Cynthia Coviak, Ph.D, R.N.

Phyllis Gendler, Ph.D, R.N, C.S.

Jeanette Waite, M.S, R.D, C.D.E.

ABSTRACT

THE EFFECTIVENESS OF AN EDUCATIONAL INTERVENTION RELATED TO KNOWLEDGE INCREASE AMONG ADOLESCENTS REGARDING DIETARY CALCIUM AND PREVENTION OF OSTEOPOROSIS

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The purpose of this study was to assess the effectiveness of an educational intervention for 6^{th} – 11^{th} grade adolescents regarding dietary calcium and the prevention of osteoporosis. This was a secondary analysis of data from a study that used a pre-experimental pre-test-posttest; no control group design. Eighty-two boys and 102 girls completed the Healthy Bones Knowledge Questionnaire (HBKQ) as a pretest, received an educational intervention based primarily on dietary calcium intake, then completed the questionnaire again as a posttest.

As a group, the students demonstrated a significant increase in correct answers to calcium-related HBKQ items ($t = 3.31$, $p = .001$). Further analysis revealed that girls experienced a knowledge increase ($t = 2.95$, $p = .004$) while boys did not.

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CHAPTER ONE

INTRODUCTION

Osteoporosis is a crippling disease without a cure. "It is a metabolic bone disease characterized by low bone mass and microarchitectural deterioration of bone tissue leading to enhanced bone fragility and a consequent increase in fracture risk" (National Osteoporosis Foundation, 1997, p. 2). Osteoporosis affects over 25 million people in the United States. Today, 10 million Americans already have the disease, and another 18 million have low bone mass placing them at increased risk for osteoporosis (National Osteoporosis Foundation, 1997). The annual medical cost of this disease is about $13.8 billion. According to the National Osteoporosis Foundation (1999), in the year of 1995, osteoporosis fractures were the presumed cause of 432,000 hospital admissions, almost 2.5 million physician visits, and about 180,000 nursing home admissions in the United States.

Calcium is a major part of the crystalline salt, hydroxyapatite, that is arranged around an organic matrix of collagenous protein to give bone its compressional strength and rigidity. Calcium is the most abundant mineral in the human body. Ninety-nine percent of the body's calcium is found in the bones and teeth (National Osteoporosis Foundation, 1997). Therefore, a lifelong intake of adequate calcium is necessary for the acquisition of peak bone mass and maintenance of bone health. Unfortunately, when the exogenous supply of calcium is inadequate, calcium is extracted from the skeleton to maintain serum considered bone removal from the skeleton, leaving the bone fragile and at risk for developing osteoporosis (National Osteoporosis Foundation, 1997). The facts illustrated above reinforce the importance of calcium and its role towards osteoporosis prevention.

The development of osteoporosis is mainly influenced by two factors: peak bone mass which is attained in the first 2 to 3 decades of life, and the rate at which bone is lost later in life (National Institute of Health, 1994). Genetics and environmental variables, such as adequate nutrition, determine bone mass. Even though genetics primarily determine one's peak bone mass, nutrition also plays a key role.

Osteoporosis has been referred to as "a pediatric disease with geriatric consequences" (Heaney, 1993). The current focus on reducing the risk of osteoporosis and skeletal fractures in later life is aimed at the role of calcium consumption in building bones during childhood and adolescence. Bone is added to the skeleton faster than bone is removed during periods of growth in children, adolescents, and young adults. This results in a high calcium demand in childhood, particularly in infancy and adolescence (Amschler, 1999, citing Matkovic, 1990).

Abram and Stuff's (1994) study, found that adequate calcium intake is essential during childhood and adolescence for bone formation, and it may be a significant factor in reducing the risk of osteoporosis in later life. During growth, calcium appears to influence bone mineral accumulation, and researchers have identified a significant relationship between bone mineral content and calcium intake (Barr, 1994). According to the U.S. Department of Agriculture (1992), the best way for children and adolescents to obtain adequate calcium intake is through eating foods high in calcium.

Unfortunately, it has appeared that significant percentages of children and adolescents, especially females, are not consuming and absorbing enough dietary calcium during this period of peak bone mass accretion (Abrams & Stuff, 1994; Barr, 1994; Weaver, 1996). The findings from the third National Health and Nutrition Examination Survey (NHANES III- 1989 – 1991) revealed that children and adolescents fail to meet the recommended calcium intake levels, and that the current calcium intake is lower than the intake reported in an earlier survey (NHANES II- 1976 – 1980; NIH, 1994). The recommended daily allowance (RDA) of calcium is 1,300 mg of calcium for children and adolescents (National Academy of Sciences, 1997). However, most children and adolescents ingest between 800 mg and 1,000 mg of calcium daily (Abrams & Stuff, 1994).

Osteoporosis is a disease that is preventable. With an adequate nutrient intake, the manifestations of osteoporosis are less likely to show themselves in one's life span. Therefore, one of the goals for preventing osteoporosis is to implement adequate calcium intake in childhood and adolescence.

In order to impact young adolescents regarding calcium intake, health-promoting actions need to be facilitated. The national health promotion and disease prevention objectives encourage schools to provide nutrition education from preschool through 12th grade (Public Health Service, 1991). "With the majority of the nation's children enrolled in elementary and secondary schools, school-based health promotion programs can exert a major influence on the acquisition of health-promoting behaviors among children and adolescents" (Pender, 1996, p. 82).

Publicizing health-promoting behaviors at school, as well as providing education in the classroom about the importance of calcium intake, will encourage greater calcium consumption. Evaluations have suggested that school-based nutrition education can improve the eating behaviors of young persons (Contento, Manning, & Shannon, 1992). More than half of U.S. youths consume one of their three major meals in school, and one in 10 children and adolescents consume two of three meals in school (Dwyer, 1995).

Nola Pender brought national and global attention to the Health Promotion Model (HPM) in mid-1980s and 1990s. The HPM served as a guide for exploration of the complex biopsychosocial processes that motivate individuals to engage in behaviors directed toward the enhancement of health (Pender, 1982). This model has been utilized in many studies observing health-promoting behaviors.

Pender's Health Promotion Model (HPM) provides a philosophical framework to analyze the various personal factors of young adolescents involved in a school-based intervention. In this study, the personal factor of level of knowledge retained from a school–based intervention regarding calcium consumption is studied.

Purpose

The purpose of this study is to determine whether a school-based intervention changed the knowledge of young adolescents regarding calcium consumption and the prevention of osteoporosis.

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

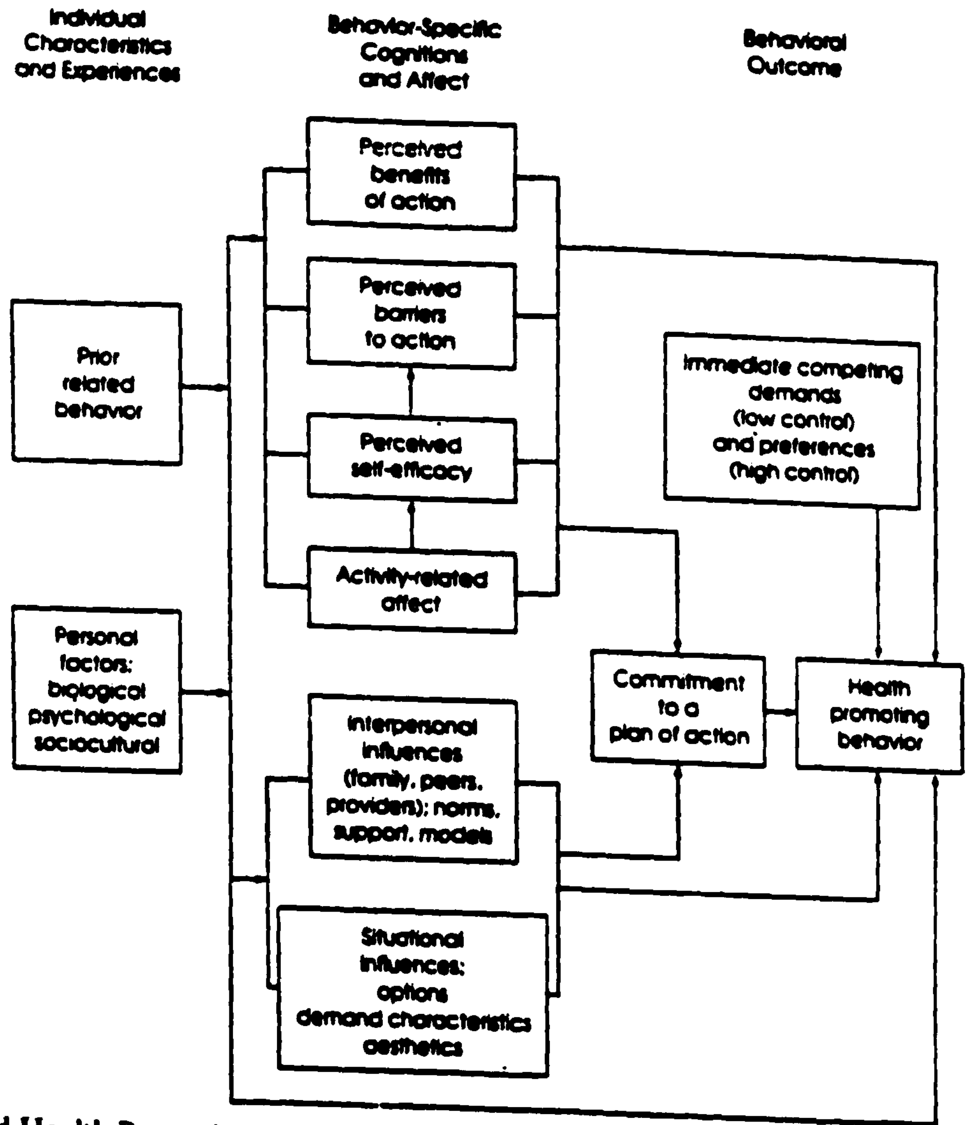
Since the late 1980s, public attention has been aimed at health promotion. Today, health promotion is the primary focus of health care. Several nursing theories and models have been developed specifically to promote healthy behaviors among individuals. The Revised Health Promotion Model (RHPM) developed by Nola Pender (1996), is one such model and has provided the conceptual framework for this study. (See Figure 1)

