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**INCREASING CALCIUM AND VITAMIN D INTAKE OF FIRST GENERATION  
CHINESE AMERICAN WOMEN**

A Dissertation in

Food Science

by

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## ABSTRACT

Osteoporosis is a national and global health problem. The annual medical cost of fractures caused by osteoporosis in the US is estimated to be \$18 billion and is likely to rise with the growing elderly population. Adequate daily dietary calcium and vitamin D intake is important to reduce the risk of osteoporosis. The calcium intake of Chinese Americans in the U.S. is well below the Dietary Reference Intake, which increases their risk of osteoporosis and women are more at risk than men. The objective of our research was to collect information on how Chinese Americans use dairy products within their family food system and then to use this information in designing a nutrition education intervention to increase Chinese American women's dietary calcium and vitamin D intake.

To accomplish this objective, three studies were conducted with Chinese American populations mainly in the Philadelphia area. In the first study, 8 focus groups, stratified by sex and marital status, were conducted in each of three PA cities to investigate factors within these strata that influenced dairy product consumption. Analysis indicated that participants' evaluated dairy products based on specific characteristics and that family dietary patterns affected their choices. In the second study, interviews were conducted with 20 Chinese American couples in each of these three PA cities to collect information on the Chinese American family food system and family use of dairy products. These couples were recruited from weekend Chinese schools, because these schools, where parents enroll their children to maintain Chinese language skills, provide access to Chinese American families. Analysis indicated that parents used roles, rules and power to balance family member food preferences and maintain the traditional Chinese meal pattern.

In the final step, using the information gathered in the two previous studies, a nutrition education intervention, based on the Theory of Planned Behavior, was designed for peri- and

menopausal married Chinese American women. Intervention impact was then evaluated using a quasi-experimental study with a nested design and pre, immediate post, and 3-month follow-up assessments. Six Chinese schools in the Philadelphia area were randomly assigned to either the experimental group (n= 3) or the control group (n=3) so each group contained about 70 women. The experimental group received a heel scan and six weekly interactive lessons. The control group received six weekly non-related financial lessons by mail. Results of repeated assessments showed that women in the experimental group significantly increased their daily dietary calcium and vitamin D intake, knowledge, and stage of change for consuming dairy products, compared to the control group at post assessments. Their attitudes towards, perceived behavioral control over, and intention of consuming calcium-rich foods were also improved compared to the control group at post assessments.

This research is the first to investigate the family food system and use a nutrition intervention to increase calcium and vitamin D intake of first generation Chinese Americans. The intervention could be used by educators to reduce the risk of osteoporosis in Chinese American women. The couple interviews shed light on the Chinese American food system. Results of both the focus groups and the couple interviews are useful to nutrition educators who hope to change the food choices of Chinese Americans.

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## Chapter 1

### Literature review

#### Study Overview

Osteoporosis has become a national as well as global public health problem (Babbar et al., 2006). The annual medical cost of fractures caused by osteoporosis is at least \$18 billion in the U.S. (National Osteoporosis Foundation, 2002; Babbar et al., 2006) and it will rise noticeably with the growing elderly population (Melton, 2003). Osteoporosis occurs more frequently in Caucasian and Asian populations, compared to other populations in the U.S. (Desimone et al., 1989; Chiu et al., 1997; Jackson and Savaiano, 2001).

Osteoporosis may be associated with various factors such as hormonal, dietary, genetic, and other life-style factors (Nilas and Christiansen, 1987; Chiu et al., 1997, Hu et al., 1993). Adequate calcium and vitamin D are two important dietary factors that reduce the risk of osteoporosis. Calcium intake has been found to have a beneficial effect on reducing the risk of osteoporosis and bone loss at various life-stages (Hu et al., 1993; Heaney, 2000). Vitamin D is considered an important nutrient that increases the absorption of calcium (Lips, 2006).

Chinese Americans are the largest Asian population in the United States. Their calcium intake is below the Dietary Reference Intakes, which increases their risk of osteoporosis (Jackson and Savaiano, 2001). The study of Lee et al. (1994b) reported calcium intake of Chinese American men (n=698) and women (n=494) was  $591 \pm 12$  mg and  $527 \pm 14$  mg per day, respectively. However, the Dietary Reference Intake for calcium is 1000 mg and 1200 mg calcium per day for adults age 19-50 and above 50 years old, respectively (National Academy of Sciences, 1998).

