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PARENTAL INFLUENCES ON CALCIUM INTAKE IN CHILDREN AND THEIR ROLE IN CHILD SUPPLEMENT AND CALCIUM-FORTIFIED FOOD USE

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PARENTAL INFLUENCES ON CALCIUM INTAKE IN CHILDREN AND THEIR ROLE IN CHILD SUPPLEMENT AND CALCIUM-FORTIFIED FOOD USE

By

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ABSTRACT

PARENTAL INFLUENCES ON CALCIUM INTAKE IN CHILDREN AND THEIR ROLE IN CHILD SUPPLEMENT AND CALCIUM-FORTIFIED FOOD USE

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Our objective was to understand how these influences of calcium intake relate to a sample of preadolescent's use of supplements and calcium-fortified foods. Qualitative interviews and surveys were used to conduct a prospective study to assess parental influences on preadolescent calcium supplement and fortified food use. The study population was a convenience sample of Asian (n=56) Hispanic (n=61), and white (n= 74) parents (n=191) of children (10-13 years). Content analysis procedures were used to identify and code interview comments as positive, neutral, or negative parental influences. Cluster analysis was used to identify groups with similar patterns of comments and chi-square analysis was used to determine associations between groups and variables of interest. Two dominant patterns of responses defined the clusters. Cluster 1 (n=128), consisted of positive parental influences for availability of dairy foods, milk, and cheese, positive health benefit beliefs for dairy, and child preference for dairy and cheese, whereas Cluster 2 (n=63) consisted of one positive parental influence, availability of milk, while the rest remained neutral. No relationship was found between cluster membership and child supplement use. Use of calcium-fortified foods was significantly more likely to occur in children represented in Cluster 1 compared to Cluster 2. Positive parental influences were related to calcium-fortified food, but not supplement use, and will need to be considered in nutrition education.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter Four **Page**

LIST OF APPENDICES

Chapter One

INTRODUCTION

1.1 Background

Inadequate calcium intake has reached crisis levels according to various professional societies and health agencies that identify it as a major nutrition priority in the United States. Data from the NHANES 1999-2000 survey estimated that 56 percent of 2 to 8 year olds and 80 percent of 9 to 18 year olds are not meeting the current dietary recommendations for calcium (Ervin *et al.*, 2004). Generally, boys consume more calcium than girls. However, the average intakes for boys documented in CSFII 1994-96 and 1998 and NHANES 1999-2000 are well below the adequate intake (AI). Calcium is an essential nutrient involved in numerous biochemical processes and inadequate intake during childhood and adolescence increases the risk for several negative health consequences such as bone fractures and osteoporosis later in life.

Calcium is the principal mineral of bone and teeth with greater than 99 percent of the body's calcium found in the skeleton. The majority of bone mass is accumulated during the first two decades of life, thus childhood and adolescence are critical times to obtain sufficient calcium to help ensure adequate mineralization of the skeleton (Abrams *et al.*, 2000). Recognition of the critical role of calcium in bone health contributed to the Food and Nutrition Board's (FNB) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and specifically the Panel on Calcium and Related Nutrients decision in 1997 to increase calcium intake

recommendations in adolescents and adults 51 + years (IOM, 1997). Unfortunately, during this time of maximum bone accretion, the majority of American youth are not consuming sufficient calcium to reach peak bone mass – potentially leaving themselves vulnerable to increased risk for bone fractures and osteoporosis later in life (Lysen & Walker, 1997). Particularly susceptible are youth of Asian or Hispanic heritage who have a higher risk of osteoporosis compared to whites (Siris *et al.*, 2001).

Osteoporosis -- a disease that gradually weakens bones and often leads to painful and debilitating fractures – affects 15-28 million Americans, including half the women over 45 years of age, and results in health care costs of $7-10 billion (NOF, Accessed 2004). One in three women and one in eight men aged 50 years and older will experience an osteoporosis-related fracture in their lifetime. Osteoporotic-related fractures have serious consequences with 24 percent of hip fracture patients aged 50 and older dying in the year following fracture (NOF, Accessed 2004). Osteoporosis is the most readily identified health issue associated with inadequate calcium throughout the lifespan and research suggests that optimal intake can help delay or ameliorate the onset of this harmful condition.

1.2 Study Rationale

Multiple and diverse factors may negatively influence calcium nutrition in preadolescents and adolescents. It has been suggested that some of these influences include: displacement of milk as a beverage with soda, juices and sports drinks (Ballew *et al.*, 2000), eating away from home (Guthrie, 1999), the perception, particularly among females, that milk and/or dairy products are fattening and

therefore intake is restricted or eliminated (Barr, 1995), lactose intolerance, and psychosocial developmental changes. The role of the family, particularly the role of the parent, is a factor of interest that may negatively or positively affect calcium intake in children. Unfortunately, limited research has been completed in this area. Parental influences play an important role in the development of children's eating patterns, eating behaviors and food preferences (Birch, 1998b). Focus group research has identified positive parental influences such as modeling of milk consumption by other family members, parental expectations that milk will be consumed regularly, and availability of calcium-rich foods in the home as influences that may work to improve intake (Novotny *et al.*, 1999; Auld *et al.*, 2002; Novotny *et al.*, 2003). A study that investigated calcium intake found that modeling of milk by mothers was shown to positively influence milk consumption in girls 5 to 9 years old (Fisher *et al.*, 2004). Further research, however, is needed to gain a clearer understanding of the role of the parent, and will be addressed in this study.

Additionally, little information is available regarding psychosocial factors behind child intake of dietary supplements and calcium-fortified foods. Over the past decade, there has been an increase in calcium-fortified food and supplement use (Miller *et al.*, 2001; Nicklas, 2003). Over half of adults age 20 years or older, 45 percent of 3 to 5 year olds, and 33 percent of 6 to 11 year olds were reported to be using vitamin/or mineral supplements (Radimer *et al.*, 2004) Characteristics of adult supplement users who have reported giving supplements to their children were more likely to be married, with higher income and education levels, and were more likely to consume a nutrient-rich diet (Yu *et al.*, 1997). Popkin et al indicated that use of

fortified foods crossed socioeconomic lines, but there are no current analyses of characteristics of fortified-food users on a large cross-section of the U.S. population (Subar & Bowering, 1988; Popkin *et al.*, 1996a). Furthermore, little is known about why parents provide supplements and calcium-fortified foods to their child and which are more likely to do so. This research study will be the first to explore the relationship between parental influences related to calcium-rich foods and their role in child use of supplements and calcium-fortified foods. Data obtained in this study will lend itself to future strategies aimed at improving calcium nutriture through calcium-fortified foods and/or supplements, consequently potentially reducing the risk for osteoporosis.

1.2 Specific Aims and Hypotheses

The specific aims of this study are:

Aim 1. To identify positive and negative parental influences related to calcium intake in preadolescents.

H1a: The most prevalent positive parental influence will be availability.

H1b: The most prevalent negative parental influence will be lack of parental modeling.

Aim 2. To identify patterns of parental influences within the sample population.

H2a: There will be one main positive and one main negative parental influence pattern of parental influences.

Aim 3. To compare patterns of parental influences to preadolescent use of calcium-fortified foods and supplements.

H3a: A positive parental influence pattern will be positively

associated with supplement and calcium-fortified food use.

H3b: A negative pattern will be negatively associated with supplement and calcium-fortified food use.

Should the research findings demonstrate that specific parental influences that are associated with the use or lack of use of supplements and calcium-fortified foods, the **long term goal** of this research is to contribute to the development of effective educational strategies aimed specifically at parents of preadolescents that address the use of calcium-fortified foods and supplements.

Chapter 2

REVIEW OF LITERATURE

2.1 Importance of Calcium

2.1.1 Overview of Calcium

Calcium accounts for 1 to 2 percent of adult human body weight with 99 percent of total body calcium found in the teeth and bones. Calcium exists primarily in the form of hydroxyapatite, and this bone mineral is almost 40 percent of the weight of the bone. Adequate calcium is essential to bone health in adolescence to ensure adequate mineralization of the skeleton, and throughout the lifespan to optimize bone mass and prevent early bone loss (Heaney, 2000a). Although the amount of calcium outside of bones and teeth is relatively small, it is required for essential biochemical functions including contraction and relaxation of muscle (including normal heart beat), coagulation of blood, transmission of nerve impulses, activation of enzyme reactions, stimulation of hormone secretions, and cell adhesiveness (Miller & Anderson, 1999; Javaid & Cooper, 2002). The level of ionized calcium in the blood must be maintained within a narrow range to perform biochemical functions. When the diet is low in calcium the bones release enough calcium into the blood stream to meet the body's needs.

In addition to bone health and essential biochemical functions, research has demonstrated the potentially beneficial roles for calcium and/or dairy foods with regard to a variety of disorders including chronic diseases such as hypertension, colon cancer, and obesity, along with breast cancer, kidney stones, polycystic ovary

syndrome, ovarian cancer, premenstrual syndrome, insulin resistance, and lead poisoning (IOM, 1997). The following sections will more extensively review the role of calcium in bone health and chronic disease prevention.

2.1.2 Bone Health

Bone is a specialized connective tissue that provides mechanical support for muscles, protects vital organs, and stores the calcium needed for essential biochemical functions. Despite its static appearance, bone is a dynamic tissue constantly being formed and broken down. This process, called remodeling, is the resorption (breaking down) of existing bone tissue and deposition of new bone tissue to replace that which has been broken down (IOM, 1997). Resorption of old bone and formation of new bone are processes that continuously overlap. The importance of these processes varies at different times throughout the life cycle. In general, from birth until about age 20, the bones are in a phase of active growth. This stage is characterized by an increase in bone length and bone width. Shaping and sculpting the growing bones, called modeling, also occurs at this time. Between the ages of 12 and 30, the rapid phase of bone dimensional growth tapers off and consolidation occurs with the attainment of peak bone mass. Although dimensional bone growth ceases at maturity, adult bone is constantly being remodeled. It is generally accepted that peak bone mass or maximum bone density and strength occurs by age 30 (Heaney *et al.*, 2000). Recent studies indicate that peak bone mass at several skeletal sites may be reached as early as late adolescence (Matkovic, 1996). Beginning in the 40s or later, resorption of existing bone starts to exceed formation of new bone, resulting in a net loss.

A number of interrelated nutritional, genetic, and environmental factors contribute to bone health. Bone has the same kind of nutrient needs as other tissues, including energy, protein and micronutrients (Heaney, 2000a). Additionally, bone requires dietary intake to supply the bulk materials needed for synthesis of the extracellular material, which comprises more than 95 percent of the substance of bone and which is largely responsible for its structural and mechanical properties (Javaid & Cooper, 2002). These bulk materials are mainly calcium, phosphorus and protein. During growth, this structural material cannot be amassed if the bulk components of bone are not present in adequate amounts in the diet. The need for dietary calcium persists even after growth has ceased. Calcium is excreted daily from the body in considerable quantity (4-8 mmol) requiring calcium replacement through the diet. In absence of adequate calcium intake, regulating hormones cause bone to release calcium to serve the essential functions in other systems of the body. Chronic dietary insufficiency can result in the formation of weak, poorly mineralized bone. The same considerations apply to the other bulk constituents of bone, phosphorus and protein. However, these nutrients are less likely to be present in limiting quantities in modern diets in the developed world. In addition to dietary factors, twin and family studies indicate that genetic factors have a strong influence on bone development. Heaney and colleagues reported that about 75% of the variability in peak bone mass is attributable to heredity (Heaney *et al.*, 2000). Furthermore, physical activity patterns including exercise and mobilization can also influence bone mass and strength (Javaid & Cooper, 2002). Thus, modifiable factors, including dietary intake and physical activity patterns, as well as genetic factors are related to bone development.

2.1.3 Calcium and Bone Health

Accumulating research, including epidemiological evidence, randomized clinical trials, and metabolic balance studies, indicates that dietary calcium throughout life helps to optimize peak bone mass achieved by age 30 or earlier, slow age-related bone loss, and reduce osteoporosis fracture risk in later adult years (Matkovic & Heaney, 1992; IOM, 1997; Ilich & Kerstetter, 2000; Wosje & Specker, 2000). An analysis of 139 papers relating to calcium intake and bone health published since 1975 provides convincing evidence of the beneficial role of calcium and calcium-rich foods in skeletal health. In 50 of the 52 investigator-controlled, calcium intervention trials, increasing calcium intake positively affected bone gain during growth, reduced bone loss in later years or lowered fracture risk (Heaney, 2000a). While most of the investigator-controlled studies used calcium supplements, six used dairy sources of calcium, which all demonstrated a positive relationship between calcium and bone health. Similar beneficial effects of calcium were demonstrated in approximately three-quarters of 86 observational studies, most of which used dairy sources of calcium (Heaney, 2000a). There are several other nutritional and lifestyle factors, such as the amount of protein in the diet, energy intake, body weight, alcohol consumption, vitamin D intake, smoking, and exercise, which have been shown to play a potential role in affecting bone mass. However, the scientifically reproducible evidence showing a connection between these factors and bone mass is not as robust as the calcium connection (Miller *et al.*, 2001).

Peak bone mass is an important measure of bone health. Approximately 60-80 percent of the variance of peak bone mass is attributable to genetics (Weaver *et al.*,

1999a), leaving modifiable factors such as diet and physical activity to influence an individual's genetically programmed peak bone mass. The majority of peak bone mass is laid down during the first two decades of life. Thus, childhood and adolescence are critical times to optimize peak bone mass. By the time adolescents finish their "growth spurt" around the age of 17 years, approximately 90 percent of their adult bone mass will have been established. Children's bodies need sufficient calcium to support their accelerated growth spurt during the preteen and teenage years. In addition, children going through puberty have a bone accretion rate approximately twice that of children before or after puberty (Weaver *et al.*, 1999a). Therefore, obtaining sufficient calcium when the skeleton is most responsive to dietary calcium during puberty helps to ensure adequate mineralization of the skeleton to promote bone health later in life and decrease the risk for osteoporosis.

2.1.4 Osteoporosis

Osteoporosis has been described as a "pediatric disease that manifests itself in old age" (Lysen & Walker, 1997). It is the most readily identifiable health issue associated with inadequate calcium intake. Osteoporosis is a condition of skeletal fragility characterized by decreases in bone mass and deterioration of the bone tissue, with a consequent increase in fracture risk (Heaney, 2000a). The rate of osteoporosis has reached epidemic proportions in the United States and is responsible for considerable morbidity, mortality, and economic costs. The health care costs associated with osteoporosis are estimated at $13.8 billion per year for osteoporosis-related fractures alone (NOF, Accessed 2004). Often termed a silent disease, osteoporosis usually goes unnoticed until back pain or spontaneous fracture occurs.

Because there often are no symptoms prior to most osteoporotic fractures, relatively few people are medically diagnosed in time for effective therapy. Consequently, many people experience unnecessary fracture-related pain, expense, and disability. Osteoporosis is a major health problem that calls for comprehensive, national preventive strategies aimed at adolescents, young adults, postmenopausal women, and older adults. While no single nutrient can prevent osteoporosis, consuming adequate calcium throughout life may play a critical role in reducing risk or complications of the disease (Kalkwarf *et al.*, 2003; Nicklas, 2003).

2.1.5 Inadequate Calcium During Childhood

In addition to osteoporosis, recent evidence suggests that effects of inadequate calcium may occur in children as well as adults. There has been a dramatic increase in the incidence of fractures over the last 30 years along with a general decline in calcium intake in children and young adults (Khosla *et al.*, 2003). Researchers have speculated that these increases may be due to low bone density associated with low calcium consumption (Khosla *et al.*, 2003; Goulding *et al.*, 2004). Subsequently, in addition to entering adulthood with compromised bone mass, thereby increasing risk for developing osteoporosis, children with low intakes may also be prone to bone fractures during childhood.

2.1.6 Other Benefits of Calcium

In addition to bone health, research suggests there may be other positive health effects associated with adequate calcium intake, particularly in the areas of chronic disease including hypertension, colon cancer, and obesity.

Hypertension

Many studies have investigated a possible role of calcium in lowering the risk of hypertension. In a review of 22 randomized intervention trials, calcium supplementation was found to reduce systolic blood pressure modestly, by 1.68 mm Hg in hypertensive adults, and had no significant effect in normotensive adults (Allender *et al.*, 1996). Diastolic blood pressure was not altered in either group. More recently, the DASH (Dietary Approaches to Stop Hypertension) trial revealed that intake of a low fat diet containing almost three servings of dairy foods (predominately low fat milk) in combination with fruits and vegetables significantly reduced blood pressure in persons with high normal blood pressure. In hypertensive participants, the blood pressure lowering effects of the DASH diet were even greater, evidenced by reductions of 11.4 mm HG in systolic and 5.5 mm HG in diastolic pressure compared to the control diet (Appel *et al.*, 1997). In this study, the increase in dairy product consumption provided a mean dietary calcium increase from 443 to 1,265 mg/day. Since publication of the DASH diet, several health organizations have issued support for the DASH diet to reduce the risk for or treat hypertension (Miller *et al.*, 2000). More research is needed, however, to understand the potential similarities and/or differences of providing calcium through supplementation versus calcium-rich food sources while controlling for other dietary factors on blood pressure in greater segments of the population.

Little is known about the relationship of calcium intake and blood pressure in children. A randomized trial on 101 boys and girls (mean age 11 years old) of African American, Caucasian, Asian, and Hispanic descent showed that calcium

supplementation of 600 mg/day could reduce blood pressure, although the effect was much larger in children who had lower baseline calcium intakes (150 to 347 mg) (Gillman *et al.*, 1995). No further reduction in blood pressure was observed in children already consuming over 1,000 m/day of calcium by supplementing them with 600 mg/day. More research is needed to fully understand the relationship between calcium and blood pressure in children.

Colon Cancer

Several different types of studies support a beneficial role for calcium against colon cancer (Lupton, 1997; Holt *et al.*, 1998; Holt, 1999; Holt *et al.*, 2001; Baron *et al.*, 2003; Wallace *et al.*, 2004). Most research has been completed using calcium supplements. However, more recent research with dairy foods has also shown beneficial effects. In an investigation of 70 patients with a history of developing polyps or noncancerous growths in the colon, increasing food sources of calcium, specifically low fat dairy foods, reduced the risk for colon cancer (Holt *et al.*, 1998). The study participants were divided into two groups, one of which maintained its baseline diet and the other which increased its dietary calcium intake to about 1,500 mg/day, mostly for diary foods. Compared to the control group, significant reductions in cell proliferation and in two markers of cell differentiation occurred in the group consuming additional dairy foods (Holt *et al.*, 1998). A randomized, double-blind trial of 930 adults with a recent history of colorectal adenomas found that increasing calcium intake by 1,200 mg/day using a calcium supplement, reduced the incidence of recurrent adenomatous polyps by 19% and the total number of tumors by 24% in less than one year (Baron *et al.*, 1999). Whether similar beneficial

effects on the recurrence of colonic adenomatous polyps would be found following intake of food sources of calcium such as dairy products is unknown.

Obesity

Although energy balance is the most critical factor in weight regulation, some recent studies suggest that adequate calcium intake may contribute to shifting the energy balance and thus play a favorable role in weight regulation (Davies *et al.*, 2000; Carruth BR, 2001; Zemel, 2004). Dairy sources of calcium have been shown to have greater favorable effects compared to supplemental sources of calcium in attenuating weight and fat gain and accelerating fat loss (Zemel, 2003). This augmented effect of dairy products relative to supplemental calcium is likely due to additional bioactive compounds, including the angiotensin-converting enzyme inhibitors and the rich concentration of branched-chain amino acids in whey, which may act synergistically with calcium to decrease adiposity (Davies *et al.*, 2000; Zemel, 2004). These concepts have been supported by epidemiological data and recent clinical trials. However, some research has also shown no beneficial effects of added calcium or dairy in promoting weight loss (Barr, 2003; Lappe *et al.*, 2004; Berkey *et al.*, 2005). More research is needed in larger trials with different subgroups where other dietary factors are controlled for to clearly delineate the effects of calcium on weight regulation.

2.2 Recommendations and Intake

2.2.1 Calcium Recommendations

Given the importance of calcium to bone health, the development and maintenance of bone is the major determinant of calcium needs (IOM, 1997). Thus, unlike other nutrients, the requirement for calcium relates not to the maintenance of the metabolic function of the nutrient, but to the maintenance of an optimal reserve for adequate skeletal support (Abrams *et al.*, 2000). Calcium functions as a threshold nutrient because the size of the body's skeletal calcium reserve is genetically limited. Therefore, at suboptimal intakes the ability of the body to store calcium as bone tissue is limited by the intake of calcium, but increasing calcium intake above that required as optimal for genetic or mechanical purposes does not result in further increases in stores (Heaney, 2000a). Thus, calcium can only be stored as bone, and increasing calcium intake above that which produces optimal bone mass will not result in more bone. There is also no biochemical assay that accurately reflects calcium nutritional status. Blood calcium concentration, for example, is not a good indicator because it is tightly regulated. Scientific literature reveals numerous potential indirect indicators of calcium adequacy, most of which are closely related to the skeletal calcium content (Cashman, 2002).

Traditionally, daily calcium requirements have been estimated by a factorial approach. This practice involves estimating the average physiological requirement for absorbed calcium derived from balance data, adjusting for incomplete utilization, individual variability, and (Heaney, 2000a) bioavailability of calcium among food sources (Cashman, 2002). This approach is subject to considerable uncertainty, as is

evident from the wide variation in estimates of daily calcium requirements made by different expert authorities. For example, the United States and United Kingdom have established very different recommendations for calcium intake (IOM, 1997; 1998) (**Table 2.1**). Much of this disagreement arose as a result of different interpretations of available data, e.g. different estimates of absorption efficiencies and obligatory losses of calcium were used by the three authorities (Cashman & Flynn, 1999). Despite differences in estimating the requirements, significant proportions of the population in a number of western countries fail to achieve recommendations for calcium (Abrams & Stuff, 1994).

Table 2.1. Recommended Calcium Intakes in US and UK

UK RNI (1991) *		US AI (1997) §	
Age Group (years)	**mg/d**	**Age Group (years)**	**mg/d**
0-1	525	0-0.5	210
		0.5-1	270
1-3	350	1-3	500
4-6	450	4-8	800
7-10	550		
11-14M	1000	9-13M	1300
15-18M	1000	14-18M	1300
11-14F	800	9-13F	1300
15-18F	800	14-18F	1300
19-50	700	19-30	1000
		30-50	1000
>50	700	>50	1200
Pregnancy	700	Pregnancy ≤18 19-50	 1300 1000
Lactation	+550	Lactation ≤18 19-50	 1300 1000

* Reference nutrient intake (RNI) (Department of Health, 1998)
§ Adequate Intake (AI) (IOM, 1997)

More recently, the US Food and Nutrition Board established recommendations for daily calcium intake for different population groups, principally using data from metabolic balance studies to develop a non-linear regression model to predict the lowest value of intake at which mean maximal calcium retention is attained (IOM, 1997) (**Table 2.1**). This approach was based on the principle that maximizing the calcium reserve in the skeleton is required in order to maximize skeletal strength, and that an adequate calcium intake is needed to achieve these genetically-determined upper limits of both skeletal size and density. A major limitation of this approach is the limited balance data available, which resulted in the establishment of an adequate intake (AI) rather than a recommended dietary

allowance (RDA), since no estimate of the average requirement could be derived (IOM, 1997; Heaney, 2000a). The recommended AI represents an approximation of the calcium intake that, in the judgment of the Dietary Reference Intakes (DRI) Committee, would appear to be sufficient to maintain calcium nutriture while recognizing that lower intakes may be adequate for some. Additional studies on calcium balance over broad ranges of intakes and long-term measures of calcium sufficiency are needed to establish a more precise and accurate recommendations.

The AIs for calcium are higher than the 1989 RDAs for most age categories to reflect current scientific information. Current dietary recommendations for calcium are 500 mg for children aged 1 to 3 years, 800 mg for children aged 4 to 8 years, 1,300 mg for adolescents aged 9 to 18 years, 1000 mg for adults aged 19 to 50 years, and 1,200 mg for adults aged 51 years and older (IOM, 1997)(**Table 2.1**). Calcium needs vary throughout life with greater needs during periods of rapid growth in childhood and adolescence, during pregnancy and lactation, and in later adult years to compensate for age-related bone loss. The following will review age-specific requirements for calcium in children 1 to18 years to understand specific differences in the recommendations that were established.