Conceptual Model

The original Health Promotion Model (Pender, 1982) consisted of three broad categories of cognitive-perceptual factors, modifying factors, and participation in health-promoting behavior. These broad categories subsumed thirteen determinants of behavior. These determinants of behavior consisted of the following: importance of health, perceived control of health, perceived self-efficacy, definition of health, perceived health status, perceived benefits of health-promoting behaviors, perceived barriers to health-promoting behaviors, demographic characteristics, biologic characteristics, interpersonal influences, situational factors, behavioral factors, and cues to action.

Pender (1996) revised the Health Promotion Model into ten determinants of behavior rather than thirteen determinants of behavior. In the revised Health Promotion Model

Figure 1



Revised Health Promotion Model. (From "Health Promotion in Nursing Practice", third edition by Nola J. Pender, 1996. Published by Appleton & Lange. Copied with permission. See Appendix A).

(RHPM), importance of health, perceived control of health, and cues to action determinants of behavior were deleted. According to Pender (1996), the definition of health, determinants of perceived health status, and demographic and biologic characteristics are repositioned in the model. Selected variables from the personal factors can be considered as relevant influences on a particular health behavior in a given target population.

The RHPM includes the following broad categories: Individual characteristics and experiences, behavior-specific cognition and affect, and behavioral outcomes. These broad categories are broken down into ten determinants of behaviors. The ten determinants of behavior consist of the following: *prior related behavior, personal factors, perceived benefits and barriers to action, self-efficacy, activity-related action, interpersonal influences, situational influences, immediate competing demands, and commitment to plan of action* (Pender, 1996). Figure 1 illustrates the existing interrelationships occurring between each determinant of behavior.

The determinant of *prior related behavior* is defined "as frequency of the same or a similar behavior in the past. It is proposed as having both an indirect and direct effects on the likelihood of engaging in health-promoting behavior" (Pender, 1996, p. 66). Prior behavior is known to be the best predictor of an individual's behavior. Personal factors have been categorized as *biologic, psychologic, and sociocultural*. Personal *biologic* factors include variables such as age, race, gender, pubertal status, and body mass index. Personal *psychologic* factors consist of self-esteem, self-motivation, perceived health status, and definition of health. Personal *sociocultural* factors reflect race, ethnicity, acculturation, education, and socioeconomic status (Pender, 1996).

Perceived benefits of action consist of "anticipated benefits of actions related to mental representations of the positive or reinforcing consequences of behavior" (Pender, 1996, p. 68). They tend to influence one's engagement in a specific health behavior. *Perceived barriers* to action are often viewed as "blocks, hurdles, or personal costs of a certain behavior taken" (Pender, 1996, p. 69). Perceived barriers may affect intentions to engage in a particular behavior. These barriers may be imagined or real.

"*Self-efficacy* is the judgement of personal capability to organize and execute a particular course of action" (Bandura, 1977, p. 69). Self-efficacy is based on one's individual skill. It focuses on the individual's level of judgement of what he or she can do with that particular skill. *Activity-related affect* "consists of subjective feelings that occur prior to, during, or following a behavior based on the stimulus properties of the behavior itself" (Pender, 1996, p. 70). The affective responses may be mild, moderate, or strong.

Interpersonal influences are affected by beliefs and behaviors of others. Norms, social support, and modeling comprise interpersonal influences. "The primary sources of interpersonal influence on health-promoting behaviors consist of families, peers, and health care providers" (Pender, 1996. P. 71). *Situational influences* of health-promoting behavior consist of "perceptions of options available, demand characteristics, and aesthetic features of the environment in which a given behavior is proposed to take place" (Pender, 1996, p. 71). Situations may directly affect behaviors by presenting stimulating environments containing various cues that trigger action.

Commitment to a plan of action is the "commitment to carry out a specific action at a given time and place, with specific persons or alone, and identification of definitive strategies for eliciting, carrying out, and reinforcing the behavior" (Pender, 1996, p. 72). *Immediate competing demands* refer to "alternative behaviors that intrude into consciousness as possible courses of action immediately prior to the intended occurrence of a planned health-promoting behavior" (Pender, 1996, p. 72). Immediate competing demands can take over the original plan of action and alter the health-promoting action.

The focus of the current study was the impact of an educational intervention on knowledge change related to osteoporosis and related calcium health behavior. Pender (1996) suggests that personal factors include various components, one of them being knowledge. Therefore, in this study the personal factors of the young adolescent are expected to influence the amount of information he or she may obtain that is related to dietary calcium and osteoporosis following the educational intervention. Applying the RHPM (Pender, 1996) personal factors, in the current case, knowledge, may have a direct influence on the adolescent's health beliefs and behavior.

The adolescent's foundation of knowledge will gear him or her towards behavior change. Knowledge opens the door to understanding why healthy behaviors are important. Not only does knowledge provide an understanding for the adolescent, but also a rationale for the change in his or her health behaviors.

Without the component of knowledge, the adolescent is less apt to change his or her health behavior. The adolescent is less apt to change his or her behavior because of being uninformed of the added health benefits of such a behavior change. Without being informed of the health benefits, how can an adolescent make a logical decision based on his or her health behaviors? Only gained knowledge will inform the adolescent of the health consequences following his or her behaviors. Furthermore, gained knowledge will allow the adolescent to make healthy choices and behavior changes in regards to his or her health and nutrient intake.

Today, the focus of health care lies in health education. In fact, the known hallmark for the advanced practice nurse is patient education across all life spans. Nurses not only provide education in the health care setting, but also in the school setting. Nurses have gained an important role in health promotion within the school systems across the United States.

According to McArthur (1998), "School-based interventions offer a number of advantages for effectively improving the consumption and nutritional patterns of children because more than 95% of children in the United States are enrolled in school" (p. 36). The school setting is an ideal environment for educational interventions. The school setting is a primary environment to increase the adolescent's knowledge regarding calcium intake and its importance in preventing osteoporosis. This knowledge increase may lead to health behavior changes among adolescents related to their calcium intake. The standard of calcium intake and its importance should be taught in all school settings, reaching young adolescents.

Pender's RHPM (1996) provides a logical framework for exploration of the adolescent's knowledge. Knowledge, as well as the other personal factors, affects the adolescent's ability to comprehend and retain information related to dietary calcium. The psychologic and sociocultural components of the adolescent may directly influence or mold his or her level of knowledge. This present level of knowledge may directly influence how the adolescent will understand and retain the educational intervention related to dietary calcium. His or her level of comprehension will determine the amount of calcium-related knowledge gained. This knowledge increase *may* lead the adolescent towards health behavior changes, such as an increase in calcium intake. Overall, the dietary calcium increase may be a factor in preventing osteoporosis from occurring in adult life.

"Pender emphasizes that health-promoting behavior is ultimately directed toward attaining positive health outcomes for the client that should result in a positive health experience throughout that person's lifetime" (Friedman, 1998, p. 409). The RHPM focuses on movement toward enhancing one's health and well being. Relative to this study, the focus of movement is to increase the adolescent's knowledge related to dietary calcium and osteoporosis. As knowledge is gained, the adolescent should be aware of the added health benefits of calcium consumption particularly in the prevention of osteoporosis. Knowledge of the health rewards of calcium consumption will empower the adolescent to make a change in his or her behavior related to calcium intake.

Research Question

The following question was tested in this study:

What is the effect of a classroom educational intervention on the knowledge of 6^{th} through 11^{th} grade students concerning dietary calcium and risk factors related to osteoporosis?