The traditional Chinese diet always includes a carbohydrate staple, such as rice, noodles or steamed buns, and accompanying meat and vegetable dishes representing other food groups. In this diet, vegetables and soy products provide 41% of the calcium intake; while dairy products provide only 23% of the total calcium intake (Lau, 1995). After immigration, Chinese Americans maintained this traditional dietary pattern while increasing their consumption of certain food items, including dairy products (Lee et al., 1994b; Lv and Cason, 2004).

Dairy products are considered the best natural source of calcium because of their high calcium content, high calcium bioavailability, and high density of other nutrients (Nicklas, 2003). In addition to dairy products, many other foods can also provide calcium, such as calcium-fortified foods and beverages, calcium-rich vegetables, beans, and fish eaten with their bones.

Many factors impact food-related behaviors, such as food preferences, sex, marital status, and influence of friends and family members. Among these factors, family members may have a powerful influence on food choice behaviors in Chinese American families, because the concept of family takes a more important place than individualism in Chinese people's lives. Mothers may consider keeping family harmony more important than introducing healthy foods. Therefore, it is important to understand all possible influencing factors before designing a nutrition education intervention to increase Chinese American's calcium intake.

There is scant literature that systematically elicits reasons for Chinese Americans' consumption of various foods, especially calcium-rich foods such as dairy products, and how they make food choice decisions in their family food system. Additionally, there are few previous studies examining attempts to alter food choices of Chinese Americans, probably because Chinese Americans are a hard-to-reach population and there has been little interest in the health issues of this population compared with other racial groups. Therefore, a systematic study to collect such information is needed before an appropriate nutrition education intervention can be designed to increase Chinese Americans' calcium intake.

### ***Objectives***

This study will explore the reasons for Chinese Americans' low consumption of dairy products and their family food system in order to develop an intervention to fit more calcium-rich foods into their diet. The long-term goal is to increase their calcium intake and decrease their risk for osteoporosis.

### ***Dissertation Content and Organization***

This study is composed of three steps. In the first step, we used the Theory of Planned Behavior to obtain information on psychosocial factors affecting Chinese Americans' consumption of dairy products through focus group interviews. We compared these psychosocial factors between married and single and between male and female Chinese Americans. In the second step, we further used the Reciprocal Determinism Model to explore Chinese American's family food system and how they use dairy products in this system through couple interviews. Since women have a higher risk of osteoporosis than men, in the third step, we developed an intervention based on the information obtained from focus groups and couple interviews to increase Chinese American women's calcium intake. The effectiveness of the intervention on calcium intake was evaluated by a quasi-experimental study with a nested design and a pre, immediate, and delayed post assessment.

This dissertation is organized into six chapters. Chapter 1 provides the literature review of Chinese Americans' demographics, diet, and osteoporosis prevalence, calcium sources, factors influencing food related behaviors, and previous education interventions, all of which leads to the rationale of the research. Chapter 2-5 are papers published or submitted. Chapter 2 reports the results of the focus groups (first step). This paper was published in Topics in Clinical Nutrition

(Lv et al., 2007). Chapters 3 and 4 report the results of the couple interviews (second step). Chapter 3 examines Chinese American families' food system in order to understand what influences food choices and thus dietary intake after immigration. This paper (Chapter 3) was accepted as a research article by Journal of Nutrition Education and Behavior. Chapter 4 focuses on learning how these families view dairy products, how they use them in their family food system, and how these impact their dietary behavior or intake. This paper will be shortened and submitted to Journal of the American Dietetic Association. Chapter 5 reports the results of the nutrition education intervention (third step). It will also be shortened and submitted to Journal of the American Dietetic Association. Chapter 6 summarizes the results and discusses the limitations of the research and suggestions for future studies.

## **Chinese Americans**

### ***Demographics of Chinese Americans***

In 2000, there were about 2.4 million Chinese Americans in the United States, having increased by 50%, since 1990 (US Census 2000a). This number is a minimum estimate, because a portion of immigrants are ethnic Chinese from the Asian countries of Vietnam, Malaysia, Indonesia, and the Philippines, etc. Therefore, these individuals may not be represented as Chinese in the US census (Edmonston and Passel, 1994). Despite under-representation, Chinese Americans accounted for 23.7% of American Asians in the 2000 US census data and they are considered the largest Asian population in the United States (US Census 2000a).

According to Census 2000 data from the U.S. Census Bureau, 50,650 Chinese Americans reside in Pennsylvania (0.4% of the total population in Pennsylvania). Of the 50,650 Chinese Americans, 17,783 reside in Philadelphia (1.2% of the total population in Philadelphia), 2950

reside in Pittsburgh (0.9% of the total population in Pittsburgh), and 1302 reside in State College (3.4% of the total population in State College) (US Census 2000b).