2.2.2 Establishing Calcium Recommendations for Children 1 through 8 years

Children 1 through 8 years retain less calcium in the body than infants, but need two to four times as much calcium per unit of body weight as adults (Miller *et al.*, 2001). Optimal calcium intake is important during these years in establishing peak adult bone mass and for promoting healthy eating habits, which have been

shown to be established during this time period (Neumark-Sztainer *et al.*, 1999). For children 1 to 3 years of age, 500 mg of calcium/day is recommended to support a calcium retention of 100 mg/day (IOM, 1997). For 4 through 8 year old children, a calcium intake of 800 mg/day is recommended to support a maximal calcium retention of 130 to 174 mg/day (IOM, 1997). As there are no balance studies available in boys, the data for girls was applied to both sexes. More recent studies have shown higher intakes of calcium to be more beneficial than current recommendations. For example, when 6 to 10 year olds consumed 1,600 mg calcium/day, bone mass accumulation was 3% to 5% higher than when calcium intake was 1,000 mg/day or less (Wosje & Specker, 2000). Other intervention studies have indicated that at least 1,200 mg calcium/day is needed to maximize calcium retention in 6 to 10 year old children (Johnston *et al.*, 1992; Slemenda *et al.*, 1997; Abrams *et al.*, 1999). High levels of calcium intake, however, may also have negative effects, such as decreasing their absorption of other minerals such as iron and zinc. These minerals may be marginal in toddlers and preschool children, especially in developing countries. Thus, there is substantial need for further investigation regarding the risks and benefits of higher calcium intake in this age group (Ilich-Ernst *et al.*, 1998; Ames *et al.*, 1999).

2.2.3 Establishing Calcium Recommendations for Children 9 through 18 years

In view of the importance of the pubertal growth spurt in determining ultimate bone mass, this time period has become one of the most studied for evaluation of calcium dietary requirements as well as bone mineral acquisition and turnover. Most, but not all, studies have focused on girls, due to the greater incidence of osteoporosis

in females and the shorter duration of pubertal bone growth in girls versus boys. As children reach the adolescent growth spurt, skeletal accumulation of calcium (calcium retention) increases dramatically. Between 140 mg and 165 mg calcium/day is deposited in the skeleton during preadolescence and as much as 350 mg calcium/day during adolescence (IOM, 1997). Compared to young adult women ages 19 to 30 years, teenage girls retain approximately four times more of the calcium they consume, or on average calcium retention of 326 mg/day (Weaver *et al.*, 1996).

At least 40% or more of the body's total skeletal mass is formed during the adolescent growth spurt (Heaney *et al.*, 2000). Although bone mass may accumulate through the third decade of life, peak adult bone mass may be reached as early as late adolescence in certain bones (proximal femur and vertebrae). Recent research indicates that the peak calcium accretion rate occurs at age 13 for girls and 14.5 for boys (Heaney *et al.*, 2000). In addition to the dramatic increase in skeletal mass during adolescence, inefficient absorption of calcium during the teenage years may contribute to an increased need for this mineral. Intestinal calcium absorption previously presumed to be 40%, has shown to be closer to 30% in teens (Abrams *et al.*, 1997; Abrams *et al.*, 2000; Badenhop-Stevens & Matkovic, 2004). Also, adolescent girls are unable to adapt urinary calcium excretion to changes in calcium intake. Very high urinary calcium levels have been detected in adolescent females with low calcium intakes (Heaney *et al.*, 2000). These factors have led to the calcium AI of 1,300 mg/day for children and adolescents ages 9 through 18 to maximize calcium retention (IOM, 1997).

2.2.4 Racial Differences in Establishing Recommendations

Racial differences in calcium metabolism have been noted in children and adults. In children and adolescents aged 9 to 18 years, Bell and colleagues (Bell *et al.*, 1993) found that African Americans had similar calcium absorption efficiency but lower urinary calcium excretion. Abrams and colleagues (Abrams *et al.*, 1996) found absorption efficiency to be similar in prepubertal African American, Mexican-American, and Caucasian girls, but significantly greater in African American girls after menarche. These metabolic differences may contribute to the widely observed higher bone mass in African American children (Gilsanz *et al.*, 1991; Bell *et al.*, 1993) and adults (Luckey *et al.*, 1989). However, implications for the calcium intake requirement are not clear, and observed differences in absorption have not resulted in race-specific recommendations at this time.

2.2.5 Tolerable Upper Intake Recommendations

Currently, the available data on the adverse effects of excess intake in humans primarily concerns calcium intake from nutritional supplements. Of many possible adverse effects of excessive calcium intake, the most widely studied and biologically important are: kidney stone formation, the syndrome of hypercalcemia and renal insufficiency with and without alkalosis, milk-alkali syndrome (MAS), and the interaction of calcium with the absorption of other essential minerals (IOM, 1997). The adult upper limit (UL) for calcium is 2,500 mg per day. This level was generated through adult research data to detect the lowest-observed-adverse-effect level (LOAEL) for MAS or nephrolithiasis. Calcium intakes of 300 to 2,500 mg/day have not been shown to cause MAS or nephrolithiasis and provide supportive evidence for

a UL of 2,500 mg/day for adults (IOM, 1997). Although the safety of excess calcium intake in children 1 through 18 yr has not been studied, an UL of 2,500 mg (62.5 mmol)/day is also recommended for this life stage group based on adult data. Although calcium supplementation in children may appear to pose minimal risk of MAS or hypercalciuria, risk of depletion of other minerals associated with high calcium intakes may be greater. Therefore a conservative UL is recommended for children due to the lack of data.

2.2.6 Actual Intake in Children

Despite calcium's expanding role in health, nationwide surveys indicate that few Americans are meeting dietary recommendations for calcium (Alaimo *et al.*, 1994; Fleming & Heinback, 1994; Albertson *et al.*, 1997; USDA, 2000). Many population groups, particularly adolescents and older adults, consume diets containing significantly less calcium than recommended. At all ages, males consume more calcium than females, presumably because of their higher energy intake. Data from the Continuing Survey of Food Intake 1994-96 (CSFII 1994-96) showed that 71% of girls and 62% of boys 6 to 11 years of age do not meet 100% of the AI for calcium, with estimated mean intake in girls to be 865 mg/day and in boys to be 984 mg/day. Similar results were observed for 10-year old children in Bogalusa, Louisiana, where 69% did not meet dietary recommendations; the percentage was higher among females (76%) than males (62%) ($p<0.001$) (Rajeshwari *et al.*, 2005). Among older females and males 12 to 19 years of age, 88% and 68%, respectively, did not meet the calcium recommendation with estimated mean intake in girls to be 773 mg/day and in boys to be 1,145 mg/day. Therefore nine out of ten adolescent

girls and seven out of ten adolescent boys failed to meet the AI for calcium. Data from the more recent National Health and Nutrition Examination Survey (NHANES 1999-2000) leads to similar conclusions as with 67% of girls and 61% of boys ages 6-11 and 84% of girls and 70% of boys ages 12-19 not meeting the AI for calcium. The mean estimated intake in 6-11 year old girls was 860 mg/day and 915 mg/day in boys and in 9-18 year old girls was estimated at 820 mg and 1,081 mg/day in boys (Ervin *et al.*, 2004). For all age groups, including adolescents (ages 12-19 years), males consumed higher amounts of calcium than females of the same age. In males, calcium intake peaked during adolescence and then declined in early adulthood. For females, the calcium intake peaked during childhood (ages 6-11 years) and began to decline in adolescence. For females, the average daily intake fell below the AI recommendation beginning at the start of the adolescent period. Race/ethnic data was collected which found similar results among groups with a lower percentage of Hispanic girls (ages 6-11) and Hispanic boys (ages 12-19) not meeting the AI for calcium compared to other groups (**Table 2.2**). Unfortunately, data from the NHANES and CSFII national

Table 2.2. NHANES 1999-2000-Percentage of Children Not Meeting the AI Calcium Recommendation

	All Race/Ethnic Groups (%)	Non-Hispanic White (%)	Hispanic (%)	Non-Hispanic Black (%)
Boys 6-11 y	67	64	71	70
Boys 12-19 y	70	69	62	71
Girls 6-11	61	65	55	72
Girls 12-19	84	82	85	90

(Ervin *et al.*, 2004)

surveys for assessing Asians, Native Hawaiians, or other Pacific Islanders intake were considered "statistically unreliable" due to small sample size.

Race/ethnic differences in calcium intake are of potential importance, as low bone density and osteoporosis occur in notable proportions among Asians, Hispanics, and Non-Hispanic whites, with lower proportions in African Americans. One study in high school students (n=900) found that more than half the students had intakes below current recommendations (Barr, 1994). Ethnicity was revealed as a predictor of total calcium intake with whites having significantly greater mean intakes (1,127 mg) than those of Asian origin (768 mg) (Barr, 1994). In another study (n=51) of Asian and Caucasian adolescents mean calcium intakes (1113 ± 491mg) were below the recommendations, but greater than previous studies with no statistical differences regarding ethnicity (Oshiro *et al.*, 2003). Sample size, however, may have been too small to demonstrate differences. A general limitation to assessing intake in different race/ethnic groups is that the nutrition assessment tool most commonly used, a food frequency questionnaire (FFQ), may not be culturally sensitive to identify important sources of calcium other than dairy. Recently, a FFQ was developed specifically for Asians, Hispanics and white youth which may provide a more comprehensive assessment of calcium intake (Jensen, 2004). More research is needed to assess intake in these subgroup populations to help target more effective intervention strategies.

2.2.7 The Magnitude of problem

Americans' inadequate calcium intake is recognized as a major public health problem (Gerrior *et al.*, 1998). In 1999, a calcium consensus conference supported

by the National Institutes of Health, (NIH), United States Department of Agriculture (USDA), National Osteoporosis Foundation and many professional societies, food producers and health agencies concluded that Americans' inadequate calcium intake had reached a level that required public health measures (Calcium Summit, 1999). The consensus panel called for strategies to increase calcium intake across virtually all segments of the population. Likewise, the federal government's Healthy People 2010 objectives for the nation identified low calcium as one of the priority nutrition problems in the US (Healthy People 2010, 2000). The inadequate dietary intake of adolescents is of particular concern because it coincides with a period of rapid skeletal growth, a critical time to maximize peak bone mass and protect against future risk for osteoporosis (Teegarden *et al.*, 1999).

2.2.8 Summary of Recommendations and Intake

The recommendations were established based on maximum bone retention and are set at a level of consumption necessary for an individual to maximize genetically determined peak adult bone mass, to maintain adult bone mass, and to minimize bone loss in later years (Miller *et al.*, 2001). There is considerable disagreement between expert groups on the daily calcium intake levels that should be recommended, reflecting the ambiguity in the data used for establishing calcium requirements (Cashman, 2002). Despite disagreements on recommended intakes, evidence indicates that dietary calcium intake is inadequate for the maintenance of bone health in a substantial proportion of population age groups, particularly adolescents. Optimizing calcium intake of the entire population cannot be expected to completely eliminate the many multifactorial disorders in which a low calcium

intake is contributing factor. However, improving calcium status appears to be a cost-effective approach to reducing the total disease burden associated with a inadequate calcium intake (Fulgoni *et al.*, 2004). For this reason, strategies to ensure optimal calcium intake in Americans, especially from calcium-rich foods, deserve attention.

2.3 Sources of Calcium

2.3.1 Dairy Foods as a Source of Calcium

In the United States, milk and other dairy products are the major source of calcium, providing 72% of the calcium available in the food supply (Gerrior *et al.*, 1998) (**Table 2.3**). In an analysis of food sources of calcium, milk and other dairy products provided 83% of the calcium in the diets of children (ages 6-12), 77% of the calcium in adolescents (ages 13-19), and between 65% to 72% of the calcium in adults' diet (Fleming & Heinback, 1994). A more recent analysis of a longitudinal study of 10-year olds in Bogalusa, Louisiana, supports earlier findings that at age 10 and in young adulthood, milk and other dairy products were the major source of calcium (Rajeshwari *et al.*, 2004). Few other foods provide such a concentrated source of calcium, which is as readily available for absorption, as do milk and other dairy products. Also, some food sources such as some vegetables contain phytates and oxalates, which can reduce the intestinal absorption of calcium (Gueguen & Pointillart, 2000). Without consuming dairy products, it is difficult to meet dietary calcium recommendations through foods (Barr, 1994; Fleming & Heinback, 1994; Neumark-Sztainer *et al.*, 1997; Fulgoni *et al.*, 2004).

Calcium-rich foods such as milk and other dairy foods provide, in many cases, about 300 mg of calcium per serving and also contain other nutrients important to health. As shown in **Table 2.3**, milk and other dairy foods provide substantial amounts of vitamin D (if fortified), vitamin A, cobalamin, riboflavin, niacin, potassium, phosphorus, and protein.

Table 2.3. Percent Nutrient Contribution of Dairy Foods to the U.S. Food Supply, 1997 (Gerrior *et al.*, 1998)

Nutrient	(%)
Energy	9.3
Protein	19.4
Fat	12.6
Carbohydrate	4.6
Minerals	
Calcium	72.1
Phosphorus	32.4
Zinc	16.2
Magnesium	15.8
Iron	1.8
Vitamins	
Riboflavin	26.1
Vitamin B_{12}	21.6
Vitamin A	15.3
Vitamin B_6	8.7
Folate	6.2
Thiamin	4.7
Vitamin E	2.8
Ascorbic Acid	2.5
Niacin	1.2

Vitamin D-fortified milk products provide almost all of American's dietary intake of vitamin D, which increases absorption of calcium (Matkovic *et al.*, 2005). Nearly all fluid milk marketed in the U.S. is fortified with vitamin D to obtain the standardized amount of 400 IU (10 ug) per quart of milk. Other dairy foods such as cheese and yogurt are not generally fortified with vitamin D.

Because milk and other dairy foods are excellent sources of calcium as well as many other nutrients (**Table 2.3**), their intakes may improve the overall nutritional quality of the diet (Fleming & Heinback, 1994; Devine, 1996; Heaney, 1999; Heaney, 2000a). A longitudinal study involving 64 postmenopausal women in Australia found that the women who were randomly assigned to receive 1,000 mg of additional

calcium per day by consuming fat free milk powder increased not only their calcium intake, but also their intake of other essential nutrients such as potassium, phosphorus, magnesium, riboflavin, thiamin, and zinc, meeting their respective DRI recommendations (Devine, 1996; Heaney, 1999). In contrast, the women who took calcium supplements increased only their intake of calcium to meet the calcium DRI recommendations (Devine, 1996). Although both milk and calcium supplements improved calcium intake, consuming the milk improved the woman's overall diet quality as well. A more recent analysis of adults (ages19-50) from NHANES 1999-2000 found that higher intakes of total dairy and milk were associated with higher intake of essential nutrients, including calcium, magnesium, potassium, zinc, iron, vitamin A, riboflavin, and folate relative to their DRI recommendations (Fulgoni *et al.*, 2004).

Similarly, among children and adolescents, consumption of milk has been demonstrated to increase both calcium intake and improve the overall nutrient adequacy of their diet (Fleming & Heinback, 1994; Johnson, 1998). When children (ages 6-10) included milk as part of their noon meal, intake of calcium as well as other essential nutrients such as vitamin A, E, and zinc also increased to meet the DRI recommendations (Johnson, 1998). These results reinforce not only the importance of dairy foods and milk as key calcium sources but as foods associated with a package of nutrients. A diet low in calcium is generally low in other essential nutrients as well and is a marker for overall poor diet quality (Barger-Lux, 1992).

2.3.2 *Nondairy Food Sources of Calcium*

Consuming dairy foods with their high calcium bioavailability, high calcium content and relative low cost is an efficient way to obtain adequate calcium. However, for many who do not consume dairy foods, there are a variety of non-dairy sources, including dark green leafy vegetables (particularly mustard greens and collards), bok choy, beans, nuts and fish (e.g., salmon, sardines, oysters), (Weaver *et al.*, 1999b; Berdainer, 2002). For certain populations (e.g. Asians, vegetarians, those with lactose intolerance) these foods can be a significant source of calcium (Novotny *et al.*, 2003; Oshiro *et al.*, 2003).

Unfortunately, a number of these nondairy foods provide less calcium per serving and are less bioavailable than milk and other dairy products (**Table 2.4**) (USDA, 1998). Therefore, more servings of nondairy foods are needed to equal the calcium intake from a typical serving of milk and other dairy foods. For example, an individual would need to consume eight cups of spinach, nearly five cups of red beans or 2 ¼ cups of broccoli to obtain the same amount of calcium absorbed from one cup of milk (Weaver *et al.*, 1999b). Components in some calcium-rich nondairy foods such as phytates in unleavened bread, seeds, nuts and most cereals and oxalates in spinach, rhubarb, sweet potatoes and walnuts can form insoluble complexes with calcium, reducing its bioavailability (Weaver *et al.*, 1999b). Consequently, it may be difficult for Americans to meet their calcium needs exclusively from nondairy foods naturally containing calcium (Weaver *et al.*, 1999b). Despite these limitations, calcium from nondairy foods is an important source and may be more useful for people unlikely to or unable to consume dairy.

Table 2.4. Calcium Contribution of Selected Foods, (USDA, 1998)

Food	Calcium (mg)
Yogurt, nonfat, plain (1 cup)	415
Cheese, Swiss (1 ½ oz)	408
Yogurt, low fat, flavored (1 cup)	314
Cheese, cheddar (1 ½ oz)	306
Milk, skim (1 cup)	302
Milk, 2% (1 cup)	297
Milk, whole (1 cup)	291
Sardines with bones (2 oz)	217
Salmon with bones (2 oz)	135
Tofu (½ cup)	130
Ice cream, soft serve (1/2 cup)	118
Turnip greens, cooked (1/2 cup)	99
Almonds (1/4 cup)	94
Kale, frozen cooked (1/2 cup)	90
Okra, cooked (1/2 cup_	50
Broccoli, cooked (1/2 cup)	36
Whole wheat bread (1 slice)	20

2.3.3 Calcium-Fortified Foods

In the United States fortification with low amounts of essential nutrients has been in practice for over 60 years and has contributed substantially to nutrient intakes and reduced risk for disease and nutrient deficiencies (Leveille, 1994; Nicklas *et al.*, 1995; Popkin *et al.*, 1996b). For individuals who limit or avoid foods naturally rich in calcium such as milk and other dairy foods, calcium-fortified foods can be a reasonable option to help achieve adequate calcium intakes (ADA, 2001). Calcium fortification has become widespread. It is now commonplace for many foods, especially beverages and grain products, to be fortified with at least 100 mg of calcium is provided in each serving. Significant calcium fortification began in the late 1980s and early 1990s specifically with the introduction of fortified orange juice and grapefruit juices. By early 1999, 234 foods and beverages "with added calcium"

had been introduced (Miller *et al.*, 2001). These products include calcium fortified breakfast cereals, breads, pastas, pancake and waffle mixes, juices, juice drinks, spreads/margarines, bottled water, candy, energy bars and soy beverages (Fishbein, 2004). **Table 2.5** lists a number of fortified foods in terms of their typical serving size, calcium (mg), and their respective values (2000b).

Table 2.5. Calcium Content of One Serving of Fortified Foods (National Institute of Child Health & Human Development, 2000)

Serving Size	Food Item	Calcium (mg)	% Daily Value
½ cup	Frozen yogurt, fat-free, calcium added	450	45%
1 cup	Calcium-fortified orange juice	300	30%
1 cup	Soy milk, calcium added	250-300	25-30%
½ cup	Tofu made with calcium	260	25%

2.3.3.1 Prevalence

The wider availability of fortified foods and beverages may be improving calcium status in Americans; however, this has not been recently investigated. An analysis of the CSFII 1989-1991, which quantified the contribution of the fortification of nine nutrients including calcium (vitamin A, vitamin C, thiamin, riboflavin, niacin, folate, calcium, iron, zinc) found that fortification substantially increased the intakes of all nutrients examined except for calcium, in all age/gender groups but especially in children (Berner *et al.*, 2001). The USDA nutrient database was updated to reflect the fortification of foods with the nine nutrients of interest and then the updated values were applied to the 3-day diet record. The breakfast cereal category was responsible for nearly all the intake of nutrients from fortified foods, except vitamin C, for which juice-type beverages made a greater contribution. Because the number

and type of fortified foods (specifically calcium-fortified foods) have increased dramatically in years after the CSFII 1989-1991 data was collected, total calcium intake from calcium fortified foods may be increasing, however, no current data exists on their current contribution. Furthermore, no data exists on how many calcium-fortified foods have stayed in the market since their increases in the late 1990s, thus current nutrient databases may not accurately reflect their presence. Calcium fortification may play a role in promoting bone health and decreasing incidence of chronic diseases (osteoporosis, obesity, hypertension), similar to folate's beneficial effects on neural tube defects (NTDs) (Werler *et al.*, 1993), thus the role of calcium-fortification needs to be considered in further research investigations.

2.3.3.2 Characteristics of Calcium-Fortified Food Users

Sociodemographic characteristics of fortified product users have not been well studied. Popkin et al (Popkin *et al.*, 1996b) indicated that use of enriched and fortified products crossed socioeconomic lines back in the 1970s, but there are no current analyses on a large cross-section of the U.S. population. For calcium-fortified foods, characteristics of users may differ based on the specific food of interest. For example, widely consumed foods such as breads, rolls, bagels, rice, and noodles which were the first type of foods used in enrichment and fortification may cross sociodemographic barriers for consumption. Ready-to-eat-breakfast-cereal (RTEBC), even though widely consumed, has been shown to be associated with more use by Caucasians, those with higher income and education levels, and those with healthier food patterns compared to nonusers (Siega-Riz *et al.*, 2000). More specific foods such as calcium-fortified orange juice or calcium-fortified cereal bars may be

purchased by people also concerned with their health, particularly in increasing their calcium intake. A greater understanding of the characteristics of calcium-fortified food users is needed to effectively target those most in need of calcium fortification.

2.3.3.3 Limitations of Calcium-Fortified Foods

The increased availability and use of calcium-fortified foods raises concerns, including the potential for calcium toxicity, lower calcium absorbability than expected and inadequate intakes of other essential nutrients. In 1997, the NAS set 2,500 mg calcium per day as the Tolerable Upper Limit for calcium (1997). Calcium intakes in excess of this amount can potentially increase risk for milk-alkali syndrome (MAS) (i.e. a condition of hypercalcemia and renal insufficiency), aggravate kidney stone formation in stone-formers who hyper absorb calcium from the intestine and inhibit the body's absorption of iron and zinc (1997). Although calcium toxicity is rare, excessive use of calcium-fortified foods, especially by individuals who are already meeting their calcium needs, is a possibility (Whiting & Wood, 1997). The bioavailability of calcium from calcium-fortified food products is another consideration and may vary, depending on the food (Fairweather-Tait & Teucher, 2002; Heaney *et al.*, 2005). In a study of 16 healthy men, the calcium from soy beverages was absorbed at only 75% the efficiency of calcium from cow's milk (Heaney, 2000b); thus, more servings of nondairy foods fortified with calcium may be needed to meet calcium recommendations. Additionally, there is concern that fortifying foods with large quantities of calcium, especially over the long term, may adversely affect the utilization of iron, zinc and magnesium (Heaney *et al.*, 2005). Finally, the nutrient profile of calcium-fortified foods are usually not nutritionally

equivalent to dairy foods (Heaney, 2000b; Nicklas, 2003; Fishbein, 2004). Individuals using calcium-fortified foods, particularly low nutrient foods, as a replacement for dairy foods, may not consume other nutrients found in dairy, such as vitamin D (if fortified), potassium, and riboflavin (Whiting & Wood, 1997; Sloan, 2000). Calcium-fortified foods can be used to enhance calcium intake, especially for individuals whose intake of dairy foods is limited. However, there is need for education about the appropriate use of calcium-fortified foods, excess intake of calcium, and under consumption of other nutrients essential for health.

2.3.4 Calcium Supplements

For those unable to meet their calcium needs through diet, calcium supplements may be effective in increasing calcium intake. With increases in recommendation levels along with research supporting calcium's numerous benefits to health, calcium supplements are increasingly becoming an important source of calcium (Berdainer, 2002; Fairweather-Tait & Teucher, 2002).

2.3.4.1 Prevalence in Adults

According to the NHANES 1999-2000 approximately 52% of US adults aged 20 years or older took at least one dietary supplement some time during the preceding month (Radimer et al., 2004). The most commonly reported supplement among adults were multivitamin/multiminerals (35%) formulas which generally provide 10% of the daily value (DV), or 100 mg of calcium. Approximately 30% of women and 19% of men take calcium supplements which generally provide 500 mg calcium per serving (Radimer et al., 2004).