Conceptual Definition of Terms

Adolescence – "a period of transition that is based on childhood experiences and accomplishments and ultimately aspires to mature, independent, and responsible functioning" (Whaley & Wong, 1991, p. 869).

Calcium- "most abundant mineral in the body, located in the bones and teeth" (Chan, 1991, p. 631).

Knowledge- "learning; all that has been perceived or grasped by the mind" (Webster's New Twentieth Century Dictionary, 1983, p. 1007).

Intervention- "the actions to be taken to achieve the stated goals" (Wilson & Kneisl, 1992, p. 55).

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

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).

Osteoporosis-" a chronic, progressive disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to bone fragility and a consequent increase in fracture risk" (National Osteoporosis Foundation, 1999, p. 26).

Operational Definition of Terms

Osteoporosis Knowledge- number of correct answers on the Healthy Bones Knowledge Questionnaire (Martin, Coviak, Mellen, Gendler, Kim, & Rodrigues-Fisher, 1999).

Healthy Bones Knowledge Questionnaire- a paper and pencil test related to osteoporosis risk factors and the role of dietary calcium in osteoporosis prevention.

Adolescent- Males and females in grades 6 through 11.

Knowledge Change- Change in scores on the Healthy Bones Knowledge Questionnaire.

LITERATURE REVIEW

Dietary Calcium Research in Adolescents

The literature pertaining to calcium and adolescents indicates that the majority of adolescents are not meeting the Recommended Dietary Allowance (RDA) of calcium. According to the National Academy of Sciences recommendations for adequate calcium intake (1997), children 1 – 3 years should ingest 500 mg, 4 – 8 years should ingest 800 mg, 9 – 18 years should ingest 1,300 mg, and 19 years and up should ingest 1,000 mg of calcium per day. Unfortunately, several studies indicate a calcium deficiency within the adolescent's diet.

Lysen and Walker (1997) conducted a study comparing 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. The non-modifiable risk factors were gender, ethnic heritage, and family history. A food frequency questionnaire (FFQ) was used as the study's tool.

Specifically focusing on the calcium intake, the authors found that 21% of the eighth grade population did not meet the RDA for calcium intake at that time period, of 1200 mg per day. Recently, the National Health Institutes of Health (NIH) revised the recommended daily calcium intake from 1200 mg to 1500 mg per day (National Institute of Health (1994)). When compared to the new revision for calcium daily requirements, 36.2 % of the eighth grade population of the study was not meeting the RDA for calcium requirements for adolescents (Lysen &Walker, 1997).

Chan (1991) obtained data that also indicate that adolescents are lacking dietary calcium in their daily diet. Chan studied 164 white healthy children ranging from 2 to 16 years old; there were 88 boys and 76 girls. Each subject was free of medications, alcohol, or smoking that may affect their calcium metabolism. The research purpose of this study was to determine if nutritional and biochemical factors affect healthy children's bone mineral status. In this study dietary calcium intake was associated with bone mineral status.

Each child was seen twice during a 3- month period. In addition, a blood draw through a veni-puncture was used to obtain measurements of serum concentration of calcium, phosphate, magnesium, alkaline phosphate, parathyroid hormone, 1,25- di-hydroxyvitamin D and 25-hydroxyvitamin D. Bone mineral status was measured by photon absorptiometry using the lunar bone mineral analyzer. The analyzer contains a scanner module with a narrow collimated scintillation detector and an iodine 125-radionuclide source (Chan, 1991).

Chan's (1991) results indicated serum values of calcium, phosphate, magnesium, alkaline phosphatase, and vitamin D did not correlate with bone mineral status. Almost all (> 90%) serum values were within the normal range. Chan's results also showed that the bone mineral status was related to the children's diet. It reflected a nutrition deficit in children older than 11 years old. Only 15 % of girls and 53% of boys, 11 years and older, met the RDA of calcium. Therefore, 63 % of the children older than 11 years old were not consuming the RDA for calcium, which at that time was 1200 mg per day.

However, the children 11 years old and younger were meeting the RDA of 800 mg per day.

A limitation of this study was that all of the subjects were healthy, white, children. This study lacked the diversity of various racial and ethnic backgrounds, which would normally reflect varied dietary patterns. A larger sample size, consisting of various race and ethnic backgrounds, may have introduced new findings related to calcium intake and the bone mineral status of children and adolescents. Another limitation in this study is that the site of the veni-puncture was not mentioned. Serum concentration levels may differ depending on the location of the site in which the veni-puncture was obtained.

Harel, Riggs, Vaz, White and Menzies' study (1998) also obtained data showing that adolescents are not meeting the RDA for calcium per day. This research involved an anonymous survey of 1,117 ninth grade adolescents ranging from 14.6 to 15.0 years, asking questions regarding their calcium knowledge and dietary intake. These subjects were racially diverse, evenly representing Caucasian, Hispanic, Portuguese, African-American, Asian American, and Cape Verdean ethnic groups. This survey consisted of a 24- hour diet recall of the adolescents' food and beverages consumed, weight/height, and body mass index (BMI). Two registered dietitians reviewed every survey.

Among these students, only 11 % were consuming 1200 mg of calcium per day, which was the RDA at the time of the study. Only 14 % of boys and 8% of girls met this dietary requirement. The remaining 89% of the subjects were not meeting the RDA of 1200 mg. The male adolescents were consuming 681+/ -28 mg/ 24 hr (57% of RDA) and female adolescents were consuming 536+/ -19 mg/24 hr (45% of RDA). There were limitations of this study. The socioeconomic status of the subjects was not mentioned. The dietary calcium intake based on a 24-hr diet recall, as well as the height and weight may have been underestimated (Harel, et al., 1998).

Several studies indicate that dietary calcium is lacking in the adolescent's diet. It is equally important to research the benefits of dietary calcium in regards to the adolescent. Researching the benefits of dietary calcium should validate the nutritional importance it plays in the young adolescent's diet, particularly in osteoporosis prevention.

<u>Benefits of Calcium to Bone Growth</u>

Efforts toward reducing the risk of osteoporosis in later life have placed an emphasis on the role of calcium consumption during childhood and adolescence (Gallo, 1996). Strong evidence indicates that calcium intake directly influences skeletal makeup as well as bone density (Amschler, 1999, citing Johnston, Miller, Slemenda, Reister, Hui, Christian, & Peacock, 1992). According to Weaver (1994), desirable calcium intake during the adolescent years is essential for achieving peak bone density.

Unfortunately, past research indicates the adolescent's diet is falling short of the RDA for calcium. However, several research studies have shown the benefits of meeting the RDA for calcium. The following literature demonstrates the benefits of dietary calcium intake particularly to the adolescent's diet.

A study was performed on 45 identical pre-pubertal twin pairs over a three- year period. One identical twin received 700 mg of calcium daily and the other twin did not receive the calcium supplementation. The supplemented twin gained between 1% and 5% more bone mineral density (BMD) than the non-supplemented twin (Kerstetter, 1995, citing, Johnston, Miller, Slemenda, Reister, Hui, Christian, & Peacock, 1992). However, how much dietary calcium each twin consumed was not reported.

Another study (Kerstetter, 1995, citing Lloyd, Andon, & Rollings, 1993) implemented a study supplementing 350 mg of calcium per day in adolescent girls over an 18-month period. The BMD, of girls who received supplements, increased between 1% and 3% when compared to the non-supplemented girls. In a similar study, Andon, Lloyd, and Matkovic, (1994) divided 248 adolescent girls into three groups, who for 6 months received respectively 1000 mg supplemental calcium per day (high), 500-mg supplemental calcium per day (intermediate), and placebo. In this study the high supplemented, intermediate supplemented, and placebo groups gained 154, 138, and 125 of total body mineral content respectively. In a third investigation, Cadogan (1997) supplemented 80 adolescent girls with an additional pint of milk per day (approximately 600 mg), over 18 months. The supplemented girls experienced a 9.6% increase of bone density compared to a 8.5 % increase among the non-supplemented adolescent girls.

The above studies tend to only focus on adolescent females, which may create a biased perception of calcium intake in adolescents. However, adolescent females have been the focus of concern because their ingestion patterns for calcium seem to significantly fall below those of male adolescents. Many studies report adolescent females are less apt to consume calcium-rich foods due to fear of gaining weight (Amschler, 1999). In contrast, studies indicate the male adolescent ingests more calcium-rich foods to increase his physical size and strength (Frenn & Porter, 1999)

In summary, past research studies have indicated the benefits of dietary calcium related to the adolescent's bone density. Unfortunately, young adolescents fail to meet the RDA for calcium. This nutritional inadequacy of calcium intake during the period of adolescence is an alarming fact. A nutritional deficiency occurring in the adolescent years may lead to the crippling health consequences of osteoporosis in later years.

Adolescents Health Beliefs and Knowledge

The health beliefs and knowledge of the adolescent will greatly influence his or her health behaviors. In the process of examining literature regarding adolescents and osteoporosis prevention, it is essential to focus on the adolescent's health knowledge, particularly related to dietary calcium. Only one study was found that addressed this topic.