The U.S. Census Bureau does not have definitions for first and second generation immigrants, so we provide our own definition of first and second generation Chinese Americans. First generation Chinese Americans are defined as Chinese Americans who were born outside the United States and are now permanent residents or citizens of the United States, or are applying for a green card. Second generation Chinese Americans are defined as Chinese Americans who were born in the United States to first generation parents. Since US 2000 Census data only offers counts of the number of people of each race/ethnic origin or ancestry, the distributions of first and second generation Chinese Americans in US and Pennsylvania are not available.

### ***Calcium in the Diet of Chinese in China and Chinese Americans***

In China, Chinese peoples' lunch and dinner always includes a carbohydrate staple, such as rice, noodles or steamed buns, and accompanying meat and vegetable dishes representing other food groups. Soup, hot tea, fresh fruit, and nuts, instead of sweets, are served after the meal.

Dairy products are lacking in Chinese peoples' dietary patterns, partly because many Chinese are lactose intolerant – they do not have sufficient lactase activity to adequately digest lactose (Neilson, 1995). In addition, compared to the western countries, production of milk and milk products are relatively low in China. Although China has been breeding milk cows and making dairy products for thousands of years, mean dairy product production per person in China was only 13 kilograms in 2002, whereas the mean dairy product production was 100 kilograms worldwide (China Animal Husbandry Industry Website, 2004). Nowadays, milk powder, pasteurized milk, Ultra High Temperature (UHT) milk, yogurt, condensed milk, and cream are produced in China. Among these, milk powder is the main dairy product produced, because it is



the only dairy product suitable for places where milk and other dairy products are not available due to the difficulty of transportation and lack of refrigeration. Nonfat dry milk, cream, cheese, condensed milk, and fluid milk are also imported into China (China Animal Husbandry Industry Website, 2004).

The calcium intake of Chinese people in Mainland China, Taiwan, and Hong Kong was found to be well below the Dietary Reference Intake at the time when the surveys were conducted (Ho et al., 1994; Lau, 1995; Tian et al., 1995; Chiu et al., 1997; Pun et al., 1991; Zhang et al., 2004; Liu et al., 2004). Good calcium sources in China include beans, soybean products, nuts, cereals, fish, eggs, and vegetables, such as Chinese cabbage, broccoli, and spinach, (Pun et al., 1991; Pan et al., 1992; Zhang et al., 2004; Liu et al., 2004).

After Chinese people immigrate to western countries, such as the United States, they have more access to meat products and dairy products (Hu et al., 1993; Suarez and Savaiano, 1997). Lee et al. (1994b) found that Chinese in North America consumed more beef, dairy products, and fruits, compared to Chinese in China (Lee et al., 1994b). Lv and Cason (2004) used a 97-item food frequency questionnaire (FFQ) modeled after a study of Chinese immigrants by Newman and Linke (1982). The FFQ measured consumption frequency of food items in seven food groups (grain products, vegetables, fruits, animal products, dairy products, fats/sweets, and beverages) 1 year before immigration and within the past 12 months in the United States. Five frequency categories (daily, weekly, monthly, yearly, and never) were used in the FFQ to measure food consumption frequencies and their definitions were given. The results showed that Chinese Americans increased consumption frequency of all seven food groups after immigration. They consumed low fat milk, cheese, yogurt, and ice cream significantly more frequently, but their milk powder consumption frequency was reduced significantly after immigration (Lv and Cason, 2004). Their other calcium sources in the U.S. were similar to those in China, including beans, soybean products, nuts, cereals, fish, eggs, and vegetables. However, for many reasons,

such as lactose intolerance, food preference, dietary habits, and limited expectation for eating dairy products (e.g., drinking milk) within families, their calcium intake was far below the Dietary Reference Intake (MacKelvie et al., 2001; Jackson and Savaiano, 2001, Lee et al., 1994a). The study of Lee et al. (1994b) reported calcium intake of Chinese American men (n=698) and women (n=494) was  $591 \pm 12$  mg and  $527 \pm 14$  mg per day, respectively. Walker and others (2007) conducted a study among Chinese American women and found that their calcium intake was  $612 \pm 17$  mg per day measured by a food frequency questionnaire (FFQ). However, the Dietary Reference Intake for calcium is 1000 mg calcium per day or more for adult men and women (National Academy of Sciences, 1998).