Comparison of NHANES 1999-2000 findings with those from previous NHANES surveys, which used similar methodology, suggests that supplement use has increased in the past 20 years. Results from the Third NHANES survey (1988-1994) were approximately 40% of adults ages 20 years and older (Ervin *et al.*, 1999b), compared with 35% in the Second NHANES survey and 23% in the First NHANES survey (Block *et al.*, 1988). Supportive of NHANES data, the National Health Interview Surveys of 1987, 1992, and 2000 found that the percentage of adults who took a multivitamin/mineral supplement increased from about one in six to one in four, and the trend in daily use of multivitamins, vitamin A, vitamin C, vitamin E, and calcium supplements by US adults increased significantly (Millen *et al.*, 2004). Additionally, the trend analysis indicated that calcium supplementation decreased from 1987 to 1992, but that from 1992 to 2000 it increased. The NHANES 1999-2000 also noted an increase in calcium supplement use, in particular in middle-aged and elderly adult females (Radimer et al., 2004). It has been speculated that these increases may be due to media reports regarding therapeutic effects of calcium in reducing the risk of other chronic diseases (e.g. hypertension, colon cancer, breast cancer, and kidney stones) in addition to the prevention of osteoporosis (Millen et al., 2004).

2.3.4.2 Prevalence in Children and Adolescents

Little is known about supplement use, particularly calcium supplement use in preadolescents and adolescents. According to the CSFII 1994, approximately 33% of adolescents (13-18 years) surveyed reported using supplements, with 16% using supplements on a daily basis (Stang *et al.*, 2000). Of the adolescents who used

supplements, only 4% used a calcium supplement (Stang *et al.*, 2000). In the 1998 Child and Adolescent Trial for Cardiovascular Health Tracking Study (CATCH III), 1,532 eighth-grade students were surveyed on their dietary intakes of supplements. 18% of the eighth graders surveyed reported using vitamin-mineral supplements on the 24-hour recall. Of those users, 47% took multivitamin and/or multimineral preparations, 37% used single nutrient supplements (mostly vitamin C) with 3.9% using calcium (Dwyer *et al.*, 2001). The CATCH III reported slightly lower use which may have been due to the age, sample size or sociodemographic characteristics of the population. Evidence indicates that few adolescents take calcium supplements. However, the most commonly reported supplement for children and adolescents is a multivitamin with minerals which generally provides some calcium and may improve intake in this population.

2.3.4.3 Characteristics of Supplement Users

There have been certain demographic/lifestyle characteristics that have been found to be associated with adult users of supplements. Analyses of previous supplement surveys have found demographic/lifestyle characteristic associations similar to NHANES 1999-2000 (Slesinski *et al.*, 1996) (Subar & Block, 1990; Zive *et al.*, 1996): higher usage rates among women, non-Hispanic white, older people, those with higher income and education levels, former and/or non-smokers, those with normal BMI, and higher rates of physical activity. Users were also shown to be more likely to have higher nutrient intakes from foods and higher total intakes for several micronutrients than nonusers (Radimer *et al.*, 2004). These characteristics are all

indicative of a healthy lifestyle (Miller *et al.*, 2003). Non-users were shown to be less likely to have adequate nutrient intakes from foods and consume a healthy diet.

The characteristics of children and adolescent supplement users has not been examined to the extent of adults and remains to be determined (Dwyer *et al.*, 2001). A study of mother and daughter (ages 5-7) pairs (n=192) found that mothers who used multivitamin/multimineral (MVM) supplements were more likely to give MVM supplements to their daughters (Lee *et al.*, 2002). Additionally mothers who reported giving MVM supplements to their children were more likely to have higher incomes and education levels (Lee *et al.*, 2002). Adolescent (13-18 years) supplement users from the CSFII 1994 were found to be more likely to be female, non-Hispanic white, from families of higher socioeconomic status, consume diets with higher nutrient intakes from foods and had higher nutrition awareness than nonusers (Stang *et al.*, 2000). Similar to the CSFII 1994, adolescent supplement users from the CATCH III trial were more likely to be non Hispanic white and had significantly higher scores on a measure of nutrition awareness (Dwyer *et al.*, 2001). These results are similar to adult findings (Eliason *et al.*, 1997; Greger, 2001; Miller *et al.*, 2003) suggesting the important role of the parent on child supplement use.

2.3.4.4 Types of Calcium Supplements, Dosage, Timing

There are currently approximately two dozen commonly prescribed calcium supplements and hundreds of different formulations (Fishbein, 2004). Calcium supplements are generally readily available over-the counter, as various salts and salt combinations, principally as carbonate, citrate, lactate and phosphate, and to a lesser degree as the gluconate, glubionate, gluceptate in many oral forms which are

generally well absorbed. Calcium supplements vary in calcium content with the largest percent of calcium (40%) in calcium carbonate (most cost effective and readily available in some antacids), with other salts such as citrate, lactate and gluconate furnishing 21%,14%, and 9.3% of calcium (Berdainer, 2002). Many of the commercially available calcium supplements also contain vitamin D, magnesium, potassium, and other minerals to help aid in absorption and promote bone health.

Physical properties such as solubility, interference from coingested medications or food stuffs, dosage, and timing can affect the bioavailability of calcium (Fairweather-Tait & Teucher, 2002). In terms of dosage and timing, calcium is best absorbed in doses of 500 mg or less (Nicklas, 2003). Individuals requiring more than 500 mg of elemental calcium from supplements should take in multiple doses with meals for efficient utilization. Use of calcium supplements may contribute to potential side effects including constipation and bloating, as well as nutrient imbalances and toxicity of taken in doses above the UL (Heaney, 2000a). Also, if calcium supplements are substituted for calcium-rich foods such as dairy products to meet calcium needs, attention needs to be given to other nutrients provided by foods (Heaney, 2000b; Fairweather-Tait & Teucher, 2002). Educational interventions are needed for the general population to understand the risks/benefits and to more effectively target those in need of calcium supplementation to optimize calcium intake for those in need (Miller *et al.*, 2001).

2.4 Parental Influences

2.4.1 Introduction

Numerous influences may negatively impact calcium nutrition in children. It has been suggested that some of these influences include (1) displacement of milk as a beverage by soda, juices and sports drinks (Harnack *et al.*, 1999; Ballew *et al.*, 2000); (2) eating away from home (Guthrie, 1999; Lin B-H, 1999); (3) the perception, particularly among females, that milk and/or dairy products are fattening and therefore intake is restricted or eliminated (Barr, 1995; Neumark-Sztainer *et al.*, 1999; Smart *et al.*, 1999); and (4) peer influences (Chapmen, 1993; Neumark-Sztainer *et al.*, 1999). In addition to these influences, the role of the parent may negatively or positively impact calcium intake.

Parental influences play an important role in the development of childrens eating patterns, eating behaviors and food preferences (Birch, 1998b; Birch & Davison, 2001) not only by the foods they make available and accessible, but also by serving as a role model, (Cutting *et al.*, 1999) and by actively encouraging or expecting them to eat certain foods at mealtimes (Drucker *et al.*, 1999). Limited research has been completed involving parental influence specific to calcium intake in children. The next sections will address parental influence through availability, accessibility, taste preference, modeling, parental expectation, knowledge, health benefit beliefs, and their potential role in influencing calcium intake in children.

2.4.2 Parental Influence on Availability and Accessibility

Availability concerns whether foods of interest are present in an environment (e.g. carrots in the refrigerator) (Cullen *et al.*, 2000; Baranowski, 2002). A

longitudinal study evaluating calcium intake from 192 girls, ages 5 to 9 years old, as a function of mother-daughter beverage choices , provided new evidence that the mother-daughter similarity in milk intake was statistically mediated by the extent to which the mothers made milk available to daughters, and that milk availability at meals and snacks was the main influence in milk intake in young girls (Fisher *et al.*, 2004). Although both groups drank more sweetened beverages as they got older, only the girls whose mothers were in the habit of frequently serving milk at meals and snacks were still drinking significant amounts of milk, and were getting enough calcium, at age 9 (Fisher *et al.*, 2004). Another study of 902 adolescents (ages 13-18) and their parents/guardians that completed the Project EAT survey and the Youth Adolescent Food Frequency Questionnaire (FFQ) found that while most parents reported that fruits and were available at home (90.3%), fewer parents reported milk was served at meals (66.6%) (Hanson *et al.*, 2005). Intake of dairy in general was less than recommended for adolescents as well as adults. However, similar to Fisher and colleagues, for those parents who did make dairy foods available at meal and snack times, their children had significantly higher calcium intakes than those who did not ($p < 0.05$) (Hanson *et al.*, 2005). These findings suggest that making milk and other calcium-rich foods routinely available may help to ensure that such foods are consumed in the amounts needed to achieve adequate calcium intakes. This relationship is consistent with the findings of studies that showed a positive association of children's fruit and vegetable intakes with the availability of those foods in the home (Domel *et al.*, 1993; Krebs-Smith *et al.*, 1995; Baranowski *et al.*,

1997; Gibson *et al.*, 1998; Hearn, 1998; Weber Cullen *et al.*, 2000; Edmonds *et al.*, 2001; Cullen *et al.*, 2003).

Accessibility concerns whether food is made available in a form and location that is likely to increase its consumption (e.g. ready-to-eat carrot sticks in a plastic bag at the front of a child-accessible refrigerator shelf next to the child's favorite low-fat dip) (Baranowski, 2002; Cullen *et al.*, 2003). Accessibility has also been positively associated with fruit and vegetable intake (Cullen *et al.*, 2000; Baranowski, 2002). Fisher and Hanson et al illustrated the importance of accessibility by finding that serving milk and dairy foods at meal and snack time, thereby making it easily accessible, had a positive impact on overall calcium intake.

2.4.3 Parental Influence on Taste Preference

The term "preference" refers to the selection of one item over others. In general usage, preference connotes that liking is the basis for selection (Birch, 1998a). The preference for sweet and salty tastes, and the rejection of sour and bitter tastes are innate and unlearned (Beauchamp *et al.*, 1994), but nearly all other food preferences are learned via children's experience with food and eating. Parents help to shape children's eating environment that is important in the formation of children's food preferences (Birch, 1998a; Birch, 1999). Children's food preferences are shaped by the quantity and quality of children's experience with food, and as a result of many eating occasions in which foods are associated with the social contexts of eating and with the physiological consequences of indigestion, children come to accept some foods and reject others, shaping their dietary intake (Birch, 1998b). By parents providing experience with some foods and flavors and not others, their impact on the

feeding environment can influence individual differences in food preferences established during childhood which may persist later in life (Birch, 1999).

Food preference is the primary factor influencing child and adult food choices (Barr, 1994; Neumark-Sztainer *et al.*, 1999; 2000a; Carruth BR, 2000). In research with adolescents, taste preference for dairy foods was associated with calcium intake (Barr, 1994; Novotny R, 1999; Smart *et al.*, 1999; Lee & Reicks, 2003; Novotny *et al.*, 2003). Barr found among high school students (n=900) that taste enjoyment of dairy foods was significantly lower among Asians than in Caucasians and other ethnic groups (Barr, 1994). In the USDA regional project, "Factors Influencing the Consumption of Calcium-Rich Foods among Adolescents," (project W191) taste enjoyment of dairy foods was identified as a key motivator and barrier with Caucasians having the most positive comments towards milk while Asians and Hispanics had more negative comments to the taste of milk. All groups liked cheese, ice cream and pizza (Novotny *et al.*, 1999; Auld *et al.*, 2002). Data collected in the regional project included focus groups of 2 age groups (11 to 12 and 16 to 17 years) and two days of 24-hour recalls from 200 male and female Asian, Hispanic, and white youth from 11 participating states (Auld *et al.*, 2002). From the W191 project in Asian focus groups in Hawaii, Novotny and colleagues found that taste was a motivator by many if served at a certain temperature and with certain "matching" foods (accompanying food type). "Milk has to be cold." "I like plain milk when it's been sitting in Fruit Loops for a long time because it tastes really good, it gets sugary." (Novotny *et al.*, 1999). More research is needed in understanding the factors

that influence children's calcium-rich food preferences which may help to positively impact calcium consumption in children and adolescents.

2.4.4 Parental Influence through Modeling

Modeling concerns a child observing parents' food selection patterns and eating behavior, and then imitating those behaviors (Birch, 1998a). In a study of 180 mothers and their 5 year-old girls, few mothers were modeling milk consumption, but the mothers who drank milk frequently had daughters who drank milk more frequently and drank fewer soft drinks. They concluded that maternal milk and soft drink consumption predicted the apparent tradeoff between milk and soft drinks in the diets of preschool-age girls (Fisher *et al.*, 2001). Similarly, in the Project EAT study (Hanson *et al.*, 2005) although the majority of parents had inadequate intake of dairy foods, those parents with higher dairy intakes were positively associated with dairy intake in their children. Another study in adolescents (n=105), found that for girls who reported often seeing their parents drink milk, their calcium intake was significantly greater than for others (Lee & Reicks, 2003). Barr also found in high school students (n=900), that modeling of milk use by a significant adult was associated with improved calcium intake for both high school males and females (Barr, 1994). These findings suggest that modeling of milk and other dairy foods by parents, may be an important factor in promoting adequate calcium intake in children and adolescents, although more research is needed.

2.4.5 Parental Influence through Expectation

Parental expectations concerns encouragement or enforcement of nutrient-rich foods to be consumed at meals (Cullen *et al.*, 2001). Parents' "do as I say " pressure

on children to "finish your vegetables" is one means of encouraging children to eat nutrient-dense foods but has not been studied to a great extent (Cullen *et al.*, 2001). Some research has suggested that pressuring children to eat may diminish children's ability to self-regulate intake, (Fisher & Birch, 1999; Birch & Fisher, 2000; Francis *et al.*, 2001) which may result in lower nutrient intake and increased risk for overweight and obesity. These studies did not look specifically at calcium intake. In the W191, a key motivator and barrier was the expectation within families for drinking milk. Limited expectation by parents was more common among older girls and Asian groups (Auld *et al.*, 2002). There may be differences, however, in how parental expectation is interpreted. For example, parents that encourage calcium-rich food consumption by discussing with their children the importance of having enough of these foods and make an effort to provide them to consume at meal and snack times may be different than parents who "force" their children to eat these foods during meals. These differences may have varying impacts on calcium intake, thus more research is needed to clearly defining parental expectation and develop measures to accurately capture this parental factor.

2.4.6 Parental Influence through Knowledge

Although many parents and children understand the importance of calcium intake to bone health during childhood and throughout the lifespan (Neumark-Sztainer *et al.*, 1997), inability to translate knowledge regarding the importance of calcium and bone health to specific dietary recommendations may contribute to inadequate intake. A survey conducted by the Quaker Oats© and the American Dietetic Association regarding influences on calcium, found that many women are

confused or uneducated about the recommended daily amount of calcium to consume. 43 % of women surveyed said, "It's too confusing to figure out how much calcium is in a serving of a particular food and then add everything up." Nearly the same number, 42% of women surveyed agreed that, "I don't know how much calcium I need." (ADA, 2003). This lack of understanding in adults may have a negative impact on children's knowledge and intake. In a study of 1117 adolescents, only 19% knew how many dairy foods that they should consume and only 10% knew the calcium content of various dairy foods, (Neumark-Sztainer *et al.*, 1997; Harel *et al.*, 1998; Harel Z, 1998). Given that nutritional education is a central component of intervention strategies, lack of knowledge translating recommendations into calcium-rich food servings may be a critical area to target during educational intervention.

2.4.7 Parental Influence through Health Benefit Beliefs

Increased understanding of importance of the dietary behavior may help consumers make behavior changes decisions that promote better health (Carslon & Gould, 1994; Wardle *et al.*, 2000). However, findings from studies exploring the impact of diet-health awareness on dietary behavior are not externally consistent. Some studies have found a positive effect of diet-health awareness (Jensen & Kesavan, 1993; Carslon & Gould, 1994; Variyam *et al.*, 1996; Variyam *et al.*, 2001), while some have found no significant effect of diet-health awareness on consumer eating decisions (Jensen *et al.*, 1992; Douthitt & Gould, 1995). The research regarding the relationship between parent diet-health awareness and its effects on children's calcium intake is limited. One study documented that mother's awareness of the diet-health relationship helped to increase children's under consumed nutrients

such as fiber and calcium but was not useful in reducing children's unhealthy nutrients (Lin *et al.*, 1996). Another study using data from the CSFII 1994-1996 was completed to examine the effects of mother's diet-health awareness on their children's dairy product consumption (Kim & Douthitt, 2003). Mothers' awareness of diet and health relationships had a significant effect on adolescents' dairy food consumption. More research is needed to understand the impact of parental diet-health awareness on child calcium intake.

2.4.8 Other Influences

In addition to the influences mentioned, additional parental influences that have been reported include cost and convenience of dairy foods, rules regarding eating and meals, the overall parent child relationship, family connectedness and familial cultural practices (Novotny *et al.*, 1999; Auld *et al.*, 2002). Family meal patterns have been shown to positively impact children's' overall diet quality including calcium intake (Gillman *et al.*, 2000; Neumark-Sztainer *et al.*, 2000; Videon & Manning, 2003). According to a study examining the nutritional quality of diets of 16,202 children ages 9-14, eating meals such as dinner with their family increased calcium intake (Neumark-Sztainer *et al.*, 2003). Compared to children who rarely or infrequently ate dinner with their family, children who ate dinner with their family each day had higher calcium intakes and were less likely to consume sodas (Neumark-Sztainer *et al.*, 2003).

2.4.9 Parental Influences Summary

Parental influences play an important role in the development of children's eating patterns, eating behaviors and food preferences, and may play an influential

role in impacting the adequacy of calcium nutrition in children. Unfortunately, there is a not a substantial body of work regarding these influences, including which influences may be most effective, and how they may differ in effect by gender, ethnicity/race, and socioeconomic status. Because eating behaviors are initiated in childhood, and may persist into adulthood, (Fletcher *et al.*, 1997; Lytle *et al.*, 2000), understanding the role of the parent in affecting calcium intake during childhood should be carefully examined in order to identify targets for intervention (Nicklas, 2003).

Chapter 3

METHODS

3.1 Overview of Study Design

This research is a cross-sectional analysis that uses a subset of data collected by the W1003 USDA multistate project entitled, "Parent and Household Influences on Calcium intake in Preadolescents." Two data sets were analyzed from the W1003: a) qualitative interviews assessing parental influences on calcium intake in children, and b) a supplement and calcium-fortified food questionnaire assessing use in parents and children. This study was conducted in three phases. The first phase was to transform the qualitative data from the interviews into a quantitative data set that includes variables on parental influences on calcium intake in children. The second phase was to transform the supplement and calcium-fortified food questionnaire data into a data set assessing use versus non-use of calcium-fortified foods and supplements in children. The third phase was to evaluate the association between the identified parental influences and supplement and calcium-fortified food use in children. Human subjects approval was obtained from University Committee on Research Involving Human Subjects (UCRIHS) (See **Appendix A** for UCRIHS informed consent). In October 2003, permission from the multistate project investigators was obtained for use of their data.

3.2 Data Sources

W1003 is a five-year, three-phase, multistate project designed to gain a greater understanding of the parental motivators and barriers to calcium-rich foods and their

influence on calcium intake in children (National Information Management and Support System: W1003 Multistate Project Summary,(Accessed 2004). The current study used selected data sets collected in phase I of W1003.

3.2.1 W1003 Multistate Subjects

The W1003 study population consisted of a convenience sample of 206 Asian, Hispanic, and Non-Hispanic white parents/guardians of 10-13 year old children. The inclusion criteria, in addition to the race/ethnicity requirements were that the parent or guardian must be the major food preparer in the household and have lived in the United States for at least one year. This convenience sample was recruited in the summer and fall of 2003 through ongoing engagement programs directed to youth, (e.g. extension youth groups, faith-based groups, scouts, and after-school programs). An informational recruitment flyer was distributed to engagement program leaders to help recruit eligible participants. A gift certificate incentive was provided for participation in the study. The data were collected in twelve states: Arizona, California, Colorado, Hawaii, Indiana, Kentucky, Michigan, Minnesota, New Mexico, Oregon, Wyoming, and Washington. Each state was given an equal number of participants of a designated race/ethnic group to recruit (e.g. Michigan recruited Hispanic and white participants). Michigan conducted 22 interviews (Schoemer-Interviewer, 2003). The project was approved by the Institutional Review Board of each respective university.

3.2.2 W1003 Multistate Measures

The first of two types of data that were collected in phase I of the W1003 multistate project was an open-ended, one-on-one qualitative interview designed to

uncover parental influences (knowledge, attitudes, beliefs, behaviors) on calcium intake in children. Interviews explored topics such as (a) availability of calcium-rich foods and alternatives to these foods in the home; (b) cost and convenience of consuming calcium-rich foods; (c) family meal patterns; (d) modeling of calcium intake in and outside the home by adult family members; (e) family expectations in and outside the home; (f) action-related behaviors related to calcium intake, e.g., regularly purchasing milk; and (g) attitudes and beliefs towards calcium-rich foods. From these interviews, the calcium-rich foods that were explored included the following: dairy (milk, cheese, yogurt), foods made with dairy (pizza, pudding, cream soup), green leafy vegetables (spinach, broccoli, greens, turnips, kale), and fish with bones (canned salmon and sardines). Parents were asked to describe if they purchased and consumed these calcium-rich foods for their home, how often they were consumed and purchased, along with reasons why they did or did not purchase and/or consume these foods. They were also asked if their child consumed calcium-rich foods, how often they consumed them, along with reasons why their child did or did not consume these foods. Parents were asked about these calcium-rich food groups as a whole (e.g. dairy, green leafy vegetables), as well as individual food within the specific food groups (e.g. milk, cheese, broccoli). The interviews were conducted by one interviewer (graduate research assistants or research professors) per state with 12 total interviewers. All interviewers were provided with an interview guide that included a list of questions that must be asked and possible follow-up probes. This guide was developed by the W1003 investigators to aid the interviewers

during interviews and provided a consistent format to follow (See **Appendix B** for interview guide).

To achieve standardization in the qualitative interviews among states included in the project, each interviewer was trained in qualitative interviewer techniques (Seidman, 1998). Practice interviews were piloted and monitored prior to initiation of subject testing. To enhance the responses of the participants and the quality of data, the researchers attempted to match the ethnicity between the interviewer and interviewee. The interviews were approximately one hour in length, were conducted in a neutral location, audio-recorded, and later transcribed. The information from these qualitative interviews has been used in W1003 to guide the design and content of a questionnaire about parental factors influencing calcium intake in children, which will be used in the next phase of the W1003 project.

The second data source was a supplement and calcium-fortified food questionnaire developed by the W1003 researchers to acquire information via a structured interview about children's use of supplements and calcium-fortified foods from their parents (See **Appendix C** for questionnaire including instructions to interviewers). The information from this questionnaire will b used in W1003 to improve quality of a calcium food frequency questionnaire which was developed and validated in the previous W191 multistate project.

During the supplement section, each parent was asked for the brand name, dose, and history of each dietary supplement he/she consumed in the previous month. In the calcium-fortified food section, a list of 9 types of calcium-fortified foods (orange juice, bread, bagels/English muffins/hot dog buns, cold ready-to-eat cereal,

cereal/granola bars, energy/protein bars, meal replacement drinks, soymilk, and tofu) were identified. Each parent was asked if he/she chose the fortified food to increase calcium intake, and if so, what was the parent's amount and frequency of use. Surrogate information for the children and spouses was also provided by the parents. Structured prompts, including pictures and follow-up phone calls, were employed when the participant failed to recall the specific type of a certain supplement or calcium-fortified food.

In addition to the supplement and calcium-fortified food data, the questionnaire also included sociodeomographic questions about the parent and his/her child. Self-reported ethnicity/race, age, gender, and level of education of the parent along with ethnicity/race, age, grade, and gender of child was collected. The children's enrollment in the free or reduced-priced School Lunch Program (SLP) was also documented as a surrogate marker for socioeconomic status.

Transformation of Data

3.3.1 Transformation of Qualitative Data

206 qualitative interview transcripts were received in April 2004 in Microsoft© Word format. A content analysis approach was used to transform these qualitative data into a quantitative data set assessing parental influences on calcium intake in children. Content analysis is a process of systematically analyzing messages in any type of communication (Kondracki *et al.*, 2002) and consists of coding raw messages (i.e. textual, material, visual images, illustrations) according to a classification scheme (Shepherd & Achterber, 1992). The procedures of the content analysis for this study are discussed in the following sections.

Developing a Coding Procedure

The purpose of the content analysis is to identify various parental influences in each household that.were expressed to have an effect on child calcium consumption. A specific set of factors (*parental influences*) (**Table 3.1**) were of particular interest to this research. These factors (*parental influences*) were chosen based on concepts prevalent in the literature. To ensure systematic identification of these factors within the qualitative interviews, a codebook of procedures was developed. Twenty-four transcripts (2 from each state) were initially sampled by the primary researcher for use in developing the codebook. The codebook includes definitions of each factor (*parental influence*), a rule for how to identify the factor in the text, as well as an example of text that qualifies to be coded as a positive or negative parental influence factor.