Harel, Riggs, Vaz, White, and Menzies (1998) conducted a study examining knowledge of 1,117 adolescents related to dietary calcium. Overall, the majority of their respondents (98%) believed dietary calcium is healthy and strengthens bones (92%), and may prevent osteoporosis (51%). However, only 20% were aware of its role in neuromuscular function and 15% in blood pressure regulation. Sixty percent were aware that adolescence is a significant period for bone mass accretion.

Focusing on the adolescent's knowledge regarding calcium, the researchers (Harel, et al., 1998), found that only 19 % of the adolescents were aware of the RDA at the time of the study, of 1200 mg of calcium. The majority of the subjects knew that dairy products are the main source of calcium, but only 10% knew about calcium content of the various sources of food. The subjects reported the main sources of information regarding calcium were health classes (55%) and parents (46%). Only 38% of the subjects reported that their health care providers discussed with them the benefits of calcium. Other sources of information consisted of books (26%), television programs (18%), friends (9%), and school nurses (7%).

This study reflects a pattern in the adolescent's level of knowledge regarding calcium consumption and his or her dietary intake of calcium. The surveys showed that adolescents, with more knowledge regarding the importance of calcium, had a higher dietary intake of that mineral. For example, adolescents who were educated on calcium's importance ingested 619-665 mg of calcium per day compared to adolescents who were uninformed, who only ingested 534-578 mg of calcium per day (Harel, et al., 1998).

Examining the adolescent's experience with his or her own health promotion is equally important because his or her experience with health promotion may influence health behaviors. Frenn and Porter (1999) conducted a study examining the adolescents' experience with health promotion particularly related to physical activity and eating patterns. This study consisted of fifteen racially and ethnically diverse adolescents ranging from ages 10 to 18 years old, examining their experiences with health promotion particularly related to physical activity and eating patterns. A semi-structured interview took place with the adolescents, asking them to describe their health, what they thought was important in promoting health, what they were actually doing to promote their health, and what made it difficult to engage in health promoting behaviors.

Adolescents in this study indicated that their beliefs related to health promotion are very similar to adults' beliefs with the exception that adolescents included "staying alive". This belief was particularly from the African American and Hispanic ethnic groups which reflects the impact violence has had on these adolescents. Adolescents also responded that the desire to partake in healthy behaviors was the result of school activities, a teacher, or peers. The reason for taking on health promoting behaviors was for the adolescent's own benefit. Fifty percent of the adolescents reported reading about health behaviors. The males indicated the reason to read such material was to become larger and stronger; the females' reason was to not feel fat and ugly. Most of the adolescents reported no obstacles related to staying healthy. The adolescents who did perceive obstacles identified the following: (a) things I do not understand, (b) not having healthy foods at home, (c) the health behaviors are hard to maintain, or (d) I was not in the mood, (Frenn & Porter, 1999).

Today, nutrition education has become one of the focal points among the school systems in the United States. According to the Public Health Service (1991), the national health promotion and disease prevention objectives encourage schools to provide nutrition education from preschool through 12th grade. In addition, the U.S. Department of Agriculture's (USDA) Nutrition Education and Training (NET) program stresses nutrition education as a large educational component of all child nutrition programs and to be offered in all schools, child care facilities, and summer sites by the year 2000 (Mandell, 1992). "School-based health promoting programs can exert a major influence on the acquisition of health-promoting behaviors among children and adolescents" (Pender, 1996, p. 82). The school setting is an accessible and effective environment to reach adolescents of all ages.

Research Related to Educational Interventions

In the literature review, no studies were found regarding a school-based intervention related to calcium intake and its importance in preventing osteoporosis. However, several studies were found showing the effectiveness of a school-based intervention for increasing knowledge regarding several health behaviors. The following studies reviewed illustrate the effectiveness of a school-based intervention as evidenced by an increase in the student's knowledge following each intervention.

Stewart, Lipis, Seemans, McFarland, Weinhofer, and Brown (1995) examined relationships among knowledge, food patterns, percent body fat, and cardiovascular disease risk factors over a three-year educational program, following 900 students from third to fifth grade, in 12 schools. Johns Hopkins Bayview Medical Center provided the educational program called FRESH (Food Re-education for Elementary School Health). The goal of FRESH was to promote heart healthy habits in children to prevent future heart disease. Since FRESH is a community service rather than an experiment, a control group was not present.

As an intervention, FRESH taught a lifestyle approach to disease prevention, providing basic knowledge about cardiovascular health, skill development, peer resistance, and behavioral proficiency. Each year, four, one- hour classroom lessons were taught by a health educator or dietitian. The classroom teacher was present during the lesson but was not an active participant. During the first year, the parents and teachers were offered workshops on healthy food and how it affects their child's diet (Stewart, et al., 1995).

Behavioral, cognitive, and physical data were obtained in the fall and spring of each year. The physical measures consisted of systolic and diastolic blood pressure, total serum cholesterol, anthropometric measures, and cognitive, and behavioral measures. The physical measures were obtained by taking the blood pressure three consecutive times, in the right arm, with the child seated. The total serum cholesterol levels were obtained through non-fasting blood samples by a finger stick. The cognitive and behavioral measures were obtained through surveys administered in the classroom (Stewart, et al., 1995).

After the three-year period, the children's scores showed a 30% increase in knowledge ($p < 0.0001$), and their use of sodium decreased by 16% ($p < .001$) from baseline. After three years, their systolic blood pressures decreased from 107.9 +/ -9.3 to 105.2+/ -10.9 ($p < 0.05$). Diastolic blood pressure did not change within the three-year period, however. Additionally, baseline total serum cholesterol decreased from 162.3+/ -28.3 mg/dl to 149.9+/ -24.8 mg/dl after two years (Stewart, et al., 1995).

However, in the third year, the total cholesterol of these children increased from 158.6+/ -28.7 mg/dl to 168.0+/ -28.7 mg/dl. Overall, the total cholesterol increased 4% from baseline ($p < 0.05$). Yet, according to Siberry and Iannone (2000), in spite of the increase, as long as the cholesterol levels are below 170 mg/dl, the children fall within desirable ranges for cholesterol levels.

No explanations for the increase were offered by the researchers however, in that particular year when the subjects were in the 5^{th} grade, entering preadolescence. A possible reason for the increase is that in preadolescence peer influence is quite powerful, and may have changed the subject's eating habits. The study's third year results reinforces the need for nutritional education within the school-age population.

This study had several limitations. There was a level of inconsistency in the teaching techniques and cooperation among the teachers. Furthermore, some parents refused consent for additional assessments because their child was "normal". Finally, within the last year of the educational program, the experienced health educator resigned from the

FRESH intervention team. With this resignation, the consistency of the teaching technique may have lessened (Stewart, et al., 1995).

This study shows the impact of an educational intervention in increasing knowledge among adolescents. Knowledge increases the adolescent's capability in choosing healthy behaviors. In particular, this study's focus was related to promoting healthy heart behaviors among adolescents. Healthy heart behaviors related to diet intake occurred following the educational intervention, reflecting its beneficial results of lowering the student's blood pressure two out of the three years (Stewart, et al., 1995). Therefore, knowledge must be reinforced in order for healthy behaviors to be implemented among adolescents.

Pitman, Hern, Gates, Amlung, and McCabe (1998) conducted a similar study, except on a considerably smaller scale. The objective of their study was to reduce dietary fat intake and to increase vigorous exercise among adolescents. The study's sample consisted of 23 adolescents (males: 10; females: 13), ranging from 14 to 17 years, predominantly Caucasian (87%), from suburban, Midwestern high school biology classes. The adolescents were recruited to participate in an educational program regarding cholesterol, nutrition, and exercise and their effects on total serum cholesterol levels. A parent permission and student assent was obtained followed by a brief medical history, which was completed and returned to the nursing faculty before the onset of the program.

The intervention group of this study consisted of one teacher's two classes of biology students (N=13), who received education about cholesterol, nutrition, and exercise. The other students did not receive an educational program, and served as the control group (N

=10). The educational program took place in the biology classrooms. Lessons provided information on total serum cholesterol, HDL, LDL, fast food information, sedentary activities, and light, moderate, and vigorous exercise. This content was taught over 20 to 30 - minute periods in three sections covering cholesterol, nutrition, and exercise. Handouts were distributed to the subjects to reinforce the information delivered. At least 6 weeks was the time period to compare total serum cholesterol level changes after the teaching intervention (Pitman, et al., 1998).

The nursing faculty supervised the completion of diet and exercise recall forms, obtained the cholesterol serum screenings, and educated the subjects about cholesterol, diet management, and exercise. The subjects had the following screenings in January, May, and October: total serum cholesterol levels, 24-hour dietary recall, 7- day exercise recall, blood pressure, weight, and height. The students' results were mailed to their parents after the second and third screenings. Students with high- risk levels were instructed to follow-up with their family physicians (Pitman, et al., 1998).