This information suggested that although Chinese Americans increased their dairy product consumption slightly after immigration, their calcium intake was still low. Chinese Americans need to increase their daily calcium intake to reduce the risk of osteoporosis.

### ***Osteoporosis in Chinese Americans***

Osteoporosis occurs more frequently in Caucasian and Asian populations than in other populations in the U.S. (Desimone et al., 1989; Chiu et al., 1997; Jackson and Savaiano, 2001). It is a public health problem among Chinese immigrants, especially among foreign-born Chinese Americans (Lauderdale et al., 2003).

One project conducted in Chicago's Chinatown investigated the bone health status of Chinese Americans who were 50 years old or older (n=469). Results showed that more than half of the Chinese Americans aged 60 years old or older were osteopenic or osteoporotic. The prevalence of osteopenia and osteoporosis also increases with age (Liao et al., 2002). For Chinese American women who were 70 to 79 years old and 80 years old or older, the prevalence of osteoporosis was 28% and 40%, respectively. Fewer Chinese American men were

osteoporotic than Chinese American women. For Chinese American men who were 70 to 79 years old and 80 years old or older, the prevalence of osteoporosis was about 7% and 12%, respectively (Lauderdale et al., 2003). Previous studies also showed that Chinese Americans had lower bone mineral density (BMD) than Caucasians at several sites (MacKelvie et al., 2001; Lauderdale et al., 2003). In the study of Lauderdale et al. (2003), Chinese American women had lower average BMD than Caucasian women. Chinese American men 50 to 69 years old had similar BMD to their Caucasian counterparts and Chinese American men 70 years old or older had lower BMD than their Caucasian counterparts.

Although osteoporosis is evident in older adults, the deterioration of BMD starts at a much younger age. Researchers found that Chinese women achieved their peak BMD at various skeletal sites within the age range of 30-44 years old (Wu et al., 2004; Liao et al., 2002). Wu et al. (2004) reported that Chinese young adults achieved peak BMD at the lateral spine and femoral neck at 30-34 years old, peak BMDs at the posteroanterior spine and total hip at 35-39 years old, and peak BMD at the ultradistal forearm at 35-44 years old. Liao et al. (2002) found similar results.

In short, Chinese American men and women are likely to have comparatively low BMD and a high risk of osteoporosis. Peak BMD at various sites were achieved at young adult age. Therefore, it is necessary for Chinese adults to consume the recommended amount of calcium at younger ages in order to achieve higher peak BMD and reduce bone loss.

### **Calcium Sources**

Available calcium sources include dairy products, calcium-fortified foods and beverages, fish eaten with bones, beans, certain vegetables, and calcium supplements.

### ***Dairy Products***

Dairy products are nutrient dense foods. They contribute 73% of calcium, 31% of riboflavin, and 33% of phosphorus, 19% of protein, 16% of magnesium, 21% of vitamin B12, 17% of vitamin A, 10% of vitamin B6, 6% of thiamin, and a large amount of vitamin D and niacin equivalents available in the US food supply (Gerrior and Bente, 1997; Miller et al., 2000).

Almost all the investigator-controlled intervention studies reviewed by Heaney (2000) showed that high calcium intake was associated with better bone balance (bone gain – bone loss), greater bone gain during growth, reduced bone loss in elderly persons, and reduced fracture risk. Studies using dairy products as the calcium treatment indicated the same positive effect of calcium at various life stages (Baran et al., 1989; Chan et al., 1995; Renner et al., 1998).

### ***Other Calcium Sources***

Other calcium sources include calcium-fortified foods and beverages, such as calcium-fortified orange juice, breakfast cereal, mineral water, soy beverages, calcium-rich vegetables, such as spinach, broccoli, kale, collards, Chinese cabbage, and Chinese mustards, fish eaten with bones, and cooked or canned beans. However, there have been some concerns about these foods as calcium sources. These concerns are focused on calcium bioavailability (i.e., spinach) and calcium content (i.e., broccoli) (Nicklas, 2003; Whiting and Wood, 1997).