Codebook development was an iterative process. During the preliminary stages of coding, the codebook was revised multiple times, to make the definitions of each of the parental influences clear and the rules more precise to ensure a more consistent coding process. After the twenty-four sample transcripts were coded, code-checking was completed by giving four transcripts along with the codebook to three nutrition professionals (two MS, RDs, and one PhD in nutrition) to check their coding decisions against that of the primary researcher. This helped to further strengthen the coding scheme by continuing to improve the clarity of definitions and rules for consistent identification of the factors.

Table 3.1. Variables Representing Parental Influences on Calcium Intake Identified Through Content Analysis

Parental Influences Variables and Definitions
Availability: Concerns whether parents stated that calcium-rich foods of interest are present in the family home (e.g. "We always have milk at our house"). Lack of availability concerns whether parents stated that calcium-rich foods were not present in the family home.
Accessibility: Concerns whether parents stated that calcium-rich foods are made available in a form and location that is likely to increase its consumption (e.g. "Cheese is cut up into slices and is served at snack times"). Lack of accessibility concerns whether parents stated that calcium-rich foods were not accessible for their children.
Convenience: Concerns whether parents stated that calcium-rich foods are quick, easy to use when preparing meals and/or providing for their child to consume at meal and/or snack times (e.g. "Yogurt is a quick, easy food that I always put in her lunches"). Inconvenience concerns whether parents stated that calcium-rich foods were inconvenient for them to prepare or inconvenient for their child to consume at meal and/or snack times.
Cost: Concerns whether parents stated that the cost of calcium-rich foods was a positive or negative factor involved in providing calcium-rich foods for their children (e.g. "We hardly ever buy yogurt because it is too expensive", e.g. "We always have cheese because we get the cheese blocks on sale so it is cheap").
Health benefit beliefs: Concerns whether parents stated that calcium-rich foods were provided to their children because of their importance for their child's health (e.g. we always have milk at dinner because the kids need to get enough calcium). Negative health benefit beliefs concerns whether parents stated that calcium-rich foods were not provided to their children because of their harmful health benefits (.e.g. "We hardly ever serve cheese for family meals or snacks because it is too fattening.").
Child Preference: Concerns whether parents stated that they were purchasing calcium-rich foods as well as making these foods a part of their meals and/or snacks because their child liked them (e.g. "We always have yogurt as a snack option because the kids love it"). Lack of child preference or child dislike concerns whether parents stated that they did not purchase or make these foods part of meals and/or snacks because their child does not like them (e.g. "We don't serve milk for meals because Jenny can't stand it").
Parental modeling: Concerns whether parents stated drinking milk at meal and/or snack times (e.g. "I always drink milk at dinner,") when asked about their milk drinking habits in the interview. Lack of parental modeling concerns whether parents verbalized not drinking milk at meal and/or snack times.
Parental expectation: Concerns whether parents stated that milk was the beverage that was expected to be consumed by their children at meal and/or snack times when asked about milk expectation in the interview. (e.g. "I make sure that they always have milk for dinner"). Lack of parental expectation

concerns whether parents stated that they let their children choose whatever they want to consume at meal and/or snack times (e.g. "She just gets what she wants out of the fridge to drink for supper").
Knowledge of calcium and health: Concerns whether parents stated that they knew that calcium was important for bone health when asked about calcium and health during the interview.
Knowledge # dairy servings: Concerns whether parents stated the correct number of dairy servings needed to meet child calcium recommendations when asked during the interview.

After the code-checking was completed, all transcripts were re-coded by the primary researcher using the revised codes. After the initial coding, further revisions were made to the codebook to make the definitions and rules for the parental influence factors more precise. Also further revisions were made because certain calcium-rich food groups (green leafy vegetables, and fish with bones) that were initially evaluated in the codebook were not widely consumed across all participants and therefore yielded insufficient data for analysis. These factors were dropped from the codebook. After revisions the transcripts were then coded for a second time by the primary researcher.

To improve the reliability of the coded data an additional coder was trained to strengthen the consistency of the coding scheme. Six training sessions (1 hour each) were completed on codebook instructions with the second coder. Codebook revisions were made to tighten the definitions and translation rules based on discussions during training sessions. The second coder then proceeded to code a sample of 24 transcripts (2 from each state). Six sessions (1 hour each) were completed after the sample coding to code-check the additional coder's results against the primary researcher's. After additional revisions, the codebook and coding form were finalized and ready for independent coding by the primary investigator and additional coder. Detailed

instructions on the coding procedure are found within the project codebook (See **Appendix D** for codebook).

Coding

The purpose of the coding procedure was to identify the positive and negative factors (or "*parental influences*") on calcium intake in children from the qualitative interviews. The factors were coded as a +1 if they were identified as a positive factor and a -1 if they were identified as a negative factor. If a factor was probed for but not mentioned within the interview then it was coded as 0 and considered a neutral factor. If specific questions within the interview content outline were skipped by the interviewer that would elicit information about a particular factor, the factor was considered missing and was coded with a period (•). The codebook corresponded to the coding form (See **Appendix E** for coding form), which provided spaces appropriate for recording the codes for all factors measured. The primary researcher coded all the transcripts for the final time. The second coder coded a subset of the total independently. 20% (40 transcripts) of the sample (n=179) that the coder had not practiced on previously were randomly selected from a random number table. The second coder was a blind coder in that they did not know the purpose, research questions, or hypotheses of the study. The final factors that were coded for which are the independent variables are listed in **Table 3.2**.

Cleaning the Data

After the coders coded the data on the coding forms, they proofread their data entries on the coding forms against the interview text that was highlighted and labeled and then entered the data into a Microsoft© Excel file. When data entry was

complete, an undergraduate assistant also checked for errors in data entry. Data was subsequently checked the quantitative data set of parental influence factors was finalized and ready for analysis.

Reliability

After the data was cleaned, a graduate student not involved in the study calculated the percentage agreement between the two coders for the interviews they both completed to provide an assessment of interrater reliability. Percentage agreement scores were calculated as the number of times of observation or coding in which the two coders agreed divided by the number of possible observations of coding.

3.3.2 Transformation of Supplement and Calcium-Fortified Food Questionnaire

The second phase of the research was to transform the supplement and calcium-fortified food questionnaire data into variables that record use versus non-use of calcium-fortified foods and calcium supplements in children and parents. The following criteria were applied to the questionnaire data: calcium supplement use was defined as use of a multivitamin with calcium or a calcium supplement three or more times per week. If use was less than this, the parent and/or child were not considered to be a supplement user. Calcium-fortified food use was defined by average daily consumption of at least one calcium-fortified food. If average use was less 1x/day then the parent and/or child was not considered to be a calcium-fortified food user. After the criteria were applied to develop the new data set, it was proofread for accuracy. The sociodemographic variables that were collected from the questionnaire were added to the data set without transformation and are listed in

Table 3.2. This data set was then merged with the data set derived from the qualitative interviews to form a complete data set in an SPSS data file. See **Table 3.2** for list of supplement and calcium-fortified food and variables.

Table 3.2. Parental Influences, Sociodemographic, Supplement and Calcium-Fortified Food Variables

Parental Influences Variables	**Possible Values**
Availability (dairy group*, milk, yogurt, cheese)	positive, negative or neutral factor
Accessibility (dairy group*, milk, yogurt, cheese)	positive, negative or neutral factor
Convenience (dairy group*, milk, yogurt, cheese)	positive, negative or neutral factor
Cost (dairy group*, milk, yogurt, cheese)	positive, negative, or neutral factor
Culture (dairy group*, milk, yogurt, cheese)	positive, negative, or neutral factor
Health benefit beliefs (dairy group*, milk, yogurt, cheese)	positive, negative, or neutral factor
Child Preference (dairy group*, milk, yogurt, cheese)	positive, negative, or neutral factor
Knowledge of number of milk servings to meet calcium recommendations	positive or negative factor
Knowledge of bone health	positive or negative factor
Parental modeling for milk	positive or negative factor
Parental expectation for milk	positive or negative factor
Sociodemographic Variables	**Possible Values**
Participant in school lunch program (SLP)	yes, no
Race/Ethnic group of parent and child	Hispanic, Non-Hispanic white, Asian
Gender of child	male, female
Gender of parent	male, female
Age of child	10,11,12,13
Grade of child	5^{th},6^{th}, 7^{th}, 8^{th}
State	AZ,CA,CO,HI,IN,KY,MI,MN,NM,OR,WA,WH
Education level of parent	<high school or high school graduate, some college, college graduate
Supplement and Calcium-Fortified Food Variables	**Possible Values**
Parent and child supplement use	user, non-user
Parent and child calcium-fortified food use	user, non-user

* Positive and negative parental influence comments were identified about the dairy group overall, along with positive and negative comments regarding individual foods within the dairy group (milk, yogurt, cheese).

3.4 Analysis

Statistical Package for the Social Sciences (SPSS) Version 13.0 was used for statistical analyses (SPSS, 2003). Interrater reliability was assessed between the two coders using percentage (%) agreement. Relationships between sociodemographic characteristics and child calcium supplement and calcium-fortified food use were evaluated using chi-square analyses. The statistical analysis for each specific aim is discussed below.

Specific Aim 1. To identify positive and negative parental influences related to calcium intake in preadolescents.

Content analysis procedures described above were used to identify positive and negative parental influences related to calcium intake in preadolescents. Descriptive statistics were analyzed to detect frequencies and percentages of the parental influences.

Specific Aim 2. To identify patterns of parental influences within the sample population.

Cluster analysis procedures were used to identify similar patterns of the following parental influences: availability (dairy group, milk, yogurt, cheese), accessibility (dairy group, milk, yogurt, cheese), convenience (dairy group, milk, yogurt, cheese), cost, (dairy group, milk, yogurt, cheese), culture (dairy group, milk, yogurt, cheese), health benefit beliefs (dairy group, milk, yogurt, cheese), and child preference (dairy group, milk, yogurt, cheese). A hierarchical agglomerative clustering method was performed to determine whether a heterogeneous pool of

participants could be classified into a smaller number of homogeneous subject profiles. Starting with each subject as a cluster, the hierarchical procedure calculates the squared Euclidean distance between each pair of clusters and continues to combine clusters that have the smallest distance until one single cluster is left. In order to determine the number of clusters, a hierarchical dendogram (See **Appendix F** for hierarchical dendogram) was used and solutions for 2 to 4 clusters were investigated. The final number of clusters was determined by a substantive analysis of the characteristics of the persons grouped into the cluster and the number of personas in the clusters. The solution of two clusters was most interpretable.

After the two cluster solution was determined, a K-means cluster method was employed (See **Appendix G** for K-means cluster method). This method produces 'K-means' or clusters of individuals who score similarly on a set of items. In a two cluster solution, the K-means procedure starts with one cluster or group and splits it in two by picking the individual farthest from the center in multidimensional space as a seed for the second cluster (Afifi, 1996). All individuals are then assigned to one or the other cluster depending on which center they are closest to in multidimensional space. The objective of clustering is to identify the smallest number of groups that both maximize distance between groups and maximize frequency within each cluster. Chi-square analysis was used to identify the sociodemographic distributions for each cluster.

Specific Aim 3. To relate patterns of parental influences to preadolescent use of calcium-fortified foods and supplements.

This third phase of analysis was to evaluate the association between the identified parental influences and supplement and calcium-fortified food use in children. Associations between cluster membership and preadolescent calcium-fortified foods and supplement use and other sociodemographic characteristics were evaluated using chi-square analyses and the Mantel-Haenszel test. The Mantel Haenszel test was used to control for sociodemographics to see if the overall association found was different across different sociodemographic groups.

Chapter 4

RESULTS

4.1 Demographic Characteristics of Sample

Of the 206 interview transcripts that were completed, 191 were used for analysis. One interview was not used because the quality of the audio recording did not allow for adequate transcription. Fourteen were not used because questions from the interview content outline were not asked or adequate probing was not used in the interview to ensure completeness of responses. Interviews included for analysis were equally represented among all states with the exception of proportionately more completed in Arizona, Michigan and proportionately less in New Mexico. Selected sociodemographic characteristics for the parent and the child (surrogate information for child provided by parent) are provided in **Table 4.1.1**. The majority of parents were mothers of children 11-12 years old, college educated (57%) and did not participation in school lunch (measured as a surrogate for income) (66%). There were more girls (55%) than boys (46%) and proportionately more children were Non-Hispanic white (39%) followed by Hispanic (32%), and Asians (29%). Within the Asian and Hispanic groups, 9 participants were mixed Asian-white and 20 were mixed Hispanic-white and were included in the Asian or Hispanic category.

Table 4.1.2 examines child race/ethnicity differences by state of residence. The majority of Asians were recruited from Minnesota, Oregon, Kentucky and Hawaii. The majority of Hispanics were recruited from Arizona, Michigan, California, Colorado and Oregon. The majority of Non-Hispanic white participants were

recruited from Arizona, Washington, Colorado, Michigan and Wyoming. Associations among sociodemographic characteristics and child race/ethnicity were examined using chi-square analysis. There were no differences among race/ethnicity groups in terms of gender, grade or age. A significant association between child race/ethnicity and participation in the free/reduced meal program was found. Out of the total sample, 19% of Hispanic, 10% of Asian and 6% of Non-Hispanic white participants were participating in school lunch while a higher percentage of both Asians and Non-Hispanic whites and a lower percentage of Hispanics were not participating (See **Table 4.1.3**). A significant association was also found between child race/ethnicity and education level where out of the total sample a higher frequency of Non-Hispanic white (29%) and Asian (20%) were college graduates compared to Hispanics (9%), while a higher frequency of Hispanics had less education when compared to Non-Hispanic whites and Asians (See **Table 4.1.4**).

Table 4.1.1. Sociodemographic Characteristics for Parents and Children

	(n=191)
Race/Ethnic Group of Child	
Asian, %	29
Hispanic, %	32
Non-Hispanic White, %	39
Child Gender	
Male, (n, %)	45
Female, (n, %)	55
Parent Gender	
Male, %	6
Female, %	94
Child Age (years)	
10,%	16
11, %	32
12, %	33
13, %	19
Child Grade	
4^{th}, 5^{th}	5, 19
6^{th}, 7^{th}, 8^{th}, %	44, 21, 10
Education Level of Parent	
< HS or HS graduate, %	18
Some college, %	25
College graduate, %	57
Child participation in free/reduced price School Lunch Program (SLP)	
Yes, %	35
No, %	66
State of Residence	
AZ, CA, CO, HI	18, 4, 8, 8
IN,KY, MI, MN,	8, 8, 11, 8
NM, OR, WA, WY, %	2, 8, 8, 7

Table 4.1.2. Child Race/Ethnicity Differences by State of Residence

State	Asian (n=56) (%)	Hispanic (n=61) (%)	Non-Hispanic White (n=74) (%)
Arizona	0	28	23
California	4	10	0
Colorado	0	13	11
Hawaii	16	5	5
Indiana	9	7	8
Kentucky	14	0	10
Michigan	0	20	12
Minnesota	29	0	0
New Mexico	0	3	3
Oregon	18	10	0
Washington	7	0	16
Wyoming	4	5	12

Table 4.1.3. Child Race/Ethnicity Differences in free/reduced price School Lunch Participation

Child Race/Ethnicity	Yes (SLP)	No (SLP)	χ^2 p Value
Asian, %	10	19	$\chi^2 = 28.836$ $p < 0.001$
Hispanic, %	19	13	
Non-Hispanic white, %	6	33	
Total, %	35	65	100
			Total N = 191

Table 4.1.4. Child Race/Ethnicity Differences in Education Level

Child Race/Ethnicity	< HS or HS graduate	Some College	College graduate	χ^2 p Value
Asian, %	7	3	20	$\chi^2 = 40.715$ $p < 0.001$
Hispanic, %	9	15	9	
Non-Hispanic white, %	3	7	29	
Total, %	19	25	58	100
				Total N = 191

4.2 Presence of Parental Influences

Table 4.2.1 and **Table 4.2.2** indicate the most prevalent positive and negative parental influences that were identified from the qualitative interviews through content analysis procedures. A percentage of 10% or greater was used as the cutoff for reporting the most prevalent parental influences. Availability (milk, dairy, cheese), child preference (dairy, cheese, yogurt, milk), health benefit beliefs (dairy, milk, cheese, yogurt) convenience (dairy, cheese, yogurt), knowledge of calcium and bone health and knowledge of the number of servings to meet child calcium recommendations were the most prevalent positive parental influences. Lack of parental modeling for milk, lack of parental expectation for milk at meals, lack of availability of yogurt, and child preference (milk, dairy) were identified as the most negative parental influences to calcium intake in children. Accessibility, cost, and culture were parental influences that were also identified in the interviews but to a lesser extent and are not included in **Table 4.2.1** and **4.2.2** (See **Appendix H** for percent prevalence of all positive, negative and neutral parental influences).

Table 4.2.1. Positive Parental Influences Related to Child Dairy Intake

	Percent Presence (%)
Availability	
Milk	94
Dairy (group)*	87
Cheese	53
Yogurt	38
Knowledge	
Calcium and bone health	96
# of servings to meet calcium recommendations	68
Child Preference (Like)	
Dairy (group) *	65
Cheese	46
Yogurt	39
Milk	26
Health Benefit Beliefs	
Dairy (group) *	55
Milk	38
Yogurt	20
Cheese	10
Convenience	
Dairy (group) *	25
Yogurt	11
Cheese	11

* Positive and negative parental influence comments were identified about the dairy group overall, along with positive and negative comments regarding individual foods within the dairy group (milk, yogurt, cheese).

Table 4.2.2. Negative Parental Influences Related to Child Dairy Intake

	Percent Presence (%)
Lack of Parental Modeling	
Milk	67
Lack of Parental Expectation	
Milk	68
Child Preference (Dislike)	
Milk	18
Dairy (group)*	15
Yogurt	15
Lack of Availability	
Yogurt	16

* Positive and negative parental influence comments were identified about the dairy group overall, along with positive and negative comments regarding individual foods within the dairy group (milk, yogurt, cheese).

4.3 Patterns of Parental Influences (Specific Aim 2)

From the cluster analysis, it was determined that two dominant patterns of responses defined the clusters. Cluster 1 (n=128), consisted of positive parental influences for availability of dairy foods, milk, and cheese, positive health benefit beliefs for dairy, and child preference for dairy and cheese, whereas Cluster 2 (n=63), consisted of positive parental influences for only availability of dairy and milk, while the rest remained neutral (See **Table 4.3.1**). Cluster 1 was considered to represent a more positive parental pattern towards child dairy use based on its higher frequency of positive parental influences mentioned when compared to cluster 2 which was considered to represent a more neutral pattern. Out of the total sample Cluster 1 had equal representation of girls and boys and proportionately more Non-Hispanic whites (28%) and Hispanics (26%) and proportionately less Asians (14%). Cluster 2 had proportionately more girls than boys and proportionately more Asians (16%), followed by Non-Hispanic whites(11%) and a lower frequency of Hispanics (6%). Clusters did not differ by education level or school lunch participation (See **Table 4.3.2**).

Table 4.3.1. Cluster Patterns

	Cluster Membership	
	Cluster 1 (n=128)	Cluster 2 (n=63)
Availability-dairy*	1	1
Availability-milk	1	1
Availability-cheese	1	0
Health benefit beliefs-dairy*	1	0
Child preference-dairy*	1	0
Child preference-cheese	1	0

* Positive and negative parental influences were identified about the dairy as a group along with individual foods within the dairy group

Table 4.3.2. Child-Parent Sociodemographics by Cluster Pattern

	Cluster 1 Positive Parental Influences	Cluster 2 Neutral Parental Influences	χ^2 p Value
Child Gender			
Female, %	33	22	χ^2 =
Male, %	34	12	4.282
			$p < 0.05$
Total, %	67	33	100
			Total N = 191
Child Race/Ethnicity			
Asian, %	14	16	χ^2=16.33
Hispanic, %	26	6	8
Non-Hispanic white, %	28	11	$p <$
			0.001
Total, %	67	33	100
			Total N = 191
Parent Education Level			
<HS or HS graduate, %	10	8	χ^2=3.061
Some college, %	19	6	NS
College graduate, %	38	19	
Total, %	67	33	100
			Total N = 191
Free/reduced price School Lunch			
Participants	24	11	χ^2 =
Yes, %	44	22	0.062
No, %			NS
Total, %	67	33	100
			Total N = 191

4.4 Calcium Supplement and Calcium-Fortified Food Use

Child and parent calcium supplement and calcium-fortified food use is presented in **Table 4.4.1**. Approximately one-third of children (35%) and one-half (49%) of parents were regularly taking calcium supplements. Ninety percent of children supplement users were taking a multivitamin/mineral with added calcium and 10% were taking a calcium supplement while 68% of parents were taking a multivitamin/mineral with added calcium and 32% were taking a calcium supplement. Almost two-thirds of children (60%) and one-half of parents(48%) were regularly consuming calcium-fortified foods. The majority of children and parent calcium-fortified food users were regularly consuming calcium-fortified orange juice followed to a lesser extent by cold and hot cereal, bread, meal replacement drinks, cereal/granola bars, soymilk, tofu, and energy/protein bars (see **Table 4.4.2**). A significant positive association was found between child and parent supplement use ($\chi 2 = 29.573$, $p < 0.001$) and child and parent calcium-fortified food use ($\chi 2 = 97.697$, $p < 0.001$). There were no differences between child supplement users and non-users in terms of gender or race/ethnicity. Out of the total sample very few users had lower education levels (some college 7%, <HS or HS graduate 4%) compared to non-users (some college 18%, <HS or HS graduate 14%), while a higher frequency of college graduates were found in both users and non-users. There were no differences between child calcium-fortified food users and non-users in terms of school lunch participation. Out of the total sample of child calcium-fortified food users had equal representation of girls and boys, proportionately more Non-Hispanic whites (27%) and Hispanics (23%) compared to Asians (10%), and proportionately more parents

with higher education levels compared to those with <HS or HS education. There were proportionately more girls than boys who did not use calcium-fortified foods. There were also proportionately more college graduates, but proportionately fewer participants with some college compared to users (See **Table 4.4.4**).

Table 4.4.1. Child and Parent Calcium Supplement and Calcium-Fortified Food Use

	Child (n=191)	Parent (n=191)
Regular Calcium Supplement Use		
-Users, %	35	49
-Non-Users, %	65	51
Regular Calcium-Fortified Food Use		
-Users, %	60	48
-Non-Users, %	40	52

Table 4.4.2 Child and Parent Calcium-Fortified Food Type

Calcium-Fortified Food Type	Child (n=114)	Parent (n=93)
Orange juice, %	68	65
Cereal, %	16	13
Bread, %	9	10
Meal replacement drinks, %	3	4
Cereal/granola bars, %	2	1
Soymilk, %	1	4
Tofu, %	1	0
Energy/protein bars, %	0	3

Table 4.4.3. Sociodemographics of Children Who Used Supplements

	Users (n=66)	Non-Users (n=125)	$\chi^2$and p Value
Child Gender			
Female, %	17	37	$\chi^2 = 0.805$
Male, %	18	28	NS
Total	35	65	100
			Total N = 191
Child Race/Ethnicity			
Asian, %	8	21	$\chi^2 = 2.961$
Hispanic, %	10	22	NS
Non-Hispanic white, %	16	23	
Total	34	66	100
			Total N = 191
Parent Education Level			
<HS or HS graduate, %	4	14	$\chi^2 = 6.581$
Some College, %	7	18	$p < 0.05$
College Graduate, %	24	33	
Total	35	65	100
			Total N = 191
Child Free/Reduced Price			
School Lunch Participation	9	26	$\chi^2 = 3.451$
Yes, %	26	40	$p < 0.05$
No, %			
Total	35	66	100
			Total N = 191

Table 4.4.4. Sociodemographics of Children Who Used Calcium-Fortified Foods

	Users (n=114)	Non-Users (n=77)	χ^2 and p Value
Child Gender			
Female, %	29	26	χ^2=4.389
Male, %	31	14	$p < 0.05$
Total, %	60	40	100
			Total N = 191
Child Race/Ethnicity			
Asian, %	10	19	χ^2 =21.989
Hispanic, %	23	9	$p < 0.001$
Non-Hispanic white, %	27	12	
Total, %	60	40	100
			Total N = 191
Parent Education Level			
<HS or HS graduate, %	9	9	χ^2 =7.503
Some College, %	19	6	$p < 0.05$
College Graduate, %	32	25	
Total, %	60	40	100
			Total N = 191
Child Free/Reduced Price			
School Lunch Participation	19	15	χ^2 = 0.451
Yes, %	41	25	NS
No, %			
Total, %	60	40	100
			Total N = 191

4.5. Relationship between Parental Influences and Patterns of Parental Influences and Child Supplement and Calcium-Fortified Food Use (**Specific Aim3**)

No relationship was found between cluster membership and child calcium supplement use. No relationship was also found between parental modeling, parental expectation, knowledge of calcium and bone health, and knowledge of number of servings to meet calcium recommendations and calcium supplement and calcium-fortified food use. Use of calcium-fortified foods was more likely to occur in children represented in Cluster 1 ($p < 0.05$), while use was equally likely to occur in Cluster 2 (**See Figure 4.5.1**). No differences between cluster membership and calcium-fortified food use by child age, gender, and race/ethnicity. However, among those with less education and lower income, children were more likely to be non-users versus users in Cluster 2 (**See Figures 4.5.2 and 4.5.3**).