Several instruments were utilized for this study. A reflotron clinical analyzer measured the total serum cholesterol of the subjects. A computer food processor analyzed the 24- hour diet recall of all types and amounts of food eaten. Lastly, a 7- day recall was completed on the amount of vigorous, moderate, and light physical activity.

The total serum cholesterol levels for both the experimental and control group combined averaged low risk (less than 170 mg/dl) for three different measures. However, the groups' levels ranged from a low of 103 mg/dl to a high of 265 mg/dl. Seven students' cholesterol levels dropped from the initial screen after receiving the education; four students' levels dropped in the control group. The 24-hour dietary recall among the experimental and control group showed no significant differences in percentage of fat in the total calories consumed. Both groups did not exceed over 30% of total calories from fat. The total calories from fat ranged from 16% to 67%. Both groups reported eating high fat foods, which is a developmental behavioral trait of the adolescent population. The seven-day exercise recall indicated that the experiment and control groups were involved in vigorous activities during the week. The students' self-reports indicated two hours of vigorous exercise each week (Pitman, et al., 1998).

A limitation of this study was the small sample of 23 subjects. Furthermore, the findings were never statistically analyzed or indicated related to the subjects' total serum cholesterol levels, total calories from fat intake, and vigorous exercise. In addition, the students independently completed the 24-hour diet and the 7-day exercise recall. The students' self-reports may reflect inconsistency or false findings related to their diet and exercise documentation. This way of collecting data often lacks consistency and validity.

Devine, Olson, and Frongillo (1992) conducted a school-based nutrition educational program called "Nutrition for Life". Nutrition for Life focused on all the same nutrition, food choices, and nutritional needs over the life span, and fitness. The objective of this study was to evaluate the impact of Nutrition for Life related to nutrition knowledge, attitudes, and self-reported behavior of 7th and 8th grade students from New York State. The overall evaluation compared students' knowledge, attitude, and behavior scores on a paper/pencil test in classes of teachers who used Nutrition for Life versus scores of students who were taught nutrition but without Nutrition for Life.

The sample of this study consisted of 1,863 7th and 8th grade students in 103 randomly selected classes in New York State. Each subject completed a paper and pencil test covering nutrition attitudes, behavior, and knowledge. Fifteen community-based peer-training teams provided Nutrition for Life training workshops to the 7th and 8th grade teachers. Afterwards, a survey was administered to assess how many teachers were implementing Nutrition for Life within their classrooms. Out of the 233 teachers who responded, 100 were using Nutrition for Life and 133 were not. The 233 teachers indicated they were teaching nutrition in health, home, or career skill classes (Devine, et al., 1992).

Two test forms were used to evaluate the students' gained knowledge related to nutrition. One test consisted of items on nutrition knowledge, attitudes, and behavior; it was sent to the teachers implementing the program. The second test consisted of attitude and behavior items; this test was sent to teachers not using the Nutrition for Life curriculum.

Overall, knowledge scores, nutrition attitudes, and behavior were higher in the Nutrition for Life user group (76%) than in the non-Nutrition for Life group (61%). Three groups formed within this study: (a) 26 classes in which no nutrition was taught (NO TEACH), (b) 37 classes in which nutrition was taught without using Nutrition for Life (TEACH) and (c) 35 classes in which nutrition was taught using Nutrition for Life (NFL). The knowledge scores of the three groups were respectively NO TEACH= 16, TEACH=9, and NFL=30, indicating the classes using NFL had significantly higher ($p < .0001$) nutrition knowledge scores than classes in which nutrition was taught without NFL (Devine et al., 1992).

Analyzing the differences in attitudes among classes using NFL teaching showed various results. On a scale of 1 to 5, the home and career classes using NFL reflected higher attitude score of 3.7 versus the TEACH home and career class attitude score of 3.6. The health classes using NFL also had higher attitude score of 4.0 versus the TEACH health class attitude score of 3.8. Furthermore, on a scale of –1 to +1, the home and career classes using NFL had a significantly higher mean nutrition behavior score of 0.18 versus the TEACH home and career class score of 0 .09. The NFL health classes also had a higher mean nutrition behavior score of 0.19 versus the TEACH health class score of 0.16. Overall, students exposed to five hours of NFL, versus two hours, scored significantly higher in nutrition attitude scores ($p = .04$). The nutrition behavior scores showed a similar pattern for those having longer NFL teaching (Devine, et al., 1992).

The United States is not the only country whose focus is geared towards school-based nutrition education and health promotion. Manios, Moschandreas, Hatzis, and Kafatos (1999) conducted a school-based intervention in Greece. The school-based intervention program began in 1992 with 4,171 first grade students within two counties of Crete. A third county of Crete with 1,510 first graders served as the control group. The objective of this school-based intervention was to promote healthy dietary and lifestyle habits among children. The primary focus of this study was to increase the awareness and knowledge of parents and children regarding a healthy diet and regular physical activity.

The intervention consisted of a health promotion program called "Know Your Body" derived from the American Health Foundation (Williams, Carter, & Eng, 1980). Workbooks were given for grades 1-6 covering dietary issues, physical activity, and fitness, dental hygiene and health, smoking, and accident prevention. The Preventive Medicine and Nutrition Clinic at the University of Crete designed and produced teaching aids consisting of posters, audio-tape fairy tales for classroom use, workbooks, and teaching manuals (Manios, et al., 1999).

Classroom teachers provided the health and nutrition components of the program by incorporating 13 to 17 hours of teaching over the academic year. The physical education (PE) instructors provided two 45- minute PE sessions per week, equaling a total of 60 classes per year. The intervention also provided 4 to 6 hours of classroom material for the subjects involved in the study. The control group did not have any health education intervention. During the PE classes, the subjects played freely under supervision of their class teacher.

The data were collected from the students during the morning periods of school during September through November 1992 through 1995. A multiple-choice questionnaire was used to assess the students' knowledge at the beginning and at the end of the three-year intervention. The questionnaire focused on diet, food products, and physical activity. The fitness assessment of the pre- and post- intervention evaluation was based on the EUROFIT tests protocol, designed by the Committee of Experts on Sports Research. The EUROFIT tests consisted of sit and reach (SAR), sit-ups (SUP), handgrip test (HGR), standing broad jump test (SBJ), and endurance 20m- shuttle run test (20mSRT). The body mass index (BMI) was also calculated by dividing wt. (kg) by height squared (m2) multiplied by 100. Lange skin fold calipers were used to measure the left tricep, bicep, subscapular, and suprailiac skin fold thickness. Venous blood samples were obtained from each child early in the morning, following a 12-hour overnight fast.

The study's results, following the three year program indicated that the intervention group experienced a decrease in total serum cholesterol levels, while the control group had an increase; the mean total serum cholesterol value for the intervention group was 173.7 mg/dl, and 190.6 mg/dl for the control group ($p = 0.001$). Children in the intervention group had a significantly higher gain in height over the three-year period compared to the control group (adjusted mean gains were 15.5 cm for the intervention group and 11.8 cm for the control group, $p = 0.009$). Furthermore, the control group showed a significantly higher change in the BMI than the intervention group (adjusted mean gain 1.8 kg/m2, $p = 0.001$) (Manios et al., 1999).

The intervention group's SBJ and SUP mean measurements over the three-year period were significantly higher values when compared to their initial values and to the control group (mean adjusted increases of 27.0, and 26.1 cm in the SBJ, and 7.8 and 5.3 repetitions for intervention and control groups). The intervention students also achieved significantly higher health knowledge mean scores at follow-up than the control students; the adjusted mean increase in the health knowledge scores for the intervention group was 12.5%, and 10.3% for the control group (Manios et al., 1999).

A limitation of this study consists of the control group lacking any health education intervention. Denial of health education to the control group during the study presents an uncommon ethical situation, which may be viewed as unjust or immoral.

Harris, Paine–Andrews, Richter, Lewis, Johnston, James, Henke, and Fawcett (1997) also examined the effectiveness of a school-based intervention called the Kansas Lean Project. This project consisted of three school-based goals: modified school lunches, enhanced nutrition education, and increased opportunities for physical activity. The intervention took place in the communities of Salina and Dighton school districts. The Salina population consists of 42,300 in an urban setting with over 6,000 students and 15 schools in the district. Cooks prepared the school meals in four centralized kitchens. Dighton consists of a population of 1,400 in a rural setting with 400 students. The school meals were prepared in one central kitchen.

The intervention of this study consisted of two registered dietitians working on site for approximately 20 to 30 hours per week assisting the food service staff, classroom teachers, and physical education (PE) teachers in conducting nutrition analysis of menus, modifying menus, implementing enhanced nutrition education in classrooms and enhancing fitness activities. In Salina, 4th graders from one school (n =74) received the intervention and 4th graders from two other schools in Salina served as the comparison group (n = 62). In Dighton, all of the 5th graders participated in the intervention (n =34). There was no comparison group in the Dighton schools, because there is only one elementary school. In both schools, PE teachers agreed to participate in designing and delivering the Kansas Lean Project (Hamilton et al., 1997).