Figure 4.5.1. Relationship between Cluster Membership and Child Calcium-Fortified Food Use ($p < 0.05$)

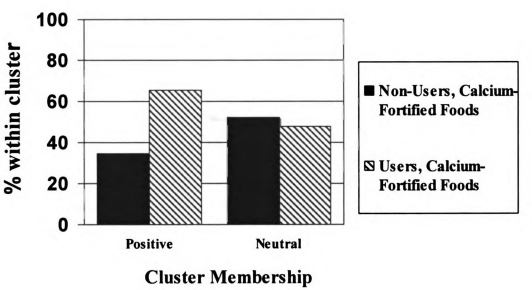


Figure 4.5.2. Relationship between Cluster Membership and Child Calcium-Fortified Food Use, among Free/Reduced Price School Lunch Program Participants ($p < 0.05$)

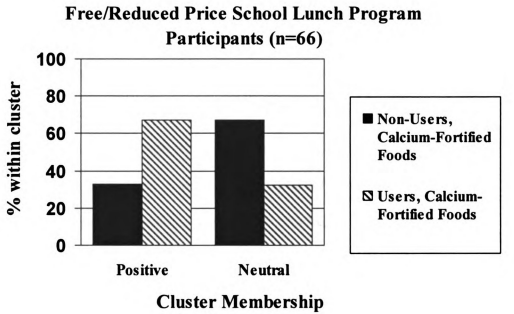
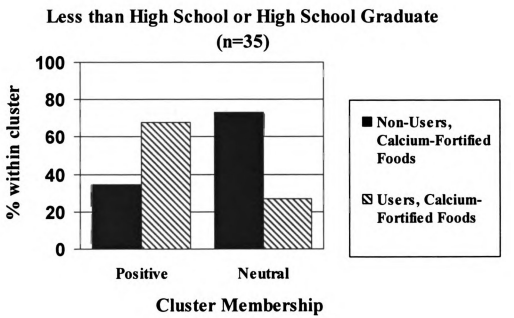


Figure 4.5.3 Relationship between Cluster Membership and Child Calcium-Fortified Food Use, Among Parents with Less Education ($p < 0.05$)



Chapter 5

DISCUSSION

A substantial body of literature indicates that parents and other caregivers can influence the food choices of children through the types of food made available at home, interactions that take place during meals and eating behaviors they model (Baranowski *et al.*, 1999; Birch, 1999; Nicklas *et al.*, 2001). Limited research, however, has been completed to understand parental influences related specifically to dairy and overall calcium intake in youth. Furthermore, little is known about child calcium supplement and calcium-fortified food use and how parental influences relate to their intake. This analysis was therefore the first to explore the relationship between parental influences related to dairy and their role in child use of supplements and calcium-fortified foods. It was completed in a group of white, Hispanic and Asian parents of preadolescents. These race/ethnicity groups have been shown to be at highest risk for developing osteoporosis later in life (Heaney, 2000a).

Parental Influences

Several parental influences were identified related to dairy foods. The most prevalent positive parental influences were availability, child preference (likes dairy), health benefit beliefs, convenience, knowledge of calcium and bone health and knowledge of the number of dairy servings needed to meet child calcium recommendations. The most prevalent negative parental influences were lack of parental modeling, lack of parental expectation for milk at meal and snack times and child preference (dislikes dairy). Other parental influences such as accessibility, cost,

and cultural values regarding food type and preparation have been identified in previous research, (Neumark-Sztainer *et al.*, 1999; Novotny R, 1999; Auld *et al.*, 2002) but were rarely mentioned by parents as reasons they did or did not provide dairy foods to their children. The prevalent parental influences that were identified are discussed in more detail in the following sections.

Availability. Parents were asked about their attitudes, beliefs, and behaviors towards dairy as a food group, as well as specific dairy foods within the dairy group. The dairy food group was mentioned as readily available by almost all parents, although milk may have been driving the high availability of dairy, which is indicated by almost all parents mentioning it as available. Other dairy foods such as cheese and yogurt were mentioned as available by many participants, but less frequently than milk. Potential reasons why these foods were mentioned less often could be because they are foods not typically part of the Asian culture (Barr, 1994) and yogurt is not typically part of the Hispanic culture (Novotny *et al.*, 2003). Also, some parents reported not purchasing specific dairy foods for health reasons (e.g. "Cheese is fattening so I don't buy it."), thereby limiting availability.

Availability has been positively associated with fruit and vegetable consumption in children and adolescents (Domel *et al.*, 1993; Krebs-Smith *et al.*, 1995; Baranowski *et al.*, 1997; Gibson *et al.*, 1998; Hearn, 1998; Weber Cullen *et al.*, 2000; Edmonds *et al.*, 2001; Cullen *et al.*, 2003). Limited research, however, has been completed with availability of dairy foods related to total calcium intake. In a recent longitudinal study evaluating calcium intake in white girls, 5 to 9 years, it was found that the mother-daughter similarity in milk intake was mediated by the extent

to which mothers made milk available to their daughters (Fisher *et al.*, 2004). Only the girls whose mothers were in the habit of frequently serving milk at meals and snacks were still drinking significant amounts of milk, and were getting enough calcium at age 9 (Fisher *et al.*, 2004). Although availability of milk was a common parental influence in the current study, due to its qualitative nature, the degree to which parents reported serving milk and other dairy foods at meal times was not assessed. This may provide a better measure of availability and will need to be considered in future research.

Adequate dairy intake in children has been inversely associated with home availability of soft drinks (Bowman, 2002; Fisher *et al.*, 2004). The degree to which soft drinks were available in the home was not addressed in the current study, although many parents reported making soda along with other beverages available at meal and snack times. Consequently, the extent to which other beverages were available may have lessened the positive impact of milk availability. Because displacement is not as likely to occur with other dairy foods such as cheese and yogurt, availability of these foods may have a positive impact on calcium intake similar to the beneficial effects seen with fruits and vegetables. Because parents are responsible for making foods available to their children, making milk and other dairy foods routinely available along with limiting consumption of other beverages at meal and snack times, may help to ensure that such foods are consumed in the amounts needed to achieve adequate calcium.

Child preference. Over half of parents (56%) reported that their child had positive food preferences towards dairy as a group, but many reported mixed

preferences for individual dairy foods (e.g. "she loves the taste of yogurt, but dislikes the taste of milk"). When asked about the dairy group during the interview, parents may have included foods like ice cream or frozen yogurt in this category, which are commonly preferred foods by children (Birch, 1999). This may have led to their overall positive food preference responses towards dairy and mixed child preferences towards milk, cheese, and yogurt.

Children's food preferences are shaped by the quantity and quality of children's experience with food and eating (Beauchamp *et al.*, 1994). As a result of many eating occasions in which foods are associated with the social contexts of eating and with the physiological consequences of indigestion, children come to accept some foods and reject others, shaping their dietary intake (Birch, 1999). Children tend to reject unfamiliar foods (neophobia), but this initial rejection can be modified through repeated exposure. A minimum of 8-10 exposures to new foods has been shown to increase preferences of these foods (Beauchamp *et al.*, 1994; Birch, 1998a; Birch, 1999). Parents are central to shaping their child's eating environment and provide early food exposure, thus play an important role in the development of children's food preferences (Baranowski *et al.*, 1999; Birch, 1999; Birch & Fisher, 2000).

Food preferences are also the primary factor influencing child and adult food choices (Barr, 1994; Neumark-Sztainer *et al.*, 1999; 2000a; Carruth *et al.*, 2000). In research with adolescents, taste enjoyment of dairy products has been shown to play an important role in the adequate intake of calcium (Barr, 1994; Neumark-Sztainer *et al.*, 1997; Smart *et al.*, 1999; Lee & Reicks, 2003; Novotny *et al.*, 2003). Taste

enjoyment of dairy foods has also been shown to be significantly lower among Asians than in Caucasians (Barr, 1994; Novotny *et al.*, 1999; Auld *et al.*, 2002). Compared to the previous findings, the current study also found that white parents reported that their children had the most positive comments relative to the taste of dairy, followed closely by Hispanics, with the least reported by Asians. Children who develop negative food preferences for dairy foods may come from cultures or individual families that do not provide repeated exposure to dairy foods during early childhood. This may have contributed to differences in child preferences that were found in this study as well as in previous findings. There is also recent research showing that children play an influential role in driving food availability within the home, often promoting less-nutrient dense foods (Roberts *et al.*, 2003; Jackson *et al.*, 2004). This may also play a role in limiting exposure to more nutrient-dense foods including dairy, possibly negatively influencing the development of food preferences.

In a USDA regional project assessing factors influencing calcium-intake in adolescents, taste enjoyment of milk was identified a key motivator if served at a certain temperature and with certain "matching" foods (accompanying food type) (Novotny *et al.*, 1999; Auld *et al.*, 2002). In the current study most parents did not report that their child only liked milk or other dairy foods if it was with an accompanying food or served at a particular temperature. This may illustrate a difference between parents perception of child preference and actual child preference for dairy foods. More research is needed to further understand how food preferences for dairy are developed, how availability and food exposure affect food preferences,

and how differing perceptions between parents and children in food preferences may influence adequate calcium intake within the family environment.

Health Benefit Beliefs. Positive health benefit beliefs were mentioned by approximately one-half of parents related to the dairy group as a whole, while milk, yogurt, and especially cheese as individual foods were mentioned much less frequently. Individual dairy foods may have been positively mentioned much less frequently based on the differing health views parents may hold for individual foods (e.g. "we buy dairy foods for the calcium, but cheese is fattening so we try to avoid it"). The most common positive health benefit belief among parents was the importance of dairy for adequate calcium for their children. Findings from studies exploring the impact of health benefit beliefs on dietary behavior in adults are not externally consistent. Some studies have found a positive effect (Jensen & Kesavan, 1993; Carslon & Gould, 1994; Variyam *et al.*, 1996), while some have found no significant effect on consumer eating decisions (Jensen *et al.*, 1992; Douthitt & Gould, 1995). Research regarding the relationship between parental health benefit beliefs and their effect on children's diet quality is limited. A recent study by Kim and Douthitt found that mothers' awareness of diet and health relationships had a significant effect on adolescents' dairy food consumption (Kim & Douthitt, 2003). In the W191 regional project with adolescents, health motivations were identified as key motivators to consuming calcium-rich foods by adolescents (Novotny *et al.*, 1999; Auld *et al.*, 2002). Parental positive health benefit beliefs, if encouraged to children, may help to promote child calcium intake, although more research is needed.

Convenience. Convenience has been mentioned as a barrier to dairy foods by children and adolescents in previous research (Neumark-Sztainer *et al.*, 1999; Novotny *et al.*, 1999; Auld *et al.*, 2002). In the current study, although mentioned much less frequently than the other factors, it was mostly mentioned as a positive versus a negative influence by parents. Parents may not perceive dairy foods as inconvenient as children because within the household and work environment, there is usually adequate refrigeration for storing dairy foods, whereas, children do not have the same accessibility to refrigeration when they are outside the home. Promotion of convenient calcium-rich foods (e.g. string cheese, cereal bars) may help to increase calcium intake in children and adolescents.

Knowledge. Similar to earlier findings (Neumark-Sztainer *et al.*, 1997; Novotny *et al.*, 1999; Auld *et al.*, 2002; Accessed 2004), almost all parents were knowledgeable of the relationship between calcium and bone health. Previous research has illustrated lack of knowledge in translating dietary recommendations into the adequate number of food group servings (Harel *et al.*, 1998; Harel Z, 1998; Neumark-Sztainer *et al.*, 1999; Wardle *et al.*, 2000). Within this sample, the majority were knowledgeable of the number of dairy servings needed. Although not quantified, most parents were not knowledgeable of the number of servings needed from other calcium-rich foods (e.g. leafy green vegetables, tofu, and fish with bones) to meet calcium recommendations. This suggests more education may be needed to translate calcium recommendations into number of food group servings outside of dairy.

Parental Expectation and Modeling for Milk. A consistent finding across race/ethnicity groups was the limited parental expectation and modeling of milk, which is comparable with earlier findings (Novotny *et al.*, 1999; Novotny R, 1999; Auld *et al.*, 2002; Lee & Reicks, 2003; Hanson *et al.*, 2005). Although few parents model dairy food intake, modeling of milk by parents, particularly mothers, has been shown to be positively associated with calcium intake in children in and adolescents, (Fisher et al., 2004; Hanson et al., 2005). Social Cognitive Theory notes the importance of the environment, including having approximate role models and norms (expectations), in shaping behaviors (Anderson *et al.*, 2000; Bandura, 2001). The apparent lack of these parental modeling and expectation influences relative to milk drinking may undermine efforts encouraging children and adolescents to drink more milk. These are two very important areas that if improved may improve overall calcium intake in children.

Patterns of Parental Influences

Parents fell into two main groupings, those indicating more positive parental influences (positive cluster) and those indicating fewer parental influences (neutral cluster) related to dairy foods. The positive grouping consisted of parents making dairy foods available, indicating the importance of dairy to health, citing the importance of adequate calcium, and having children with positive food preferences towards dairy. They mentioned these positive influences for dairy as a group and also for the specific dairy foods of milk and cheese. The neutral grouping, with the exception of making dairy available, did not mention positive comments towards the dairy group or specific dairy foods for their children.

There were more white and Hispanic parents in the positive grouping and more Asians in the neutral grouping. This may help to partially explain the two groupings that were identified. Cheese is a commonly consumed food in the Hispanic culture, and dairy foods are a commonly consumed food group among whites, but much less prevalent in consumption among Asians. There were also more girls than boys in the neutral grouping, suggesting that parents may have not promoted dairy for girls as much as for boys. The idea that parents as well as children think that boys need more calcium than girls has been reported in previous literature (Barr, 1994; Neumark-Sztainer *et al.*, 1997; Novotny *et al.*, 1999; Auld *et al.*, 2002) and may help to explain the gender differences reported in the current study. There were no differences between the groupings by income or education level. This is somewhat surprising due to other work showing a positive relationship between higher income and education levels and parental influences (e.g. availability, accessibility, family meal patterns) (Baranowski *et al.*, 1999; Cullen *et al.*, 2001; Fisher *et al.*, 2002; Boutelle *et al.*, 2003; Neumark-Sztainer *et al.*, 2003). This study, however, had a disproportionate number of participants of higher income and education levels, which may help to explain why no differences were found between groupings. The other parental influences, knowledge, parental expectation, and parental modeling for milk were initially included in the grouping analysis but did not contribute to distinguishing different patterns among participants so were removed from the groupings.

This is the first study to identify groupings of parental influences related to dairy. Many studies have investigated individual parental influences (e.g.

availability, health benefit beliefs, food preferences), but not in combination. This research provides new evidence that patterns of parental influences may exist and should be considered in further research and nutrition education directed towards families.

Supplement and Calcium-Fortified Food Use

The proportion of reported regular supplement users were 35% in preadolescents, similar to NHANES III estimates of 34-35% among 6-11 year olds and 24-28% among 12-19 year olds (Ervin *et al.*, 1999a). The proportion of parent users was 49%, similar to NHANES 1999-2000 estimates of 43% among 20-39 year olds and 56% among 40-59 year olds (Radimer et al., 2004). Only 10% of the preadolescents taking any supplement were taking a calcium supplement, which is similar to previous findings of preadolescent and adolescent calcium supplement use. The rest were taking a multivitamin/multimineral containing calcium (Barr, 1995; Dwyer *et al.*, 2001; Lee *et al.*, 2002; Millen *et al.*, 2004; Radimer *et al.*, 2004). 32% of parent supplement users, which were primarily mothers, reported taking a calcium supplement, similar to NHANES 1999-2000 estimates of 30% of adult women taking calcium supplements (Radimer et al., 2004). Consistent with previous findings, preadolescent supplement users were more likely to be from families with higher income and education levels, and had parents who were supplement users (Subar & Block, 1990; Slesinski *et al.*, 1996; Zive *et al.*, 1996).

Almost two-thirds of preadolescents and one-half of parents reported use of calcium-fortified foods, with the majority of both parents and preadolescents reporting use of calcium-fortified orange juice. Preadolescent users differed from

non-users by gender. Users had equal representation of males and females while non-users had proportionately more females. There may have been more females non-users based on research mentioned earlier which suggests that many adolescents and parents have the perception that boys need more calcium than girls, thus calcium-fortified foods may be promoted more with boys compared to girls. Additionally, research has suggested that boys consume more calcium because of their higher average energy intake compared with girls, so girls lower energy intake may also help to explain why there were more female non-users. Users also differed from non-users by race/ethnic group. Whites and Hispanics were more likely to users, and Asians were more likely to be non-users. Cultural differences in the purchasing of calcium-fortified foods may have impacted use in that calcium-fortified foods are not typical foods of the Asian culture. This is the first study to report calcium-fortified food use and their associated sociodemographic characteristics in preadolescents. There are no current analyses of characteristics of fortified-food users on a large cross-section of the U.S. population and no analyses specifically on calcium-fortified food users, thus more research is needed in this area.

Parental Influences and Calcium-Fortified Food and Supplement Use

The findings of this research provide new evidence that those with more positive parental influences related to dairy (positive cluster) were associated with more calcium-fortified food use in preadolescents. Fewer parental influences (neutral cluster) had no effect on use except with families with less education and lower income, where it was associated with less use of calcium-fortified foods. Fewer parental influences (neutral cluster) may be mediated by other factors we did not

measure in families with more education and income, such that fewer influences was not associated with less use in their children.

No relationship was found between parental influences related to dairy and preadolescent supplement use. Parents from the positive grouping, (e.g. that make dairy foods available, provide dairy for calcium, and have children that are receptive to dairy), may be more likely to purchase calcium-fortified foods because they are widely available foods, contain high amounts of calcium, and are commonly consumed foods by children (e.g. orange juice, cereal, granola bars). Supplements, are generally less available, more expensive, inconvenient, and children have been shown to have poor compliance and adherence with a supplement-dosing regimen (Block *et al.*, 1988; Andon *et al.*, 1994; Dwyer *et al.*, 2001; Greger, 2001). Additionally, most supplement users in the current study were taking a multivitamin/multimineral, not a calcium supplement. Therefore, the parental intent for supplement users may have not been to increase intakes of calcium specifically, but rather to rectify a poor diet or add insurance to their child's diet quality. Also, because of the small sample size of calcium supplement users, there was probably not enough information to find any relationships. Therefore, the similarities between dairy and calcium-fortified foods and their differences from supplements may help to partially explain the relationships that were found.

Parental influences related specifically to supplements was not the focus of this study, however, a positive relationship between child and parent use was found, suggesting that parents do play an important role in influencing use, likely by making available and possibly by modeling. Children from families of higher income and

education levels have been shown to be more likely to be supplement users (Subar & Bowering, 1988; Slesinski *et al.*, 1996; Yu *et al.*, 1997; Radimer *et al.*, 2004), as was found in the current study, suggesting that sociodemographic characteristics may also play an important role in influencing preadolescent supplement use. This also suggests that supplement use may not be as effective as calcium-fortified foods can be for reaching those in lower income and lower education families who are most in need.

Inadequate calcium intake is a prominent health concern in preadolescents. In addition to increasing risk for developing osteoporosis later in life, inadequate intake has been associated with the dramatic increase in incidence of fractures during childhood (Miller *et al.*, 2001; Goulding *et al.*, 2004). There are many factors which negatively impact adequate calcium intake in this age group, such as increases in food eaten away from home, displacement of milk for other beverages, lactose intolerance, peer and school influences and psychosocial developmental changes. With all these negative factors, encouraging a family environment that promotes other calcium-rich sources, such as calcium-fortified foods, in addition to dairy, may be more effective in bridging the gap between actual intake and the higher calcium recommendations during this time period. Parental influences may be particularly effective for those with less education and income, who may be most at risk of inadequate intake. Thus, educational strategies involving parents, particularly of lower socioeconomic status, will need to be considered in developing effective interventions towards increasing calcium in youth.

Strengths and Limitations

A strength of this research is that it is a secondary data analysis on a relatively large convenenience sample of qualitative data from three different race/ethnic groups at risk for osteoporosis. It is also the first to explore the relationship between parental influences as they relate to dairy foods and supplement and calcium-fortified food use in an understudied population (preadolescents). This data has not been reported before due to little research on parental influences related to dairy foods and preadolescent supplement use, and no research on preadolescent calcium-fortified food use. Information resulting from this study will aid in the development of intervention strategies and educational resources by focusing on strategies to improve intake in preadolescents who may not consume enough calcium from naturally occurring sources.

Some limitations of this study should be acknowledged. Due to the non-random sampling, cross-sectional design, and disproportionate number of subjects of higher socioeconomic status, the findings from this research are preliminary and need validation with further research. An assessment of acculturation may have added more precision to the analyses but was not utilized. Furthermore, the regional nature of the study prevents concluding that the same influences would be found in ethnic groups from different parts of the country. Thus the findings differences are strongly suggestive, but warrant caution in generalizing the results. The accuracy in the level of assessment may have been lessened by utilizing a secondary data set which provided limited involvement with the data collection process. The interviews took place at multiple locations with different interviewers for different states that were

involved. The interviewers were given the same outline to follow, however, inconsistencies arose with the ways the interview were conducted, such as differences in how the questions were asked, with some questions added or omitted by the interviewer, and differences in probing accountability. Subsequently, possible measurement error may have occurred during assessment. Additionally, a level of bias may have been introduced by the way the data was collected in that surrogate information for the preadolescent was obtained indirectly through the parent without further validation. This may have also may impinged on the accuracy of the data set. Direct interviews with the child would have reflected a more accurate assessment of actual intake of calcium-fortified foods and supplements. Furthermore, the calcium-fortified food questionnaire measured intentional use or purchase by the parent. Unintentional use was not noted because a complete dietary assessment was not completed (e.g. FFQ, 24-hour recall) so an exact depiction of total use could not be evaluated.

Chapter 6

CONCLUSIONS AND IMPLICATIONS

These findings suggest that a major component of parental influences related to dairy are due to cultural differences. Educational strategies related to calcium-rich foods should address different ways to incorporate culturally appropriate messages. Within some families and/or cultures, where dairy is not likely to be consumed, educational strategies are needed for parents that discuss other ways of obtaining sufficient calcium for children through foods that would be more culturally appropriate for their families.

In families that are receptive to consuming dairy, educational strategies that target parents in promoting dairy foods, may also promote use of calcium-fortified foods. Educational strategies that help to promote dairy foods through parental influence, may also promote use of calcium-fortified foods. This may be particularly effective in those most at risk for inadequate intake, those with less education and lower income, thereby possibly helping to improve overall calcium intake.

Parental influences play an important role in establishing food preferences in childhood (Birch & Davison, 2001), thus promoting positive parental influences may be particularly important during childhood and preadolescence to help offset the additional negative influences arising during adolescence (e.g. peer influences, psychosocial developmental changes, eating away from home, displacement of milk with other beverages). Research with young adults , suggests that eating habits are

established during childhood (Birch, 1998a), further supporting the need to establish early, healthy eating habits.

Because children have more non-milk options when eating away from home, there needs to be a place where calcium-rich foods and beverages are available and emphasized, including newer calcium-rich options such as calcium-fortified foods. A family environment that encourages dairy along with other calcium-fortified foods may help to achieve adequate calcium intake in this vulnerable population.

Little research on parental influences related to calcium-rich foods and no prior research relating parental influences to calcium supplement and calcium fortified food use is available. Thus these findings need to be confirmed in larger, more socioeconomically diverse studies. Also, quantitative assessment tools are needed to assess the salient parental influences that have been identified. Further research is also needed to more thoroughly explore the factors that affect the establishment of calcium eating patterns in preadolescent families to ensure that the family interventions address relevant concerns and needs. Furthermore, research is needed directly examine calcium-fortified food use in children and adults, evaluating their prevalence, contribution to total calcium intake, and influences affecting use. Research with calcium-fortified foods is also needed to see if characteristics of users differ by calcium-fortified food type. Improved understanding of parental influences on calcium intake in children along with a greater understanding of how calcium-fortified foods may help to improve strategies aimed at improving calcium intake in preadolescents, a vulnerable population.