The Kansas Lean School Intervention project's goals consisted of changing school lunches to reduce dietary fat while maintaining adequate calories; enhancing nutrition education by promoting an increase in consumption and variety of fruits and vegetables, more high-fiber foods, and fewer higher fat foods; increasing physical activity by incorporating classroom fitness status and modifying PE classes to increase cardiovascular fitness activities.

Using menu analysis, a review of food service records, and student surveys on nutrition and fitness, it was found that the percentage of youth who answered the nutrition knowledge skills and attitude scores correctly or more favorably, increased their scores significantly from pre-test (71%) to post-test (84%) in Dighton. This increase was maintained at a one-year follow-up (83%). In Salina, the intervention students' scores were significantly higher (82%) in nutrition knowledge, skills and attitude versus the comparison students (74% & 72%) who did not receive the Kansas Lean School Intervention Project. Similar findings were replicated with 5th graders receiving the same school intervention in the following year, their knowledge increased from pretest (68%) to posttest (83%). After the intervention, the results indicate the fat content of school lunches was reduced, maintaining or increasing the total calories at both sites. In Dighton, the fat content of the school lunches decreased from 40% to 30%. In Salina, it reduced from 38% to 30% after the menus were modified. In both school sites, physical fitness increased from pretest to posttest. In Dighton, the percentage of the students' fitness level increased from pretest (18%) to posttest (29%). In Salina, the intervention students showed a significantly larger reduction in the amount of time to finish the mile run from pretest to posttest compared to same grade students in comparison schools. The girls in the intervention group reduced their average time by 1.21 minutes compared to the girls in the comparison group, who reduced their time by only 0.32 minutes. The boys' intervention group reduced their average time by 1.76 minutes, versus the comparison group, which only reduced its average time by 0.64 minutes (Hamilton et al., 1997).

Nicklas, Johnson, Myers, Farris, and Cunningham (1998) conducted a multi-component, school-based nutrition intervention with 2,213 students (56% female, 44% males) in 12 Archdiocesan high schools in greater New Orleans. The majority of the subjects were Caucasian (84%) with African-American (4%), Hispanics (9%), and other ethnic groups represented (3%). The objective of this study was to increase the fruit and vegetable intake of the subjects over a three - year period. The subjects were followed from 9th through 12th grades.

The intervention consisted of school-wide media campaigns, classroom workshops, school meal modification, and parental support. A class administered, 45- minute self-report instrument evaluating knowledge, self-efficacy, program awareness, stages of change, and fruit and vegetables was used. Over the 3 years there was an increase of 14% in daily serving of fruits and vegetables of the intervention group compared to the control group. The intervention group's knowledge scores were also significantly higher than those of the control group ($p < .0001$) (Nicklas et al., 1998).

Limitations of this study include its failure to obtain a sample representative of minority ethnic groups. The majority of the subjects were Caucasian (84%). Also, because the fruit and vegetable consumption was measured through self-report, it puts in question the validity of the results.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) (1996), implemented the largest school-based field trial sponsored by the National Institute of Health (Resnicow, Robinson, & Frank). CATCH implemented an *Eat Smart* nutrition program in 56 schools, representing an ethnically and socio-economically diverse student population, over a 3-year period. The purpose of CATCH was to assist school food service personnel and faculty in implementing the current dietary recommendation for total fat, saturated fat, and sodium. The CATCH study had three goals to accomplish at the environment and individual level. The first goal was: (a) decrease the saturated fat in food served in school cafeterias to no more than 30%, and less than 10% of total calories (b) to allow 600-1000mg of sodium per lunch meal, respectively, (c) increase the amount of physical education (PE) class time that students spent in moderate to vigorous physical activity to 40%, (d) on the individual level, reduce total cholesterol by 5mg/dl relative to comparison students.

The *Eat Smart* program consisted of four major interventions: menu planning, food purchasing, food preparation, including recipe modification and food production, and program promotion. To reinforce the Eat Smart school nutrition program, the CATCH nutritionists conducted standardized two-hour booster sessions at the beginning, second, and third year of the study. Furthermore, nutritionists conducted visits to each intervention school at least once a month during the trial.

Over the course of the CATCH study, the project did not meet its goals for reduction in fats, but there was a significant decrease in the percentage of fat calories in the foods served in school lunches of intervention schools, (decreased from 38.7% to 31.9%), compared to the control schools, (where the decrease was 38.9% to 36.6%). The saturated fat in the experimental schools also decreased from 14.8% to 12.0% in the school lunches compared to the control schools, 15.1% to 13.7%. The sodium increased during the study, however, significantly less so in the experimental schools than in the control sites. Children in the CATCH schools also showed a significant increase in moderate to vigorous physical activity during PE class from 37% to 52% compared to the control sites 34% to 42% (Resnicow, Robinson, & Frank, 1996).

There were several weaknesses in the CATCH study. The magnitude of this study may make it difficult for other schools to replicate a similar study. Furthermore, CATCH may be unrealistic in regards to time and money for other schools to implement a similar study. One of the strengths of this investigation is the large and diverse sample of 56 schools studied over a three-year period of time. A study such as CATCH, conducted over a long duration, has greater chances of revealing consistent behaviors from the subjects, thereby ensuring reliability and validity of results.

Overall, the CATCH study illustrates the impact it had in a multitude of schools and students. This study obtained the majority of its health goals, having a significant public health impact. CATCH is a significant contribution to the body of literature illustrating the effectiveness of school-based interventions in increasing knowledge and behavior changes related to health promotion among students.

Nutrition is not the only target of educational intervention within the school setting. The following research studies indicate that educational interventions have expanded outside the realm of nutrition education: Farrell and Meyer (1997) implemented a study focusing on the effectiveness of a school-based curriculum for reducing violence among urban sixth grade students; Levy, Perhats, Weeks, Handler, Zhu and Flay (1995) have also assessed the impact of a school-based AIDS prevention program on risk and protective behavior for newly sexually active students; Lowe, Balanda, Stanton, and Gillespie (1999) implemented a school-based study, over a three-year period, evaluating an educational intervention to increase sun protection among adolescents.

Overall, the above studies were successful in obtaining a knowledge increase among their subjects. However, several investigators found that only some of the subjects were receptive to a knowledge increase. For instance, the results of Farrel and Meyer's (1997) study show that some of the subjects did not achieve a knowledge increase, due to absenteeism, expulsion, or dropping out of school during the educational intervention. In the study by Levy et al. (1995) number of sexual partners did not change, however, the intervention group did indicate a knowledge increase by indicating a variety of barrier contraceptives used. Lastly, Lowe et al. (1999) found a knowledge increase, by the schools reinforcing sun protective behaviors among students. However, the level of policy implementation in some of the schools changed; therefore, some of the subjects did not show a similar level of knowledge increase as other subjects in various schools.

Today, the school setting is becoming the ideal environment for health education related to health promotion and disease prevention for students of all ages. Through past research, it has been shown knowledge increase occurs through educational interventions. This gained knowledge may promote behavior change among young adolescents and possibly enhance their quality of life.

CHAPTER THREE

METHODS

Research Design

This research was a secondary analysis of data from a previous study that used a pre-experimental design with pretest and posttest. The purpose of this study was to assess the effectiveness of a school-based intervention designed to impact adolescent knowledge regarding calcium intake and its prevention of osteoporosis. The Healthy Bones Knowledge Questionnaire (HBKQ) (Martin, Coviak, Mellen, Gendler, Kim, & Rodrigues-Fisher, 1999) was administered to all participants before the school-based intervention and again after the intervention. The independent variable was the exposure to the school-based teaching. The adolescents' knowledge increase related to calcium intake and its importance in preventing osteoporosis served as the dependent variable.

The original study was conducted in the spring of 1999. The data were collected in the students' classrooms at the beginning of the science period. An educational script was used to ensure consistency of the school-based intervention directed to $6^{th} - 11^{th}$ grade students. In this study, a secondary analysis was completed specifically focusing on the role of calcium in osteoporosis prevention. Knowledge scores related to calcium intake and prevention of osteoporosis before and after the school-based intervention were examined.

Sample & Setting

A convenience sample of 184 adolescents from the original study were used. The data collection for the initial study occurred in a small public charter school located in west Michigan. The sample of subjects consisted of a multiethnic group, however, the majority consisted of Caucasian ethnicity. All students in grades 6th – 10th were targeted as subjects of this study.

Characteristics of the Sample

Table 1 summarizes the number of participants as a whole in each grade level, with boys and girls combined together (N = 184). The boys and girls ranged from 11 to 17 years old. The mean age was 13.5 years (SD= 1.28). Students from grades 6 through 11 were represented, with 8th grade being the mode for both groups combined.

Table 1

Number of Male and Female Participants as a Whole in Each Grade

Grade	Boys & Girls (N= 184)
6th grade	21
7th grade	50
8th grade	65
9th grade	45
10th grade	1
11th grade	2

Table 2 summarizes the number of male and female participants at each grade level in both groups. The boys' group was smaller in number (N= 82) than the girls' group (N=102). The mean age was 13.4 (SD= 1.3) for the boys' group and 13.5 (SD=1.3) for the girls' group. The ages ranged from 11 to 17 years for both of the groups. Grades 6th through 11th represented the sample of subjects, with the 8th grade being the mode for both groups.

Table 2

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

Instrument

The initial study used the Healthy Bones Knowledge Questionnaire (HBKQ) to measure student knowledge regarding calcium intake and osteoporosis. Kim, Horan, and

Gendler (1991) developed the Osteoporosis Knowledge Test for the adult population. The Osteoporosis Knowledge test was then used as a guide for the adolescent version (HBKQ) developed by the research team at Grand Valley State University (Martin, Coviak, Mellen, Gendler, Kim, & Rodrigues-Fisher, 1999). The adolescent test was modified to the appropriate age and developmental level. The questionnaires were gender oriented for male and female students. The female version (See Appendix B) asked questions related to menstruation. The male version (See Appendix C) eliminated questions related to menstruation and had different exercise options for the males to consider. A demographic questionnaire was attached to the front of each version of the HBKQ, but served primarily as an identification number to match the student's pretest and posttest scores (See Appendix D).

The HBKQ was developed by adaptation of the adult instrument, prior to its administration to a group of female students in grades 7 – 12 (N=100) who took the test in Spring 1998. Two weeks later, 50 female students were randomly selected from the original pretest sample to complete a retest. Out of the 50 female students, three groups of 5 to 6 girls were selected to participate in focus groups after taking the retest. The retest and focus groups served as a tool to evaluate the level of clarity in the questions and directions of the HBKQ. The original test scores and pretest scores reflected a test-retest stability coefficient of > .65. The K-R 20 for internal consistency was .67.

In this current study, the girls' pretest K-R 20 was .5145; the boys' pretest K-R 20 was .6070. The girls' posttest K-R 20 was .6477; the boys' posttest K-R 20 was .7443. The boys' stronger K-R 20 coefficient gives a higher level of credibility to their knowledge scores. Overall, for the combined sample the pretest K-R 20 was .5799 and the posttest

K-R 20 was .7036. The posttest K-R 20 was consistently higher in the boys, girls, and as a whole, than the pretest K-R 20.

The HBKQ consists of two sub scales. The female version consisted of (a) general osteoporosis knowledge (items 1- 17), (b) calcium specific questions (items 25-33), (c) exercise specific questions (items 1-24). For the current study, the specific items that were examined for the female version were 3, 4, and 25 – 33. The male version consisted of (a) general osteoporosis knowledge (items 1 – 18), (b) calcium specific questions (items 27 – 35), (c) exercise specific (items 1 – 26). For the current study, the specific items that were examined for the male version were 4, 5, and 27 – 35.

Items 3 & 4 on the female version and items 4 & 5 on the male version are statements concerned with identification of risk factors for osteoporosis and contained the following choices: more likely, less likely, nothing to do with, and not sure. Items 25 – 33 in the female version and 27 – 35 in the male version consisted of multiple choice questions concerned with the calcium content of various foods, with four possible answers; one answer is correct. The female and male versions can have a possible score of 11 for the calcium items.

Procedure

The original researchers obtained approval of Grand Valley State University Human Research Review Committee regarding their ethical treatment of subjects, before the collection of data (See Appendix E). Permission was obtained for this secondary analysis of calcium items from the same body (See Appendix F). For the original study, students in a small public charter school were recruited with the permission of the school administration (See Appendix G) and through passive parental consent (See Appendix

H). Permission was also obtained from the investigators of the original study to use the data obtained with the HBKQ (See Appendix I).

The HBKQ was given as a pretest and then as a posttest after the educational intervention. In March of 1999, all students completed the HBKQ as a pretest measure of knowledge. Administers of the test consisted of six doctorally prepared nurse professors and five nurse Master's Degree students from a local university. Two administers visited every science classroom, introduced themselves and requested the students take a paper and pencil test. All of the students were reassured that the test would not be scored nor count toward their grade. The students were instructed not to put their names on the instrument to ensure confidentiality. Following the pretest, an educational intervention was provided by three doctoral prepared nurses and a dietitian who held a master's degree. The intervention consisted of a script (See Appendix J) containing content that included oral and interactive sessions about what osteoporosis is, how bones grow, and what helps them grow. The educational script primarily addressed nutrition and some content on physical activity and exercise. After the educational script was completed, a game similar to "The Price is Right" called the "The Calcium is Right" was played. In April of 1999, the same students completed the HBKQ again to measure any knowledge gain. The posttest was administered using the same procedure as the pretest.

CHAPTER FOUR

DATA ANALYSIS

Eighty-two boys and 102 girls completed the pretest and posttest of the Healthy Bones Knowledge Questionnaire. The Statistical Package for the Social Sciences (SPSS) was used for analysis of the data of the pretest and the posttest. The data analysis also explored the demographic characteristics of the boys and girls and their answers to the research questions.

The responses to items on the pretest and posttest had either correct (1) or incorrect (0) answers. In this study, responses to individual items of the pretest and posttest are considered nominal data. The number correct is totaled to obtain a score reflecting knowledge regarding calcium and osteoporosis prevention. The parametric paired t-test was then used to test differences between knowledge before and after the intervention. The data were tested by using a 95% confidence level for type II error that was statistically significant ($p < .05$).

Research Question

The research question of this study asked "What is the effect of a classroom educational intervention on knowledge of 6th to 11th grade students concerning dietary calcium and the risk factors related to Osteoporosis?" To answer this question a paired t-test was used to analyze the difference between the pretest and posttest mean percent scores of the calcium- related items in both groups.

The overall *posttest scores* of the sample as a whole show an increase in number of correct calcium items (t =3.31, p =.001) reflecting an increase in calcium knowledge and the prevention of osteoporosis. As a whole, the boys and girls obtained a mean pretest score of 4.78 (SD = 2.11) and a posttest score of 5.55 (SD = 2.37), showing a .77 increase in calcium knowledge following the educational intervention. Table 3 summarizes the number and percent correct of calcium knowledge items at pretest and posttest.

Table 3

Number and Percent Correct of Calcium Knowledge Items at Pretest & Posttest as Whole

		(N= 184)
	Pretest	
Mean Percent		43.5%
Mean Score		4.78
Standard Deviation		2.11
	Posttest	
Mean Percent		50.5%
Mean Score		5.55
Standard Deviation		2.37

Findings of Interest

This study found contrasting results in data among the girl and boy subjects. Table 4 summarizes the number and percent correct of calcium knowledge items at pretest and posttest. The results of the paired t-tests comparing the pretest and posttest means for the girls ($t = 2.95$, $p = .004$) and boys ($t = 1.77$, $p = .080$), indicated for the girls a significant increase in calcium knowledge regarding osteoporosis prevention after the educational intervention. The boys' results, however, indicated no significant increase in calcium knowledge regarding osteoporosis prevention after the educational intervention.

Table 4

Number and Percent Correct of Calcium Knowledge Items at Pretest & Posttest for boys and girls

	Boys (N=82)	Girls (N=102)
Pretest		
Mean Percent	40.0%	46.0%
Mean Score	4.43	5.05
Standard Deviation	2.27	1.94
Posttest		
Mean Percent	46.5%	53.6%
Mean Score	5.12	5.90
Standard Deviation	2.65	2.07

CHAPTER FIVE

DISCUSSION AND IMPLICATIONS

Discussion

The purpose of this research study was to assess the impact of an osteoporosis educational intervention for 6th to 11th grade children on their knowledge of dietary calcium and its importance. Past research literature has shown the Recommended Daily Allowance (RDA) of calcium is not met in boys and girls of school age and in their adolescent years. Past research has also indicated the importance of calcium intake in regards to osteoporosis prevention. Therefore, an educational intervention was utilized to impact the young adolescent's knowledge on calcium intake and its importance towards osteoporosis prevention.

Based on the literature review, the investigator expected to find a significant increase in knowledge in both boys' and girls' posttest knowledge scores. However, as a whole, the girls experienced a significant increase in knowledge and the boys did not experience a significant increase in knowledge following the educational intervention. There are several factors that may explain the different findings among the male and female subjects. One is the low reliability of the HBKQ. The reliability analysis reflects a stronger internal consistency for the boy subjects than the girl subjects. The reasons for a higher K-R 20 for the boys' data are not clear, however, most of the girls had previous exposure to the HBKQ in its early testing (Martin et al., 1998), and respondent familiarity with the questions may have led to boredom and inconsistent responses. Another consideration is that the boys' sample (N= 82) was smaller than the girls' sample (N= 102). A smaller sample gives a smaller power, therefore, reflecting less believable results.