APPENDICES

APPENDIX A

UCIHRS Informed Consent

RESEARCH PARTICIPANT CONSENT FORM

Parent and Household Influences on Calcium Intake among Preadolescents

Beth H. Olson, Ph.D.
Michigan State University
Department of Food Science and Human Nutrition

Purpose of Research

We are asking you to help in a study that is looking at the factors (knowledge, attitude, behavior, and environment) associated with food intake of adolescent children (ages 11-12 years).

Specific Procedures to be Used

Your participation in the study will include completing an individual interview that will ask about information on parental knowledge, attitudes, and behaviors, and environmental factors affecting food intake. The interview will have two parts: part 1 will gather sociodemographic information, and part 2 will collect information on your food intake and food choices. Then, you will complete a questionnaire given by the interviewer asking about the use of dietary supplements and fortified foods by you and your child. The entire process will last about an hour. You have the right to decline any questions or stop the interview at any time. The interview will take place in a neutral location that is convenient for you. We will audiotape the interview, but your name will not be attached to your tape. We will not share your tape with anyone except for the project investigators. Tapes will be transcribed into a written format. This will allow all (anonymous) comments to be summarized and then analyzed by a computer program for common answers.

Duration of Participation

The interview will last about one hour.

Benefits to the Individual

The information you provide will help us develop new messages for improving dietary intakes of adolescents. You will receive compensation for participation.

Risks to the Individual

There are no known risks associated with completing the individual interview.

Compensation

You will be paid $25 when you complete the interview.

Confidentiality

Any information about you that is recorded on the tape or any information that is written down by us for this study will always be locked up. We have created a secret code system to keep your information private. Once the code numbers have been checked, any lists with names and codes will be destroyed. Upon the completion of the study, audio tapes will be destroyed. Your name will not be seen next to any information or in any written reports. Your privacy will be protected to the maximum extent allowable by law.

Voluntary Nature of Participation

You do not have to participate in this research project. If you agree to participate you can withdraw your participation at any time without penalty.

Human Subject Statement:

If you have any questions about this research project, you may contact the principal investigator, Dr. Beth H. Olson at (517)355-8474, x113. If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact – anonymously, if you wish – Ashir Kumar, M.D., Chair of the University Committee on Research

Involving Human Subjects (UCRIHS) by phone: (517) 355-2180, fax: (517) 432-4503, e-mail: ucrihs@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

I voluntarily agree to participate in this study.

Participant's Signature	Date
Participant's Name	
Researcher's Signature	Date

APPENDIX B

W1003 Qualitative Interview Guide

Questions for Qualitative Interview with Parents about Calcium Intake and calcium rich foods in Parents and Children

Intro: Thank you for taking the time to talk with me today. As part of a research study being done in 12 states, we are interviewing parents of children 10-13 years old to find out ways to make nutrition information more useful for families like yours. I want to stress that there are no right or wrong answers in this interview. We are interested in your thoughts and opinions on factors that influence you and your child's eating habits.

We would like to tape this interview so we are sure we capture your thoughts in your own words. But your name will not be linked to the tapes. This interview will include mostly talking but also some hands on activities. It will take about one hour.

Do you have any questions before we get started?

I. Calcium-rich foods:

1. I'm going to show you some pictures of foods or groups of similar foods and ask you a few questions about each one.
   [*Show picture(s):*] How often do you eat _____ (state name of food or food grouping)?
   a. *If they eat this food:* Tell me some reasons you choose this food. (Probe about - cost, cultural/family influences, availability, taste, convenience, accessibility)
      1. Where do you typically eat this (these) food(s)? (i.e. do they eat it at home and/or when out)
2. *If they do not eat the food:* Tell me some reasons you don't eat this (these) food(s). (Probe about – cost, cultural/family influences, availability, taste, convenience, accessibility)
   a. Would you like to include this food in your diet?
   b. *If yes*: What are the main reasons you don't include this in your diet?

3. Does _____ (name 11 or 12 year old child) eat this (these) food(s)?
   a. *If yes*: What are the reasons your child eats this food?
   b. *If no*: What are the reasons your child does not eat this food?

Repeat Questions 1-3 for each food picture. [Dairy; Foods made with Dairy; Hispanic/Mexican; Asian (including tofu & Hmong foods); Pastas; Greens; Fish; Beverages (inc. soda, juice, coffee drinks)]

II. General family meal patterns
(transition) Now we'd like to talk a little about your family meal patterns.

4. Let's walk through the day and have you describe **your family's eating and drinking patterns** starting from when you first get up. We are primarily interested in your eating habits and the eating habits of _____ (name 11-12 yo child), but we also want to talk about the whole family.
Let them go through day with minimal probing, asking questions as needed to get information about each of the following:
   a. Where each meal usually eaten
   b. What time each meal usually eaten
   c. Who prepares each meal
   d. Whether this meal usually eaten together with children or separately
   e. Usual foods eaten at meals (for self and for 11-12 yo child)
   f. Usual drinks/beverages served at meals (for self and for 11-12 yo child)

5. **Child's meal pattern:**
How is _____ (name of 11-12 yo child) dietary/meal pattern similar or different from yours?
*Go back through and ask more detail **about child's eating pattern**. If information (relating to questions a-f above) has already been given for the child, there is not need to repeat all of these questions. Only ask questions about aspects of child's eating patterns that were not included in the previous discussion about family eating patterns. In talking about the child's eating patterns, include additional questions to find out about child's snacking, and include question b below specifically about child's snacks & activities after school.*
   a. Tell me about the snacks your child eats.
      i. What time snack usually eaten
      ii. Where snack usually eaten
      iii. Usual foods eaten as snacks
      iv. Usual drinks taken with snacks
   b. What happens once school gets out?
      i. Where do your children go after school? What do they usually do after school?
      ii. What do you have around the house for your child to eat after school? What do you have available for your child to drink after school?
      iii. Do you give your kids money to buy foods away from home?
      iv. Do they eat at a friend's house?

6. **Parental expectations:**
Now I'd like to ask you a bit more about your meals together as a family.
   a. Do you expect your child to eat certain foods before leaving the table?
   b. What happens if your child doesn't like what you are serving for a meal?

i. Do you offer choices to your children or family members at meals? Can you provide an example?

c. What do you expect your kids to drink with meals?
   i. Do you offer different beverages to your children at meals? What beverage choices? What about milk?

d. What do you expect your kids to drink with snacks?

7. **Eating out:**
How often do you eat out? Or order a meal in?
   a. What are some of the reasons you might decide to eat out or order a meal in?
   b. When you go, where do you usually eat out?
   c. What do you typically eat when you go out? What do you usually drink?
   d. What would your child typically order when you go out? What would your child typically drink when you eat out?

8. How do **extra-curricular activities** affect your family's meal patterns? For example, your child's participation in sports, school activities, etc. Or your participation in sports, volunteer work, etc.
This question may be addressed somewhere in the discussion about family meals, depending on the flow of the conversation. If the question is not addressed during the flow of conversation in Questions 1-5, ask it as a separate question before moving onto the next section of the interview.

III. Influencing children's eating

(transition) Now we would like to talk with you a little more about food and health.

9. What kind of conversations do you have about foods with your kids? Do you talk about food and health with your kids? What kinds of things do you say?

10. Tell me about a food you think is healthy for your child. How do you get your child to eat it?
   a. Do you eat this food? How does this influence your child?
   b. Do you reward your children for eating certain foods?
   c. Do you make healthy foods available in your home?

IV. Knowledge of calcium and health

11. *[Show the respondent a lifespan picture (without DRI numbers):]* Here's a picture of people at different ages. At what age do you think calcium requirements are highest? Any reasons for that choice(s)?

12. What can you tell me about calcium and health?
   a. *If they do NOT mention bone health (and most will probably mention this), ask*: What about calcium and bones?

13. What are the benefits of getting enough calcium *for you*? How does eating enough calcium benefit *you*?
    a. What would happen if *you* didn't get enough calcium?

14. What are the benefits of *your child* getting enough calcium?
    a. What would happen if *your child* _____ (name 11-12 yo child) didn't get enough calcium?

15. Do you have a history of osteoporosis or bone fracture in your family?
    a. *If yes:* Tell me about it.

16. How **concerned** are you that _____ (name 11-12 yo child) gets enough calcium every day?
    a. What are the reasons you are concerned (or not) about your child's intake of calcium?

17. *[Show lifespan picture with DRI answers:]* This picture shows the requirements for calcium at various ages in the lifespan. You can see that calcium requirements for children ages 9-18 are as high as anytime during the lifespan. This is to support bone growth and development during adolescence and to strengthen adult bones?
    a. What are your thoughts on this information?

18. We talked about your concerns about whether _____ (name 11-12 yo child) gets enough calcium everyday. Does this information change your thoughts on this?

V. Knowledge of calcium requirements and content in foods

(transition) Let's talk about calcium in foods a little more.

19. How **confident** are you that your child gets enough calcium in their diet each day?

20. [*Show poster with pictures of various foods with blank lines for estimating servings:*] I have a poster with pictures of different foods. Now I'd like you to estimate how many servings of each of these foods your child would need to eat to get 1300 mg of calcium. In other words, if each of these foods were the only source of calcium in your child's diet, how many servings would they need to get the recommended amount? *(Allow respondent to guess the number of servings on the poster)*

21. [*Show poster with number of servings required to provide DRI for 10-13 year olds:*] This is the actual number of servings your child would need of each food to get the recommended 1300 mg of calcium. You can see that dairy foods are good sources of calcium. You only need a few servings of these foods to meet calcium needs. Other foods are not as rich in calcium.

a. Does any of this information surprise you? Tell me what surprised you.
b. How much calcium would you guess 10-13 year old children typically eat on average?
c. How much calcium would you guess adults eat on average?

22. [*Show poster with number of servings plus average calcium intake of pre-adolescents and adults:*] The goal is for 10-13 year olds to eat 1300 mg calcium per day. Here's the calcium an average teenager eats. Here's the calcium an average adult eats.
    a. The average American pre-adolescent gets about 70% of the calcium she/he needs. Girls (ages 9-13 years) typically eat about 900 mg calcium per day. Boys (ages 9-13) usually eat a bit more, about 1,000 mg calcium each day. The average adult only gets about 80% as much calcium as she/he needs.
    b. What's your reaction to this information? Does this change your perspective on whether you/child gets enough calcium?

23. What type of information would help you to encourage your child to eat more calcium rich foods?

Thank you very much for your time and thoughts. They will be very helpful in developing education strategies and materials.

APPENDIX C

W1003 Supplement and Calcium-Fortified Food Questionnaire Interview Guide and Questionnaire

DIETARY SUPPLEMENTS AND CALCIUM-FORTIFIED FOODS QUESTIONNAIRE

Purpose

1. This questionnaire is focused on the consumption of dietary supplements and calcium-fortified foods over the past month.
2. Using this questionnaire, we are trying to determine:
    1) Consumption of calcium supplements and calcium-fortified foods, such as frequency and amount, in 11-12 year-old adolescents through the knowledge of parents.
    2) Frequency and amount of parents' intake of calcium supplements and calcium-fortified foods.
    3) Whether people unintentionally consume calcium-fortified foods.
3. This questionnaire will ultimately help us modify the present food frequency questionnaire to better capture the consumption of calcium supplements and calcium-fortified foods.

Materials Needed

1. Interview Guide
2. Dietary Supplement Table
3. Dietary Supplement Pictures
4. Block Food Frequency Questionnaire Pictures (Block FFQ Pictures)
5. Household glasses of sizes 6 oz, 8 oz, and 10 oz.
6. Response Sheet for each respondent

How to Use Materials

1. The interview guide works well in a 3-ring binder. Keep a post-it handy to mark your place should you have to flip through the pages during the interview. Although it looks like a lot, if you practice before your first interview, you'll discover it flows nicely.
2. The dietary supplement table works well if put aside within easy reach of the interviewer. If the supplement has a Mona Lisa label – there is a picture of that supplement.
3. The dietary supplement pictures work well in the same 3-ring binder as the interview guide. Use a divider to mark the pictures. Flipping back

and forth between the interview guide and pictures works easily especially if you mark your place with a post-it or your finger.

4. The Block FFQ Picture works well on its own positioned that the respondent can easily view it at all times during the food part of the questionnaire.
5. The household glasses can also be on view at all times.
6. The response sheet needs to be copied for each respondent. Mark answers clearly as you will do your own data entry.

Part I: CHILD'S SUPPLEMENT USE INTERVIEW GUIDE

To Say:	To Do:
I am now going to ask you a series of questions about child's name use of vitamin pills or supplements over the past month.	
1. *Depending upon the responses received from the parent concerning supplements, use the appropriate question below.* **a. You said child's name took vitamin pills or dietary supplements, did he/she take any supplements, this past month?** **b. Did child's name take any vitamin pills or supplements, this past month?** **c. You said that child's name does not take supplements. I just want to confirm that he/she took no supplements this past month.**	Check the appropriate response box for question 1. If yes, go to question 2; otherwise, go to question 4.
2. What were the supplements child's names took this past month?	Record each supplement under the "Name" column of question 2 as the interviewee lists them. Do not ask for any clarification at this time.
2.	If interviewee responds with complete name or names, find the product(s) in the Supplement Table and write the number of the supplement(s) under the "#" column on the response sheet.
2.	For any supplement recorded, if the interviewee is able

To Say:	To Do:
	to "remember all" of the product name that it can be easily identified in the Table, then circle 1 on the response sheet at question 2.
2. *(continued)* **What specific type of Centrum did <u>child's name</u> take over the past month?**	If the interviewee remembers the manufacturer's name but not the specific "type" (for example, if the interviewee says "Centrum"), then ask question to the left. Find the product(s) in the Supplement Table and write the number of the supplement(s) on the response sheet at question 2.
	If the interviewee progresses to the "type" question, then on the response sheet at question 2, circle 2.
2. *(continued and continuing with the Centrum example)* **Would it be A to Zinc, Kids Chewable, Kids, Performance, Silver for adults 50+, or Liquid?**	If the interviewee can not remember the type, then list the types from the Supplement Table using the "would it be" question to the left. Write the number of identified supplement(s) on the response sheet at question 2.
	If the interviewee

To Say:	To Do:
	progresses to the "would it be" question, then on the response sheet at question 2, circle 3.
2. *(continued)* **(I have some pictures of supplement packages, would viewing these pictures help you remember?**	If the interviewee draws a complete blank, then ask if seeing "pictures" would help. Show the interviewee supplement pictures if he/she agrees. Write the number of supplement(s) on the response sheet at question 2.
	If the interviewee progresses to the "pictures", then on the response sheet at question 2, circle 4.
2. *(continued)* **How about if I call you at home and ask you the type of supplement? Would you be agreeable to that? When is a good time to call?**	If all of the prompts fail, then ask the interviewee to check at home. On a separate sheet of paper, write the time and method of contact for the "phone call". Fill in the corresponding boxes when you call.
	If the interviewee progresses to the "phone call", then on the response sheet at question 2, circle 5.

To Say:	To Do:
2.	If the interviewee says a product not listed in Table 1, record the name on the response sheet at question 2. If necessary, follow the same prompts above.
I am now interested in how often <u>child's name</u> has taken these supplements this past week and how many he/she takes at one time.	*[Each supplement identified above is assigned with a letter, beginning from A.]* Ask the following questions for each supplement recorded on the response sheet at question 2.
3. **How often this past month did <u>child's name</u> take (<u>fill in name of supplement</u>)?** ***PROBE:*** *Clarify each response. For example, after a response, "every other day", ask, Would you say that is 3 or 4 times per week?*	If the interviewee can recall and state the response as a frequency, then record the response under the "how often" column in question 3. The answer could be per day, per week, or per month, but not all. Write in number of times, e.g., 2, 3.5, 5 under the correct "/day", "/week", or "/month" column.
3. **When <u>child's name</u> took this supplement how many did he/she take each time?**	Record the response under the "how many" column in question 3. Write in a number or fraction, e.g., 1, 1.5,

To Say:	To Do:
	2. If it is a liquid supplement, record how many teaspoons the child takes each time.

Part II: Adults' Supplement Use

To Say:	To Do on Response Sheet:
You may ask questions for both adults simultaneously (as shown below) or one after the other. **I am now going to ask you a series of questions about your use of vitamin pills or supplements, as well as your spouse's over the past month.**	*Also record the supplement intakes of his/her spouse on the next page if the interviewee is willing and able to respond to these questions.*
4 and/or 7. If the interviewee volunteered previously that he/she took supplements, then use the first question (a) below, otherwise use the second question (b). **a. You said you took supplements, did you take any supplements, this past month?** **b. Did your husband/wife take any vitamin pills or supplements, this past month?**	Check the appropriate response box for question 4 and/or question 7. If yes, go to question 5 and/or 8. Otherwise, go to Part III.
5 and/or 8. What were the vitamin pills or supplements you took this past month? What vitamin pills or supplements did your husband/wife take?	Record each supplement as the interviewee lists them. Do not ask for any clarification at this time.
5 and/or 8	If interviewee responds with complete name or names, find the product(s) in the Supplement Table and write the number of the supplement(s) under the "#" column on the response sheet.
5 and/or 8.	For any

To Say:	To Do on Response Sheet:
	supplement recorded, if the interviewee is able to "remember all" of the product name that it can be easily identified in the Supplement Table, then circle 1 on the response sheet at question 5 and/or 8.
5 and/or 8. *(continued)* **What specific type of Centrum did <u>you</u> take over the past month, as well as your <u>husband/wife</u>?**	If the interviewee remembers the manufacturer's name but not the specific "type" (for example, if the interviewee says "Centrum"), then ask question to the left. Find the product(s) in the Supplement Table and write the number of the supplement(s) on the response sheet at question 5 and/or 8.
	If the interviewee progresses to the "type" question, then on the response sheet at question 5 and/or 8, circle 2.
5 and/or 8. *(continued and continuing with the Centrum example)* **Would it be A to Zinc, Kids Chewable, Kids, Performance, Silver for adults 50+, or Liquid?**	If the interviewee can not remember the type, then list the types from the Supplement Table using the "would it

To Say:	To Do on Response Sheet:
	be" question to the left. Write the number of identified supplement(s) on the response sheet at question 5 and/or 8.
	If the interviewee progresses to the "would it be" question, then on the response sheet at question 5 and/or 8, circle 3.
5 and/or 8. *(continued)* **I have some pictures of supplement packages, would viewing these pictures help you remember?**	If the interviewee draws a complete blank, then ask if seeing "pictures" would help. Show the interviewee supplement pictures if he/she agrees. Write the number of supplement(s) on the response sheet at question 5 and/or 8.
	If the interviewee progresses to the "pictures", then on the response sheet at question 5 and/or 8, circle 4.
5 and/or 8. *(continued)* **How about if I call you at home and ask you the type of supplement? Would you be agreeable to that? When is a good time to call?**	If all of the prompts fail, then ask the interviewee to check at home. On a separate sheet of paper, write the time and

To Say:	To Do on Response Sheet:
	method of contact for the "phone call". Fill in the corresponding boxes when you call.
	If the interviewee progresses to the "phone call", then on the response sheet at question 5 and/or 8, circle 5.
5 and/or 8.	If the interviewee says a product not listed in Table 1, record the name on the response sheet at question 5 and/or 8. If necessary, follow the same prompts above.
I am now interested in how often these supplement shave been taken this past week and how many at one time for you and your husband/wife.	*[Every supplement identified above is assigned with a letter, beginning from A.]* Ask the following questions for each supplement recorded on the response sheet at question 5 and/or 8.
6 and/or 9. How often this past month did <u>you</u> take (<u>fill in name of supplement</u>)? ***PROBE:*** *Clarify each response. For example, after a response, "every other day", ask, Would you say that is 3 or 4 times per week?*	If the interviewee can recall and state the response as a frequency, then record the response under the "how often" column in question

To Say:	To Do on Response Sheet:
	6 and/or 9. The answer could be per day, per week, or per month, but not all. Write in number of times, e.g., 2, 3.5, 5 under the correct "/day", "/week", or "/month" column.
6 and/or 9. When <u>you</u> took this supplement how many did <u>you</u> take each time?	Record the response under the "how many" column in question 6 and/or 9. Write in a number or fraction, e.g., 1, 1.5, 2. If it is a liquid supplement, record how many teaspoons the child takes each time.
That was the last of the supplement questions. I am now going to ask you a series of questions about the use of calcium fortified foods in your family over the past month.	

Part III: CALCIUM FORTIFIED FOODS

To Say:	To do on Response Sheet:
10. When you purchase juice or juice drinks, do you purposely select the brands that are fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 11a; otherwise, go to question 12.
11. a. To the best of your knowledge, how often did child's name drink calcium-fortified juice or juice drinks this past month?	Check appropriate response on response sheet. *Allow the respondent to spontaneously state the frequency. If the frequency doesn't fit one of the standard responses, clarify with respondent.*
11 b. When he/she drank calcium-fortified juice, how much did he/she usually drink?	Check appropriate response on response sheet*. Prop=Household glasses
11 c. How often did you drink calcium-fortified juice or juice drinks this past month?	Check appropriate response on response sheet.
11 d. When you drank calcium-fortified juice, how much did you usually drink?	Check appropriate response on response sheet*. Prop=Household glasses
11 e. What are the brands of fortified juices/juice drinks that child's name drank this past month?	Check all responses that apply.
11 f. What are the brands of the fortified juices/juice drinks that you drank this past month?	Check all responses that apply. Go to question 13.
12. What brands of juice or juice drinks have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

**: Juice boxes are 4 and 6 oz which would be less than ¾ cup (6 ounces) and ¾ to 1 ¼ cups (6 to 10 ounces), respectively.*
Juice pouches are 6 and 11 oz which would be ¾ to 1 ¼ cups (6 to 10 ounces) and more than 1 ¼ cups (10 ounces), respectively.

To Say:	To do on Response Sheet:
13. When you purchase breads, do you purposely choose the brands that are fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 14a; otherwise, go to question 16.
14. a. To the best of your knowledge, how often did child's name eat calcium-fortified bread this past month?	Check appropriate response on response sheet.
14 b. When he/she ate calcium-fortified bread, how much did he/she usually eat?	Check appropriate response on response sheet. No prop.
14 c. How often did you eat calcium-fortified bread this past month?	Check appropriate response on response sheet.
14. d. When you ate calcium-fortified bread, how much did you usually eat?	Check appropriate response on response sheet. No prop.
15. Can you tell me the brand name(s) of the fortified bread you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 17. *If different products are purchased for child and parent, place a C by child's products and a P by parent's products. Same with other calcium-fortified foods.*
16. What brands of bread have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
17. When you purchase bagels or English muffins, or hamburger or hot dog buns, do you purposely choose those brands that are fortified with calcium?	Mark Yes or No on response sheet. If yes, go to 18a; otherwise, go to question 20.
18. a. To the best of your knowledge, how often did child's name eat calcium-fortified bagels, English muffins or hamburger or hot dog buns this past month?	Check appropriate response on response sheet.
18 b. When he/she ate calcium-fortified bagels or English muffins, hamburger or hot dog buns, how many did he/she usually eat?	Check appropriate response on response sheet. No prop.
18 c. How often did you eat calcium-fortified bagels, English muffins or hamburger or hot dog buns this past month?	Check appropriate response on response sheet.
18 d. When you ate calcium-fortified bagels or English muffins, hamburger or hot dog buns, how many did you usually eat?	Check appropriate response on response sheet. No prop.
19. Can you tell me the brand name(s) of the fortified bagels or English muffins, hamburger or hot dog buns you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 21.
20. What brands of bagels or English muffins, hamburger or hot dog buns have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
21. When you purchase cold (ready-to-eat) cereals, do you purposely select those brands that are fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 22a, otherwise, go to question 24.
22. a. To the best of your knowledge, how often did child's name eat calcium-fortified cold cereals this past month?	Check appropriate response on response sheet.
22 b. When he/she ate calcium-fortified cold cereals, how much did he/she usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
22 c. How often did you eat calcium-fortified cold cereals this past month?	Check appropriate response on response sheet.
22 d. When you ate calcium-fortified cold cereals, how much did you usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
23. What brands of calcium-fortified cold cereals did you and your child eat over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 25.
24. What brands of cold cereals have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
25. When you purchase hot cooked cereal, such as oatmeal, do you purposely select those brands fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 26a, otherwise, go to question 28.
26. a. To the best of your knowledge, how often did child's name eat calcium-fortified hot cereals this past month?	Check appropriate response on response sheet.
26 b. When he/she ate calcium-fortified hot cereals, how much did he/she usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
26 c. How often did <u>you</u> eat calcium-fortified hot cereals this past month?	Check appropriate response on response sheet.
26 d. When <u>you</u> ate calcium-fortified hot cereals, how much did <u>you</u> usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
27. Can you tell me the brand names of the calcium-fortified hot cereals you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 29.
28. What brands of hot cereals have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
29. When you purchase granola bars or cereal bars, do you purposely select those brands fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 30a, otherwise, go to question 32. *The next question refers to meal replacement bars. If those are mentioned here, let the respondent know you'll ask about those next.*
30. a. To the best of your knowledge, how often did child's name eat calcium-fortified granola bars or cereal bars this past month?	Check appropriate response on response sheet.
30 b. When he/she ate calcium-fortified granola bars or cereal bars, how much did he/she usually eat?	Check appropriate response on response sheet. No prop.
30 c. How often did you eat calcium-fortified granola bars or cereal bars this past month?	Check appropriate response on response sheet.
30 d. When you ate calcium-fortified granola bars or cereal bars, how much did you usually eat?	Check appropriate response on response sheet. No prop.
31. Can you tell me the brand names of the calcium-fortified granola bars or cereal bars you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 33a.
32. What brands of granola bars or cereal bars have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
33 a. To the best of your knowledge, how often did child's name eat meal replacement, energy, or high-protein bars?	*Note the format of this question differs from the previous ones.* Check appropriate response on response sheet. If never, go to question 33d.
33 b. When he/she ate meal replacement, energy, or high-protein bars, how much did he/she usually eat?	Check appropriate response on response sheet. No prop.
33 c. Can you tell me the brand names of the meal replacements, energy, or high-protein bars he/she ate over this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 33d.
33 d. How often did <u>you</u> eat meal replacements, energy, or high-protein bars?	Check appropriate response on response sheet. If never, go to question 34a.
33 e. When <u>you</u> ate meal replacements, energy, or high-protein bars, how much did <u>you</u> usually eat?	Check appropriate response on response sheet. No prop.
33 f. What brands of meal replacements, energy, or high-protein bars did <u>you</u> eat over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 34a.