The girls' knowledge increase is consistent with most of the studies related to health education, which also found significant increase in knowledge after an education intervention (Devine et al., 1992; Hamilton et al., 1997; Manios et al., 1999; Nicklas et al., 1998; Pitman et al., 1998; Resnicow et al., 1994; Stewart et al., 1995). The studies listed also based their educational intervention on nutrition and healthy behaviors. Similarly to our current investigation, each study's sample consisted of school age to young adolescents. In addition, each study also used the school environment for their research setting.

However, past studies (Devine et al., 1992; Hamilton et al., 1997; Manios et al., 1999; Nicklas et al., 1998; Pitman et al., 1998; Resnicow et al., 1994; Stewart et al., 1995), found an increase in knowledge in both genders, inconsistent with the current investigation. In this investigation, only the girls experienced a significant increase in knowledge following the educational investigation and the boys did not. This could be due to the boys not being involved in the previous study testing the stability of the instrument.

Relationship of Findings to Theoretical Framework

The RHPM (Pender, 1996) provides a logical framework to assess the adolescent's knowledge. The personal factor, knowledge, will have a degree of influence on the adolescent's change in health beliefs related to dietary calcium intake following the educational intervention. According to Pender (1996), "personal factors are proposed as directly influencing both behavior-specific cognitions and affect as well as health-promoting behavior" (p. 68).

Therefore, following Pender's model, a change in the adolescent's personal factor, knowledge, would be expected to influence his or her behavior-specific cognitions and health- promoting behavior related to dietary calcium intake. With this outside influence of knowledge change, following an educational intervention, the adolescent may be more apt to increase his or her calcium intake in an attempt to prevent osteoporosis from occurring in their later years.

Pender's model (1996) suggests that the personal factor, knowledge, has a direct influence on health behaviors and beliefs. In this study, the girls have shown a significant increase in knowledge related to dietary calcium intake after an educational intervention. However it is unknown to the researcher whether this change in knowledge will have a direct influence on health behaviors.

Limitations

This study has several limitations. One of the limitations is that the study is a secondary analysis. Since this was a secondary analysis, the investigator did not have the ability to collect the exact data that might have been needed for more thorough examination of the variables (Polit & Hungler, 1999).

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 to administer the pretest and posttest. The level of knowledge related to data collection varied among the test administrators. This variation of data collection may have influenced the results to be less or more accurate even though the instrument was the same.

A second limitation involving instrumentation was that the responses from girl subjects revealed considerably lower K-R 20 coefficients than the boy subjects. The boy subjects had higher pretest and posttest K-R 20 coefficients than the girl subjects. With the girl subjects having a low K-R 20 coefficient, the credibility and reliability of their results may be questioned.

A third limitation involving instrumentation was that several female subjects previously participated in a study testing the same instrument used in this study. No data were collected to document how many of the female subjects had participated in the earlier study. Those who participated in the first study may have gained knowledge related to osteoporosis prior to taking the pretest and posttest. Therefore, the female subjects may have had an advantage over the male subjects. This advantage may explain the higher pretest scores in the female subjects over the male subjects' pretest scores. Therefore, the posttest mean knowledge scores may not accurately represent knowledge gain between the male and female subjects.

The main threat to the external validity in this study is the experimenter effects. The performance of the subjects may be affected by the characteristics of the researchers (Polit & Hungler, 1999). The researchers may have unconsciously communicated their expectations to the subjects during the study. However, in the current study, each researcher was given the same script to deliver the tests to the subjects in the same manner in attempts to avoid experimenter effects.

Lastly, the convenience sample of this study is also considered a limitation. The majority of the adolescents are Caucasian. Lacking a distribution of various ethnic and cultural groups limits the generalization of the current study's results. Furthermore, the sample size of the boys (N=82) and girls (N=102) is quite small. A small sample size reflects a weak power, making the results less valid and reliable.

Implications and Recommendations

The current investigation reveals conflicting results between the subjects regarding a significant increase in knowledge following the educational intervention. A nursing implication of this study would be to further assess the effectiveness of an educational intervention and its relationship with knowledge increase in students.

In this study, an advanced practice nurse delivered the educational intervention. Another nursing implication and recommendation points toward the role of the advanced practice nurse. Additional research is needed to measure the effectiveness of the nurse educator role. In the future, further research in nursing education may provide different teaching methods that are found to be more effective in knowledge increase in children and adolescents.

Another nursing implication of this study would be to conduct future studies analyzing the long-term effects of knowledge change that occurred in children or adolescents. The long-term effectiveness of knowledge change in children and adolescents related to health beliefs and behaviors is a missing component of research. Several past studies show a change in knowledge, however, they never indicate if the knowledge change will last over the adolescent's lifetime and often measurement of health behaviors is inadequate. Unfortunately, this study was unable to address these questions.

In future research, investigators should also look at other personal factors listed in the RHPM that may influence the adolescent's knowledge regarding dietary calcium. Other personal factors of the adolescent may help explain the reasons knowledge has or has not occurred following an educational intervention. Understanding which personal factors of the adolescent that have the largest influence towards knowledge change is essential. However, more importantly, to determine whether knowledge will actually change the adolescent's health behaviors lies as the future question in nursing research.

Summary

In conclusion, the main purpose of this study was to assess the impact of an educational intervention on adolescent knowledge related to dietary calcium consumption as an osteoporosis preventive behavior. The findings indicate that the girls experienced a significant increase in knowledge regarding dietary calcium following the educational intervention. However, the boys did not experience a significant increase in knowledge related to dietary calcium and osteoporosis prevention. Therefore, further studies need to be done to assess what is the most effective learning tool for knowledge increase to occur in children and young adolescents. Once nursing research finds the most effective educational intervention to cause an increase in knowledge, investigators must then assess "does increased knowledge cause an actual change in adolescents' behavior?" Lastly, further studies are needed to assess what other personal factors, if any besides an increase in knowledge, will cause behavior change in adolescents.

APPENDICES

APPENDIX A

THE UNIVERSITY OF MICHIGAN
SCHOOL OF
NURSING

May 22, 2000

Deborah K. Fast
1160 Billings Ct., SE Apt. 2A
Grand Rapids, MI 49508

Dear Deborah.

You have permission to use my Revised Health Promotion Model in your thesis. There is no fee involved. Good luck with your research.

Cordially,

[redacted]

Nola J. Pender, PhD, RN, FAAN
Associate Dean for Research

APPENDIX B

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

2/12/99

ID NO. ___________

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

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 18. Which of the following exercises is the <u>best way</u> 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</u> <u>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 the most calcium?

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

0 1 26. Which of these foods gives a person the most calcium?

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

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

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

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

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

0 1 29. Which of these foods gives a person the most 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 best 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 necessary 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

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. 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. 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

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

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

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ID NO. ___________

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0 1 20. Which of the following exercises is the <u>best way</u> 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. <u>How many days a week</u> 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 <u>LEAST AMOUNT OF TIME</u> 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 <u>hard enough to make breathing</u>:

A. Just a little faster than normal
B. So fast that talking is not possible
C. <u>Much faster</u>, 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 <u>best way</u> 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 <u>best way</u> 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 <u>the most</u> calcium?

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

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

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

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

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

2/12/99

ID NO. __________

For office use only

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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 best 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 necessary 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 D

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 E

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 F

GRAND VALLEY
STATE UNIVERSITY
1 CAMPUS DRIVE • ALLENDALE, MICHIGAN 49401-9403 • 616/895-6611

July 21, 2000

Deborah K. Fast
1160 Billings Court SE, #2A
Grand Rapids, MI 49508

Dear Deborah:

Your proposed project entitled **The Effectiveness of an Educational Intervention Related to Knowledge Change in Dietary Calcium and Osteoporosis Prevention Among Adolescents** 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 G

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 6[th] through 11[th] 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 H

Permission Letter
DRAFT pending HRR approval

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 I

GRAND VALLEY
STATE UNIVERSITY

401 W. FULTON STREET • GRAND RAPIDS, MICHIGAN 49504-6431

September 6, 2000

Ms. Deborah Fast, B.S.N., R.N.
1160 Billings Ct., SE, #2A
Grand Rapids, MI 49508

Dear Deborah:

It is my pleasure to grant you permission to use the data collected in our study, "*Healthy Bones Education: An Adolescent Osteoporosis Prevention Project*" in a secondary analysis you will report in your thesis. As you know, these data were collected in the spring of 1999, and include a pretest dataset and posttest dataset.

Good luck in your project. We look forward to hearing your results.

Sincerely,

[redacted]

Cynthia Pellier Coviak, Ph.D., R.N.
Associate Professor

Kirkhof School of Nursing

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.)

"These foods in the <u>milk group</u> 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."**

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

"<u>Vegetable and fruit group</u> 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.).

"<u>Grain foods</u> 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.)

<u>Mystery cards</u>

(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?"

"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

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 same 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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