To Say:	To do on Response Sheet:
34 a. To the best of your knowledge, how often did child's name drink meal replacements, energy, or high-protein beverages such as Instant Breakfast®, Ensure®, PediaSure®, Boost®, Slimfast®?	Check appropriate response on response sheet. If never, go to question 34d.
34 b. When he/she drank meal replacements, energy, or high-protein beverages, how much did he/she usually drink?	Check appropriate response on response sheet. Prop=household glasses
34 c. Can you tell me the brand names of the meal replacements, energy, or high-protein beverages he/she drank this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 34d.
34 d. How often did <u>you</u> drink meal replacements, energy, or high-protein beverages such as Instant Breakfast®, Ensure®, Slimfast®, Boost®?	Check appropriate response on response sheet. If never, go to question 35.
34 e. When <u>you</u> drank meal replacements, energy, or high-protein beverages, how much did <u>you</u> usually drink?	Check appropriate response on response sheet. Prop=household glasses
34 f. What brands of meal replacements, energy, or high-protein beverages did <u>you</u> drink over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 35.

To Say:	To do on Response Sheet:
35. When you purchase soy milk, do you purposely select those brands fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 36a, otherwise, go to question 38.
36 a. To the best of your knowledge, how often did child's name drink calcium-fortified soy milk this past month?	Check appropriate response on response sheet.
36 b. When he/she drank calcium-fortified soy milk, how much did he/she usually eat?	Check appropriate response on response sheet. Prop=household glasses
36 c. How often did <u>you</u> drink calcium-fortified soy milk this past month?	Check appropriate response on response sheet.
36 d. When <u>you</u> drank calcium-fortified soy milk, how much did <u>you</u> usually eat?	Check appropriate response on response sheet. Prop=household glasses
37. Can you tell me the brand names of the calcium-fortified soy milk you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 39.
38. What brands of soy milk have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
39. When you purchase tofu, do you purposely select those brands fortified with calcium?	Mark Yes or No on response sheet. If yes, go to question 40a, otherwise, go to question 42.
40 a. To the best of your knowledge, how often did child's name eat calcium-fortified tofu this past month?	Check appropriate response on response sheet.
40 b. When he/she ate calcium-fortified tofu, how much did he/she usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
40 c. How often did <u>you</u> eat calcium-fortified tofu this past month?	Check appropriate response on response sheet.
40 d. When <u>you</u> ate calcium-fortified tofu, how much did <u>you</u> usually eat?	Check appropriate response on response sheet. Prop=Block FFQ Pictures
41. Can you tell me the brand names of the calcium-fortified soy milk you and your child ate this past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember. Go to question 43a.
42. What brands of tofu have you purchased over the past month?	Record the brand name(s) on the response sheet or check "don't know", if the respondent doesn't know or can't remember.

To Say:	To do on Response Sheet:
43 a. To the best of your knowledge, did child's name eat or drink any other calcium-fortified foods we have not asked about over the past month?	Mark Yes or No on the response sheet. If yes, go to question 43b, otherwise, go to question 43e.
43 b. What is this food and what is the brand name?	Record the food name and brand name on the response sheet. Check "don't know" if the respondent doesn't know or can't remember the brand name. *Record only one food each page. If more than one calcium-fortified food is consumed by the same person, record others on the next page(s).*
43 c. How often did he/she eat or drink it this past month?	Check appropriate response on response sheet.
43 d. How much did he/she usually eat or drink each time?	Record the amount on the response sheet, including serving unit: e.g. cup. Go to question 43e. Props as necessary.
43 e. Did <u>you</u> eat or drink any other calcium-fortified foods we have not asked about over the past month?	Mark Yes or No on the response sheet. If yes, go to question 43f, otherwise, you are finished with this questionnaire.
43 f. What is this food and what is the brand name?	Record the food name and brand name on the response sheet. Check "don't know" if the respondent doesn't know or can't remember the brand name. *Record only one food each page. If more than one calcium-fortified food is consumed by the same person, record others on the next page(s).*
43 g. How often did <u>you</u> eat or drink it this past month?	Check appropriate response on response sheet.
43 h. How much did <u>you</u> usually eat or drink each time?	Record the amount on the response sheet, including

	serving unit: e.g. cup, teaspoon. Props as necessary.
That was the last question about calcium-fortified foods. It was also the last question for today's talk. Thank you very much for your time and the information you shared with us.	If any information is not clear about the food(s) mentioned in Part III, ask whether you can call the interviewee at home to clarify. Write the time and method of contact on a separate sheet of paper. Complete the corresponding spaces when you call. Thank the interviewee for participating.

APPENDIX D

Codebook

Calcium Factors Codebook

Instructions

This codebook is designed to help you in the process of coding transcripts from an audio taped recording of an interview with an adult. In this codebook you will be given a set of definitions, rules, and examples of positive and negative factors that you are to identify in the transcripts. Each factor is defined based on its use in **this** study. You are to refer to these definitions and only these definitions while coding your transcripts. *You may know of other definitions for these words, but those* ***do not*** *apply to this study.* Your first step is to familiarize yourself with the positive and negative factors and their definitions, rules and examples. Do this by reading through the list a few times. **Ask questions if you do not understand the definition.** After identifying the positive and negative factors you will code them on the corresponding coding form. You are to code the transcripts based on the instructions that follow. When reading through the instructions in the codebook have the coding form out to refer to as you read along. You may have previous experience in research or coding but because each study is different you are to **code only according to these instructions.**

Basic Instructions

1. Read each transcript completely one time through without identifying any positive and/or negative factors.

2. Read each transcript a second time to identify the factors. Be careful, these factors may be found in words, phrases or even abbreviations. As you find factors mark them on the corresponding coding form.

3. On the coding form, mark a -1 if the factor is negative, 0 if the factor is not mentioned, 1 if the factor is positive, and mark a •(dot) if the factor is missing. Missing information can be defined if the interviewer in the transcript does not ask one of the following questions that would prompt a specific factor to be identified. (a. what are some reasons why you and your child do/do not consume or purchase dairy foods; b. what do you drink for meals and snacks; c. what do you expect your child to drink at meals and/or snack times; d. what does your child eat during the day and how often; e. what do you know about calcium and health, f. how many servings of milk are needed to equal 1300 mg calcium that is the recommendation for calcium intake in 9-18 year olds; g. how often does your family eat out or order a meal in; and h. how does you feel about your son or daughter taking vitamin/mineral supplements).

4. An example for coding can be described if someone in the interview mentions **COST** as a reason why they don't buy yogurt then you would mark a -1 in the yogurt column to indicate that cost is a negative factor. Conversely, if someone mentions **COST** as a reason why they do buy yogurt, then mark a 1 in the yogurt column. If

the interviewee does not mention **COST** as a reason why they do or do not buy yogurt then the column for yogurt would be marked as a 0.

5. When you have identified a specific factor in the transcript use a highlighter to highlight and also label the specific factor that you are identifying (e.g. +1 cost for milk) in the transcript as well as marking it on the coding form.

6. The factors (availability, accessibility, convenience, cost, culture, health benefit effects and child preference) will be applied only to the dairy foods that are mentioned in the transcript. For example you will be looking to see if foods in the dairy group as a whole are available, milk is available, cheese is available and yogurt is available. Even though other foods are probed for in the interview transcript like leafy green vegetables, you will not be looking to see if leafy green vegetables are available. You are only concerned about identifying these factors in relation to dairy foods specifically. The specific dairy foods that are **included** and foods that are **excluded** for analysis are specified below.

Foods to Include

- **Dairy Group**: The factors (*i.e. availability*) are referred to in discussion when looking at the dairy foods as a whole group, not just one particular dairy food. (i.e. "Yes, we buy all of these dairy foods and always have them in the house.)
- **Milk**: Any type of milk including chocolate milk, strawberry, vanilla, skim, ½%, 1%, 2% or whole milk.
- **Cheese**: All kinds of hard cheese, i.e. string, cheddar, aged cheese, mozzarella, American, etc. Cottage cheese would also be included in the cheese group.
- **Yogurt**: Regular, reduced fat, light, and fat free yogurt included with all flavors included.

Foods to Exclude

- **Asian food group**: All Asian foods, i.e. stir-fry, chow mein, chop suey, tofu
- **Beverage group**: Soda, iced tea, coffee, latte, orange juice
- **Calcium-fortified foods**: Calcium-fortified juice (i.e. orange juice, cranberry juice) calcium-fortified cereal, calcium-fortified cereal bars, calcium-fortified soy milk
- **Fish group**: Cod, halibut, regular salmon, canned salmon with bones, sardines
- **Foods made with dairy**: Pizza, pudding, cream soups, frozen yogurt, ice cream, cheese wiz, cheese sauce, cheese sticks, and/or cheese spread
- **Greens:** All vegetables, i.e. broccoli, cabbage, lettuce, spinach
- **Hispanic food group**: All Hispanic foods, i.e. enchilada, burrito, taco, tortilla
- **Milk**: Soymilk, rice milk, cultured buttermilk

- **Pasta food group**: All pasta foods, i.e. macaroni and cheese, lasagna, spaghetti

The definitions, rules, and examples for identification of **factors** 1-11 are given below:

1a. **Availability** [Positive Factor, (+)]

- **Definition:** Dairy food is present in the family home. The interviewee **does** make dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] present in their home.
- **Rule**: The interviewee must verbalize that he/she buys, gets, has, keeps, purchases, or cooks with a particular dairy food for the factor to be marked as a positive factor.
- **Example#1: Interviewer:** "*What are some reasons why you choose these foods,* dairy foods? **Interviewee:** Ok, well milk, we have that in the house every day. That's a must." **Coding Answer**: +1 Availability milk
- **Example#2: Interviewer**: "*What are some reasons why you choose these dairy foods*?" **Interviewee:** "OK, so they love yogurt so I always try to keep the yogurt around as a snack." **Coding Answer**: +1 Availability yogurt
- **Example#3: Interviewer:** *"Why does she pick these dairy foods?"* **Interviewee:** "Because I get them and give them to her." **Coding Answer**: +1 Availability dairy

1b. **Lack of Availability** [Negative Factor, (-)]

- **Definition**: Dairy food is not present in the family home. The interviewee **does not** make dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] present in their home.
- **Rule**: The interviewee must verbalize that he/she rarely buys/gets/keeps/cooks with, not often buys/gets/keeps/cooks with or does not buy/get/keep/cook with a particular dairy food in their home. If the interviewee states that she does not eat a particular dairy food or states that their child does not either eat it cannot be automatically marked as a negative availability factor. If the interviewee states that he/she sometimes buys/gets/keeps/cooks with a particular dairy food, it would be marked as neutral factor. If the interviewee does not verbalize availability as a positive or negative factor then the availability factor category will be coded as a neutral factor on the coding form.
- **Example#1**: **Interviewer**: *"What are some reasons why you don't drink milk or eat yogurt?"* **Interviewee:** "We just have juice or water. **Interviewer**: *"But basically, that is it?"* **Interviewee**: "Yeah, juice or water. We do not purchase milk because our family is all lactose intolerant. We do not purchase yogurt because it is too expensive." **Coding Answer**: -1 Availability milk, -1 Availability yogurt
- **Example #2**: **Interviewer**: *"Why does she not eat yogurt?"* **Interviewee**: "She's never been exposed to it cause I don't' get it."
  Coding Answer: -1 Availability yogurt

- **Example#3:** *"Why does she not eat yogurt?"* **Interviewee**: "Because I hate to buy something and then it just sit there and no one will eat it, so I don't buy it." **Coding Answer**: -1 Availability yogurt

2a. **Accessibility** [Positive Factor, (+)]

- **Definition**: Dairy food that is made available in a form and location that is likely to increase child consumption in the home. The interviewee **does** make dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] available in a form (e.g. cutting up cheese in slices with crackers for a snack) and/or location (e.g. bottom shelf of refrigerator) that is likely to increase their child's consumption.
- **Rule**: The interviewee must verbalize that he/she does make dairy foods and/ or beverages available in a form and/or location likely to increase their child's consumption.
- **Example#1**: **Interviewer**: *"Why does your child consume these dairy foods?"* **Interviewee**: "Well because I buy Gogurts© brand yogurt, the kind he likes, and leave them on the bottom shelf of my refrigerator so my son can always get to it." **Coding Answer**: +1 Accessibility yogurt

2b. **Lack of Accessibility** [Negative Factor, (-)]

- **Definition**: Dairy food that is not made available in a form and location that is likely to increase child consumption in the home. The interviewee **does not** make dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] available in a form and/or location that are likely to increase their child's consumption.
- **Rule**: The interviewee must verbalize that he/she does not keep dairy foods and/or beverages available in a form and/or location that is likely to increase their child's consumption. If the interviewee does not verbalize accessibility as a positive or negative factor then the accessibility factor category will be coded as a neutral factor on the coding form.
- **Example#1**: **Interviewer**: *"Why do you consume these dairy foods?"* **Interviewee**: "I purchase fat free yogurt for myself because I am on a diet, but my child cannot have it so I keep it in a place where they cannot reach it." **Coding Answer**: -1 Accessibility yogurt

3a. **Convenience** [Positive Factor, (+)]

- **Definition**: Dairy foods are **quick and easy** to use or prepare. The interviewee thinks that dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are easy to use, easy to transport, quick, convenient and/or require little preparation.
- **Rule**: The interviewee must verbalize that dairy foods are quick, convenient, easy, or require little preparation.

- **Example#1**: **Interviewer**: *"What are some reasons why you chose these foods, dairy foods?"* **Interviewee**: "Well, um yogurt, I don't know, it's just kinda quick, kinda lunch kinda thing or early in the morning quick kinda thing." **Coding Answer**: +1 Convenience yogurt
- **Example#2**: *"What are some reasons why you choose these dairy foods?"* **Interviewee**: "If there are quick snack times that is what we choose. Right now we'll grab like a slice of cheese or yogurt from the refrigerator on our way out." **Coding Answer**: +1 Convenience yogurt, +1 Convenience cheese

3b. **Lack of Convenience** [Negative Factor (-)]

- **Definition**: Dairy foods are **not quick and easy** to use or prepare. The interviewee thinks that dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are not easy to cook with, prepare, store, and/or transport.
- **Rule**: The interviewee must verbalize that dairy foods and/or beverages are not easy to cook with, prepare, store, and/or transport. If the interviewee does not verbalize convenience as a positive or negative factor then the convenience factor category will be coded as a neutral factor on the coding form.
- **Example#1**: **Interviewer**: *"What are some reasons why you do not choose these foods, dairy foods?* **Interviewee:** "Because they do not store well for the kids lunches." **Coding Answer**: -1 Convenience dairy
- **Example#2**: *"What are some reasons why you do not choose these foods, dairy foods?* **Interviewee:** Because I don't know to how to cook with them." **Coding Answer**: -1 Convenience dairy

4a. **Cost** [Positive Factor, (+)]

- **Definition**: Dairy foods are **inexpensive or not costly or cheap**. The interviewee thinks that price of dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are inexpensive or cheap.
- **Rule**: The interviewee must verbalize that dairy foods are inexpensive or cheap.
- **Example#1**: **Interviewer**: *"What are some reasons why you eat these foods?"* **Interviewee**: "They're cheap, and they taste good." **Coding Answer**: +1 Cost dairy
- **Example #2**: **Interviewer**: *"What are some reasons why you eat these foods, other than just the taste?"* **Interviewee**: "You can prepare a lot of foods with cheese and it is not expensive." **Coding Answer**: +1 Cost cheese

4b. **Cost** [Negative factor, (-)]

- **Definition**: Dairy foods are **expensive or cost a lot of money**. The interviewee thinks that price of dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are expensive or cost a lot of money.
- **Rule**: The interviewee must verbalize that dairy foods are expensive. If the interviewee does not verbalize cost as a positive or negative factor then the cost factor category will be coded as a neutral factor on the coding form.
- **Example#1**: **Interviewer**: *"What are some reasons why you do not eat these foods?"* **Interviewee**: "Yogurt, we can not afford it." **Coding Answer**: -1 Cost yogurt
- **Example#2**: **Interviewer:** *"What are some reasons why you do not eat these foods?* **Interviewee:** "I eat yogurt too but since I don't have a lot of money in a month I may only get to eat it once or twice." **Coding Answer**: -1 Cost yogurt

5a. **Culture** [Positive factor, (+)]

- **Definition:** Dairy foods are part of the **family's culture** and/or what the family grew up eating. The interviewee thinks dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are part of their culture and/or what they grew up eating.
- **Rule**: The interviewee must verbalize that dairy foods are a part of their culture and/or what they grew up eating.
- **Example#1**: **Interviewer**: *"What are some reasons you eat cheese?"* **Interviewee:** "I'm Mexican, this is part of my culture." **Coding Answer**: +1 Culture cheese

5b. **Culture** [Negative Factor, (-)]

- **Definition:** Dairy foods are not a part of the **family's culture** and/or what the family grew up eating. The interviewee does not think that dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are part of their culture and/or a type of food that they grew up eating.
- **Rule**: The interviewee must verbalize that their culture and/or the way they grew up are reasons why they or their child does not purchase or consume dairy foods. If the interviewee does not verbalize culture as a positive or negative factor then the culture factor category will be coded as a neutral factor on the coding form.
- **Example#1: Interviewer**: *"What are some reasons why you do not drink milk?"* **Interviewee** "It is not in my culture to drink milk. "It is not the way I grew up to drink and eat these types of foods." **Coding Answer**: -1 Culture milk
- **Example#2: Interviewer:** *"What are some reasons why you do not drink milk?"* **Interviewee:** "You know Asians do not drink much milk because we grew up this way." **Coding Answer**: -1 Culture milk

- **Example #3: Interviewer:** *"What are some reasons why you do not eat cheese?"* **Interviewee Response**: "My husband don't do, most Asians do not, because when we were born we don't eat it." **Coding Answer**: -1 Culture cheese

6a. **Positive Health Benefit Beliefs** [Positive Factor, (+)]

- **Definition**: Dairy foods are **good for health**. The interviewee thinks that dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are important for their own and/or their child's health.
- **Rule**: The interviewee must verbalize that dairy foods are good for health reasons. The interviewee can state any reason that relates to health (e.g. stating that it is good for them or good for their child, healthy, high in calcium, good for bones, has protein, helps to control weight, or is low in fat). If you read a transcript in which the interviewee gives a positive and a negative factor to a particular food (e. g. "yogurt is good for you but is sweet"), then the column for health benefit effects of yogurt would be given a 0.
- **Example#1: Interviewer:** *"What are some reasons that you eat these dairy foods?* **Interviewee**: "They are good for your health." **Coding Answer**: +1 Health effects dairy
- **Example#2: Interviewer:** *"What are some reasons that you drink milk?"* **Interviewee**: "Well, for the calcium and is an excellent source of protein." **Coding Answer**: +1 Health effects milk
- **Example#3: Interviewer:** *"What are some reasons that you eat these dairy foods?* **Interviewee**: "They are low in fat and calories." **Coding Answer**: +1 Health effects dairy

6b. **Negative Health Benefit Beliefs** [Negative Factor, (-)]

- **Definition**: Dairy foods are **not good for health**. The interviewee thinks that dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] are bad for their or their child's health.
- **Rule**: The interviewee must verbalize that dairy foods are bad for health in any type of way. Bad for health reason examples include it is bad for me, bad for my child, makes me sick, gives me allergies, and is fattening or high in calories. If the interviewee does not verbalize health effects as a positive or negative factor then the health effects factor category will be coded as a neutral factor on the coding form.
- **Example#1**: **Interviewer**: *"What are some reasons that you don't choose the cheese very often?* **Interviewee**: "It's fattening I think." **Coding Answer**: -1 Health effects cheese
- **Example#2**: **Interviewer**: *"What are some reasons that you don't choose yogurt?"* **Interviewee**: "It has too much sugar so I would never buy it or give it to my child." **Coding Answer**: -1 Health effects yogurt

7a. **Child Preference (Like)** [Positive factor, (+)]

- **Definition**: Child enjoys or **likes** the taste, texture or flavor of dairy foods. The interviewee's child does like the taste, texture, or flavor of dairy foods and/or beverages [a. dairy group, b. milk, c. cheese, d. yogurt] or likes them with other foods.
- **Rule**: The interviewee must verbalize that her child likes the taste, texture and or flavor of a dairy food, likes it with other foods, or is a big dairy food consumer. If the interviewee verbalizes that **we** like the particular food instead of saying that their child specifically likes the food, it would still count as a positive factor for the child. If you read a transcript in which the interviewee verbalizes that her child likes one type of dairy food (i.e. loves peach yogurt, but not any other kind of yogurt), then it would still be coded as a positive factor.
- **Example#1**: **Interviewer:** "*Why does your child eat dairy foods?*" **Interviewee:** "Because she likes the taste." **Coding Answer**: +1 Child preference dairy
- **Example #2**: **Interviewer:** *"Does she like milk much?"* **Interviewee:** **"**She likes chocolate milk and likes it with cereal**."** **Coding Answer**: +1 Child preference milk
- **Example #3: Interviewer:** *"Does she ever eat yogurt?"* **Interviewee:** "She loves yogurt for the taste. She doesn't like yogurt with fruit. There is one kind that doesn't have fruit on the bottom." **Coding Answer**: +1 Child preference yogurt

7b. **Child Preference (Dislike)** [Negative factor, (-)]

- **Definition**: Child does **not like** or enjoy the taste texture, or flavor of dairy foods or is allergic to them or has lactose intolerance. The interviewee's child does not **like** the taste, texture, or flavor of dairy foods, is allergic to them or has lactose intolerance.
- **Rule**: The interviewee must verbalize that their child does not like, is allergic to, or has lactose intolerance to dairy foods. If the interviewee mentions that the child will not consume a particular dairy food this would also be coded as a negative factor. If the interviewee does not verbalize child preference as a positive or negative factor then the child preference factor category will be coded as a neutral factor on the coding form.
- **Example #1**: **Interviewer**: '*Why does your child not drink milk?"* **Interviewee:** "She refused to drink it because she hates the taste. I have tried everything to get her to drink it, every flavor, and everything. She just will not touch it." **Coding Answer**: -1 Child preference milk
- **Example#2: Interviewer**: '*Why does your child not drink milk?"* **Interviewee:** Yes, she's a big ice cream eater but when it comes down to milk, I can't get her to drink that." **Coding Answer**: -1 Child preference milk

8a. **Knowledge of # of Milk Servings** [Positive Factor (+)]

- **Definition:** Understanding of the number of milk servings that are needed to meet dietary calcium recommendations in children. The interviewee is knowledgeable of how many servings of milk are needed to meet the calcium dietary recommendations for children between the ages of 9-18 years old.
- **Rule:** The interviewee is able identify the correct amount of servings for milk accounting for answers that are +/- 1 correct serving (**Correct Answer**: 3-5 servings). If the interviewee gives a range for the correct servings (i.e. 2-3) and one of the numbers in the range is correct then the interviewee would get a +1 correct score. The interview question that you need to look for in the interview transcript to identify this factor is, "How many servings of milk are needed to equal 1300 mg calcium that is the recommendation for calcium intake in 9-18 year olds?"
- **Example#1: Interviewer:** *"How many servings of milk equal 1300 mg of calcium?* **Interviewee:** "Oh, I am not sure; I think 4 servings of milk." **Coding Answer**: +1 Knowledge of # of milk servings

8b. **Lack of Knowledge of # of Milk Servings** [Negative Factor, (-)]

- **Definition:** No understanding of the number of milk servings that are needed to meet dietary calcium recommendations in children. The interviewee is not knowledgeable of how many servings of milk are needed to meet the calcium dietary recommendations for children between the ages of 9-18 year old.
- **Rule:** The interviewee is not able identify the correct amount of servings for milk accounting for answers that are +/- 1 correct serving (**Correct Answer**: 3-5 servings). This question will only have a positive or negative factor response. There is no neutral factor response. If the question is not asked in the interview transcript then the column will be marked as missing. The interview question that you need to look for in the interview transcript to identify this factor is, "How many servings of milk are needed to equal 1300 mg calcium that is the recommendation for calcium intake in 9-18 year olds?"
- **Example#1: Interviewer**: *"How many servings of milk equal 1300 mg of calcium*?" **Interviewee:** "Probably 8 servings." **Coding Answer**: -1 Knowledge of # of milk servings

9a. **Modeling** [Positive Factor, (+)]

- **Definition**: **Consuming milk** at meal and/or snack times. The interviewee consumes milk at meals and/or snack times.
- **Rule**: The interviewee must verbalize that he/she drinks milk at least once daily for a meal and/or snack. If the interviewee states that he/she has milk **and** another beverage at meal and/or snack time this would also be marked as a positive factor. The interview question that you need to look for in the interview transcript to identify this factor is, "What do you drink for meals and snacks?"

- **Example#1**: **Interviewer**: *"What do you usually drink with meals each day?* **Interviewee**: I drink milk with lunch and dinner daily." **Coding Answer**: +1 Modeling
- **Example#2**: **Interviewer**: *"What do you usually drink with meals?* **Interviewee**: I drink milk with breakfast everyday." **Coding Answer**: +1 Modeling

9b. **Lack of Modeling** [Negative Factor, (-)]

- **Definition**: **Not consuming milk** at meal and/or snack times. The parent does not consume milk at meal and/or snack times.
- **Rule**: If the interviewee states that he/she has milk daily in cereal or drinks it a lot, sometimes, usually, or sometimes daily it would be marked as a negative factor. Also if the interviewee verbalizes that he/she drinks milk **or** another beverage at meal and/or snack time it would also count as a negative factor. This question will only have a positive or negative factor response. There is no neutral factor response. If the question is not asked in the interview transcript then the column will be marked as missing. The interview question that you need to look for in the interview transcript to identify this factor is, "What do you drink for meals and snacks?"
- **Example #1**: **Interviewer**: *"What do you drink with meals and/or snacks?"* **Interviewee**: "Diet coke and water only." **Coding Answer**: -1 Modeling
- **Example#2: Interviewer:** *"What do you drink with meals and/or snacks?"* **Interviewee**: "Water, coffee, milk, or soda." **Coding Answer**: -1 Modeling
- **Example#3: Interviewer:** *"What do you drink with meals and/or snacks?* **Interviewee**: "My husband and I will usually drink water and tea sometimes." **Coding Answer**: -1 Modeling

10a. **Parental Expectation** [Positive Factor, (+)]

- **Definition**: Encouragement or enforcement of milk to be consumed at meal and/or snack times. The interviewee encourages and/or enforces that their child has milk with meals and/or snacks.
- **Rule**: The interviewee must verbalize that he/she encourages, enforces, expects, makes, forces or tells their child to drink milk with at least one meal or snack daily. The interviewee must verbalize milk as the only beverage that is expected. The interview question that you need to look for in the interview transcript to identify this factor is, "What do you expect you child to drink at meals or snacks?"
- **Example#1**: **Interviewer**: *"What do you expect your child to drink with meals?* **Interviewee**: "Milk." **Coding Answer**: +1 Parental expectation
- **Example#2: Interviewer**: *"What do you expect your child to drink with meals?* **Interviewee**: "Yes, I expect him to drink milk ." +1 Parental expectation
- **Example #3: Interviewer**: *"What do you expect your child to drink with meals?* **Interviewer:** *"Why does your child drink milk at meals?"*

Interviewee: "Because I tell her she has to or I make her drink it."
Coding Answer: +1 Parental expectation

10b. **Lack of Parental Expectation** [Negative factor, (-)]

- **Definition**: No encouragement or enforcement of milk to be consumed at meal and/or snack times. The interviewee does not encourage or enforce their child to have milk with meals and/or snacks.
- **Rule**: The interviewee must verbalize that he/she does not encourage, enforce, expect, make, force or tell their child to have milk with meals and/or snacks. If they mention milk **or** some other beverage is expected at meal and/or snack time then it would also count as a negative factor. This question will only have a positive or negative factor response. There is no neutral factor response. If the question is not asked in the interview transcript then the column will be marked as missing. The interview question that you need to look for in the interview transcript to identify this factor is, "What do you expect your child to drink at meal and/or snack times?"
- **Example #1**: **Interviewer**: *"What do you expect your child to drink with meals?* **Interviewee** "I don't know, whatever is in the house, usually juice or water, whatever they want." **Coding Answer**: -1 Parental expectation
- **Example#2: Interviewer:** *"What do you expect your child to drink with meals?* **Interviewee**: "Well, if they don't drink anything it is ok with me. They can drink milk, juice, water. All that is better than soda. Soda is the last choice they have. Soda is for me." **Coding Answer**: -1 Parental expectation

11a. **Knowledge of Calcium and Bone Health** [Positive Factor, (+)]

- **Definition:** The interviewee is **aware** that calcium is important to **bone health**.
- **Rule:** The interviewee must verbalize an understanding between the association of the importance of calcium to healthy bones by stating that calcium is good for bone health or by stating that calcium is needed to help prevent osteoporosis. The interview question to look for is, "What do you know about calcium and health?"
- **Example#1: Interviewer:** *"What do you know about calcium and health?* **Interviewee**: "It is important for your bones." **Coding Answer**: +1 Knowledge of calcium and bone health
- **Example#2: Interviewer:** *"What do you know about calcium and health?* **Interviewee**: "It is important to prevent osteoporosis." **Coding Answer**: +1 Knowledge of calcium and bone health

11b. **Lack of Knowledge of Calcium and Bone Health** [Negative Factor, (-)]

- **Definition:** The interviewee is **not aware** that calcium is important to **bone health**.

- **Rule:** The interviewee verbalizes no association of the importance of calcium to healthy bones. This question will only have a positive or negative factor response. There is no neutral factor response. If the question is not asked in the interview transcript then the knowledge of calcium and bone health factor category will be marked as missing. The interview question to look for in the interview transcript is, "What do you know about calcium and health."
- **Example#1: Interviewer:** *"What do you know about calcium and health?* **Interviewee**: "I don't know. Not very much." **Coding Answer**: -1 Knowledge of calcium and bone health

APPENDIX E

Coding Form

Calcium Factors Coding Form

Date: _____ **Subject ID**: _____ **Scoring Duration Time (minutes)**: _____

Coding Sheet Instructions

Use thee accompanying codebook for detailed instructions. Mark a +1 for a positive factor, -1 for a positive factor, 0 for a neutral factor, • for a missing factor. Make any comments next to factors that you are unclear about, have questions, etc. Some items have been blacked out on the coding sheet to indicate that a response is not needed.

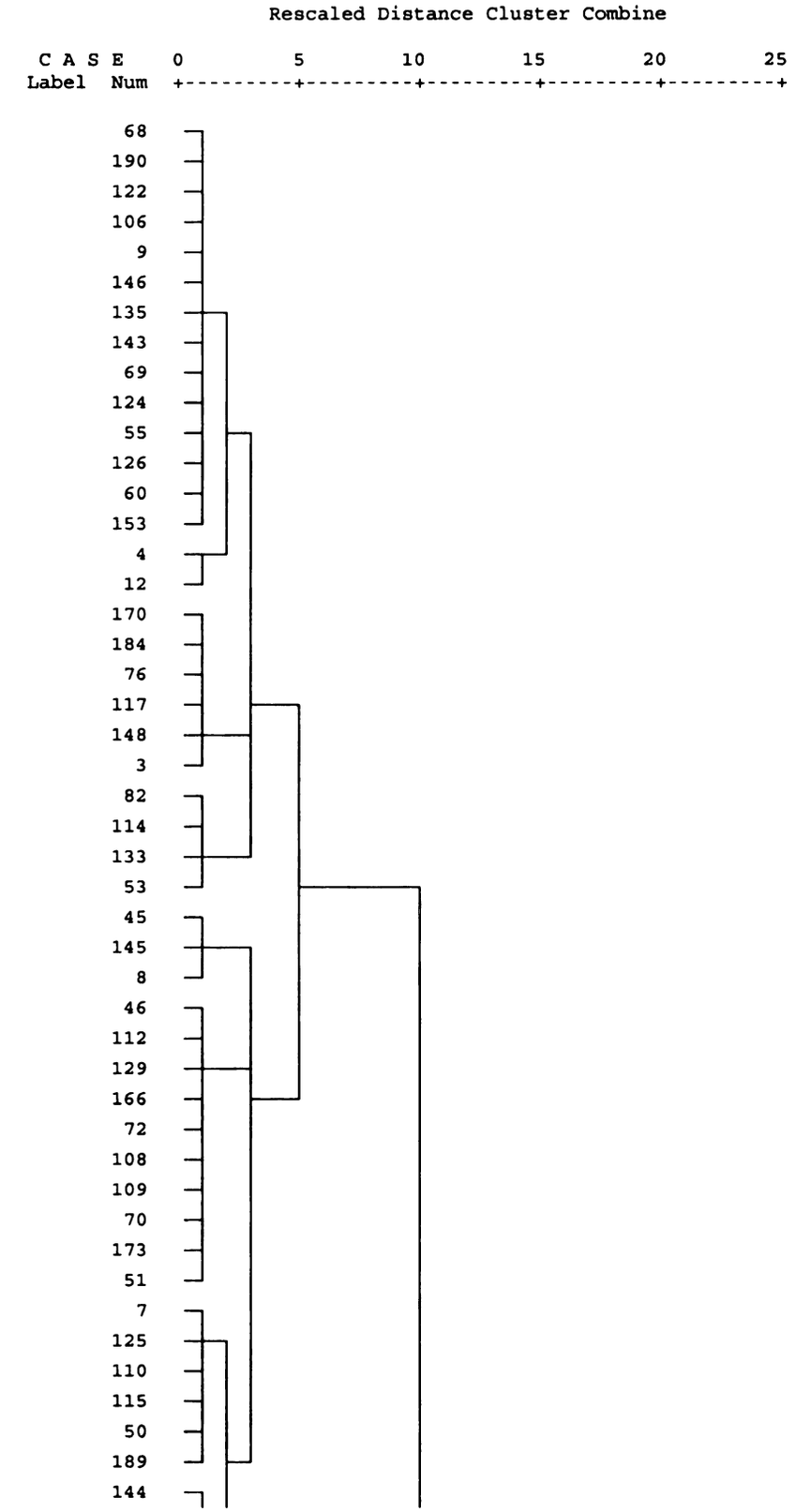
Factor	Dairy Group	Comments	Milk	Comments	Yogurt	Comments	Cheese	Comments
1. Availability								
2. Accessibility								
3. Convenience								
4. Cost								
5. Culture								
6. Health Effects								
7. Child Preference								
8. Knowledge of # of Milk Svgs								
9. Parental Modeling								
10. Parental Expectation								
	+/- Factor	Comments						
11. Knowledge of Calcium and Bone Health								

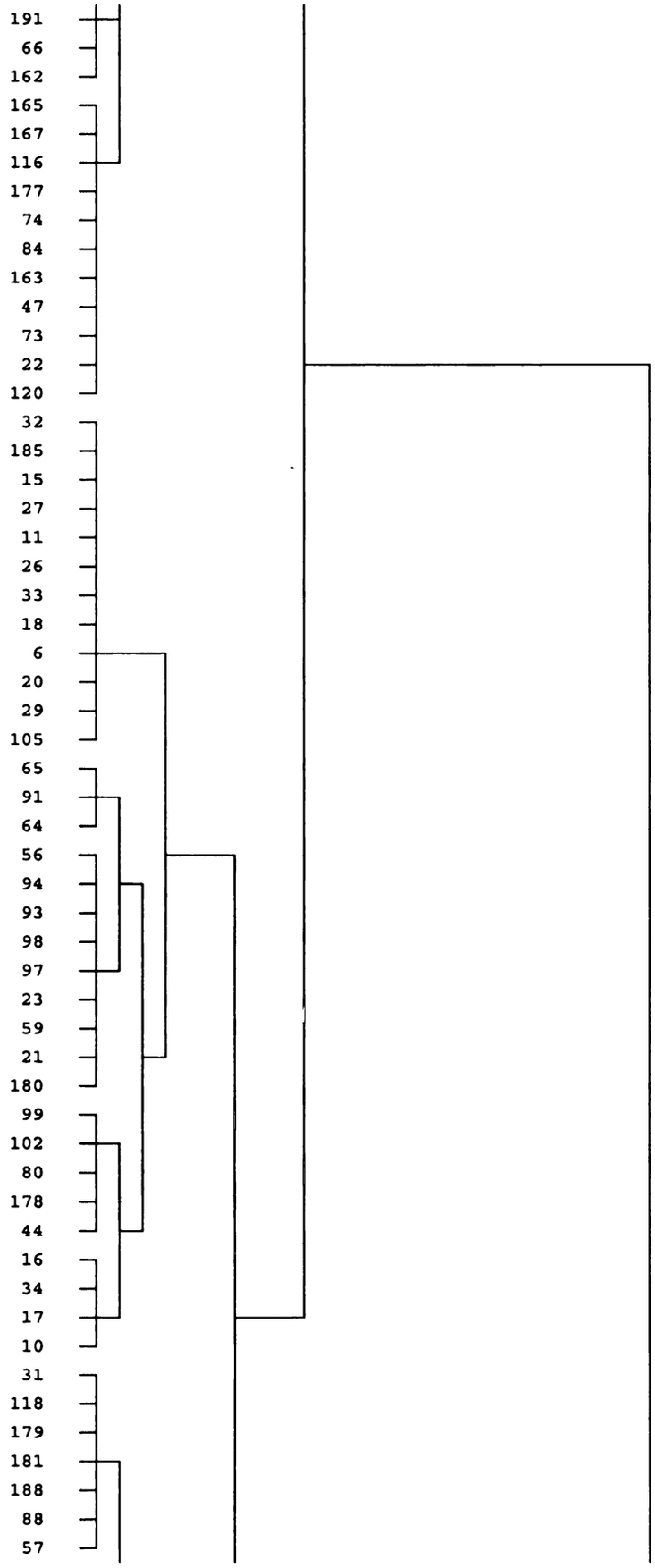
APPENDIX F

Hierarchical Cluster Dendogram

* * * * * * H I E R A R C H I C A L C L U S T E R A N A L Y S I S * Dendrogram

using Ward Method

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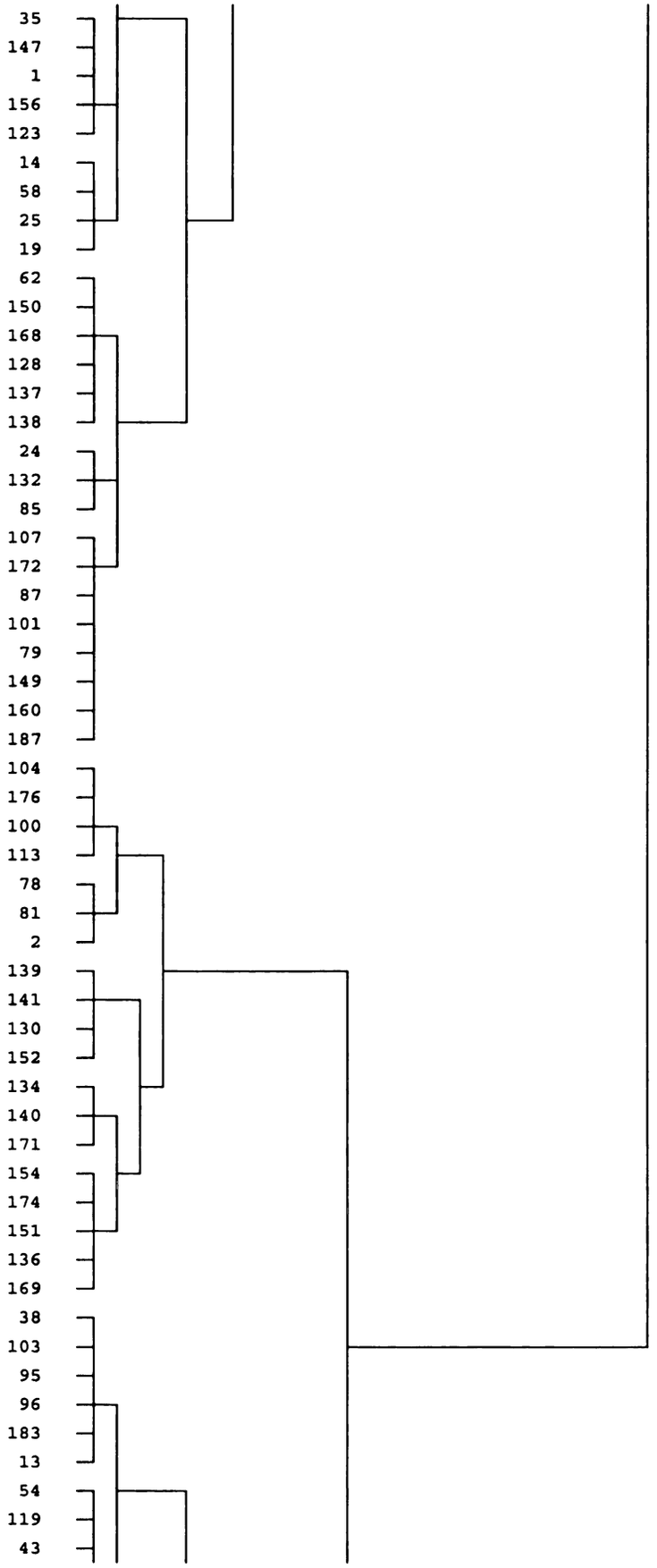
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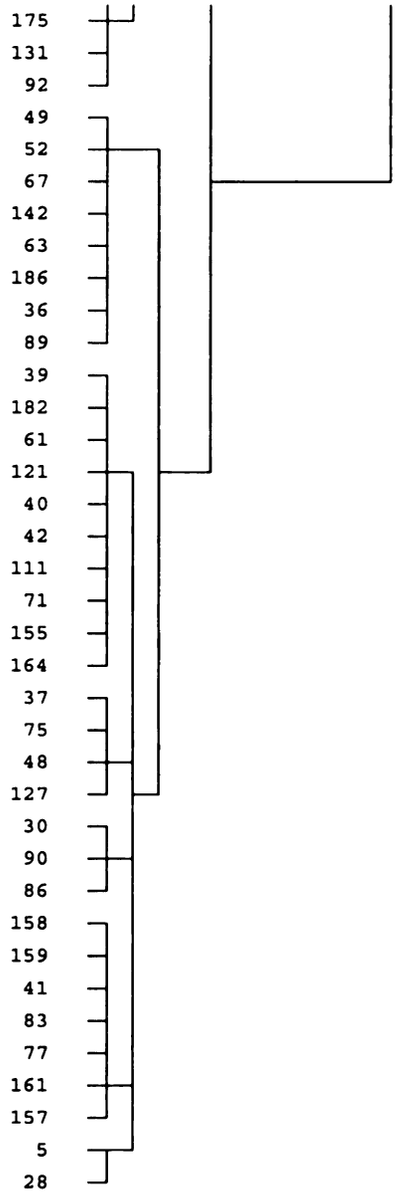
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83
77
161
157
5
28

APPENDIX G

K-means Cluster Method

Initial Cluster Centers

	Cluster	
	1	2
Availability dairy	1	-1
Availability milk	1	-1
Availability yogurt	1	-1
Availability cheese	1	-1
Accessibility dairy	0	0
Accessibility milk	0	0
Accessibility yogurt	0	0
Accessibility cheese	0	0
Convenience dairy	1	0
Convenience milk	0	0
Convenience yogurt	1	0
Convenience cheese	1	0
Cost dairy	0	-1
Cost milk	0	0
Cost yogurt	0	-1
Cost cheese	0	0
Culture dairy	0	0
Culture milk	0	0
Culture yogurt	0	0
Culture cheese	0	0
Health effects dairy	1	0
Health effects milk	1	0
Health effects yogurt	0	0
Health effects cheese	0	0
Personal factors dairy	1	-1
Personal factors milk	1	-1
Personal factors yogurt	1	1
Personal factors cheese	1	-1

Iteration History[a]

Iteration	Change in Cluster Centers	
	1	2
1	2.292	2.785
2	.084	.402
3	.034	.176
4	.055	.246
5	.150	.414
6	.043	.094
7	.049	.111
8	.032	.069
9	.017	.036
10	.014	.030

a. Iterations stopped because the maximum number of iterations was performed. Iterations failed to converge. The maximum absolute coordinate change for any center is .022. The current iteration is 10. The minimum distance between initial centers is 5.916.

Final Cluster Centers

	Cluster	
	1	2
Availability dairy	1	1
Availability milk	1	1
Availability yogurt	0	0
Availability cheese	1	0
Accessibility dairy	0	0
Accessibility milk	0	0
Accessibility yogurt	0	0
Accessibility cheese	0	0
Convenience dairy	0	0
Convenience milk	0	0
Convenience yogurt	0	0
Convenience cheese	0	0
Cost dairy	0	0
Cost milk	0	0
Cost yogurt	0	0
Cost cheese	0	0
Culture dairy	0	0
Culture milk	0	0
Culture yogurt	0	0
Culture cheese	0	0
Health effects dairy	1	0
Health effects milk	0	0
Health effects yogurt	0	0
Health effects cheese	0	0
Personal factors dairy	1	0
Personal factors milk	0	0
Personal factors yogurt	0	0
Personal factors cheese	1	0

Distances between Final Cluster Centers

Cluster	1	2
1		1.851
2	1.851	

Number of Cases in each Cluster

Cluster	1	128.000
	2	63.000
Valid		191.000
Missing		.000

APPENDIX H

Percent prevalence of positive, negative and neutral parental Influences

Percent Prevalence of Positive, Neutral and Negative Parental Influences

	Positive	**Neutral**	**Negative**
Availability dairy, %	87	9	4
Availability milk, %	94	3	3
Availability yogurt, %	38	43	16
Availability cheese, %	52	41	7
Accessibility dairy, %	3	97	0
Accessibility milk, %	1	99	0
Accessibility yogurt, %	1	99	0
Accessibility cheese, %	1	99	0
Convenience dairy, %	25	78	1
Convenience milk, %	3	96	1
Convenience yogurt, %	12	89	1
Convenience cheese, %	13	90	0
Cost dairy, %	2	89	9
Cost milk, %	1	98	1
Cost yogurt, %	1	94	5
Cost cheese, %	1	97	2
Culture dairy, %	1	97	3
Culture milk, %	0	99	1
Culture yogurt, %	0	100	0
Culture cheese, %	1	99	0
Health benefit beliefs dairy, %	55	40	6
Health benefit beliefs milk, %	33	66	2
Health benefit beliefs yogurt, %	20	78	3
Health benefit beliefs cheese, %	10	84	6
Child preference dairy, %	65	20	15
Child preference milk, %	26	56	18
Child preference yogurt, %	39	46	15
Child preference cheese, %	46	48	6
	Positive	**Negative**	
Knowledge of bone health, %	96	4	
Knowledge of # of milk svgs to meet child calcium recommendations, %	68	32	
Parental modeling for milk, %	33	67	
Parental expectation for milk, %	33	67	

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