Bioavailability of calcium differs among calcium sources. For example, Heaney et al. (2000) found that bioavailability of calcium in soy beverages was 75% of that from cow's milk. However, the soy beverages consumed by Chinese in China and by Chinese Americans are generally not fortified with calcium. An 8-oz cup of Chinese soy beverage may only provide 4% of daily calcium need (Manufacturer's Nutrition Facts for Kong Kee soy milk). Oxalic acid

contained in spinach and chard can combine with calcium to form calcium oxalate, and reduce the calcium bioavailability in these vegetables (Harvard School of Public Health, 2004; Weaver, 1992). Phytic acid in calcium-fortified breads and cereals can reduce calcium bioavailability as well (Weaver, 2001; Weaver et al., 1999). Therefore, people must consume more than the recommended servings of these foods to obtain enough calcium. For example, to obtain the same amount of absorbable calcium in one cup of milk, people must consume eight cups of spinach or 2 ½ cups of broccoli (Weaver, 2001; Weaver et al., 1999). People are unlikely to consume these large amounts of single calcium-containing foods in any given day but we know little about how people combine various less rich sources of calcium in a daily pattern.

### *Calcium Supplements*

People who are concerned about their calcium intake may turn to calcium supplements. However, a recently published study (Napoli et al., 2007) suggested that food is the preferred calcium source rather than calcium supplements. In this study, healthy postmenopausal Caucasian women were given instructions and recorded what they ate in 7 days. They were divided into three groups based on their 7-day dietary record: supplement group, diet group, and diet and supplement group. The supplement group obtained more than 70% of the calcium intake from supplements and less than 30% from the diet. The diet group obtained more than 70% of the calcium intake from diet, mainly from dairy products, and less than 30% from supplements. In the diet and supplement group, both diet and supplements contributed more than 30% but less than 70% of calcium intake. Results of their BMD showed that the diet group had a greater BMD than the supplement group, even though their total daily calcium intake was lower than the supplement group. The diet and supplement group had the highest BMD, probably because of the additive effect of dietary calcium and calcium supplements and their high total daily calcium

intake.

It is not clear whether an excessive intake of calcium supplements is associated with a high kidney stone risk. In the study of Jackson and others (2006), 36282 post-menopausal women, aged 50-79 years old, were randomly assigned to either an experimental group (18176) receiving two calcium tablets providing 1000 mg calcium and 400 IU vitamin D daily or a control group (n=18106) receiving placebos during a 7-year period. The experimental and placebo group reported 449 and 381 cases of kidney stones, respectively. Although statistically significant, the difference was very small. Recently, Heaney (2008) reviewed 12 randomized controlled trials of calcium supplementation and found calcium supplement intake up to 2000 mg/d did not increase the risk of kidney stone.

In addition, the concern that calcium supplements may increase the risk of prostate cancer is unresolved as well (Harvard School of Public Health, 2004). Excessive calcium intake of more than 2000 mg per day may be associated with higher risk of prostate cancer in men, because excessive calcium intake may reduce the production of 1,25-dihydroxy vitamin D<sub>3</sub> and increase cell proliferation in the prostate (Rodriguez et al., 2003; Giovannucci et al., 1998). However, other researchers found no association between calcium supplements and the risk of prostate cancer (Kristal et al., 1999; Koh et al., 2007; Baron et al., 2005).

### ***Dairy Products on the Market and Culturally Appropriate Dairy Products for Chinese***

Dairy products have high calcium bioavailability and calcium content compared to the other calcium sources (Nicklas, 2003). They are also available in a large variety in the US market. “These products include milks (unflavored, flavored, evaporated, condensed, sweetened condensed, dry, nonfat dry), cultured or culture-containing dairy foods (yogurt, kefir, acidophilus milk, cultured buttermilk, sour cream), creams (heavy, light, whipping, half-and-half), butter, ice

cream, and cheese” (Miller et al., 2000). Dairy products available in US market differ in taste, nutrition, healthfulness, and convenience level to meet the consumers’ needs. For example, nonfat milk, low fat milk (i.e., 1% and 2%), and whole milk were developed to meet consumers’ demands for different fat content. Lactose free milk was developed to meet the needs of lactose intolerant consumers.

However, some dairy products may not be in a culturally appropriate form that would fit with traditional Chinese meal or snacking patterns. Although little information on types of culturally appropriate dairy products for Chinese Americans on US market is available, previous studies suggested that preferences for dairy products differ among people from different cultures. In the study of Spindler and Schultz (1996), results of 4-day food records showed that milk was consumed by 60% of foreign-born first generation Chinese American women (n=21), 56% of white American women (n=23), and 50% of second or third generation Chinese American women (n=20), respectively. Foreign-born first generation Chinese American women reported consuming whole milk most often; white American women reported consuming nonfat milk most often; whereas, second or third generation Chinese American women preferred 1% milk (Spindler and Schultz, 1996). This preference of foreign-born first generation Chinese American women for whole milk is probably because milk in China tastes more like whole milk in the US. None of these foreign-born first generation Chinese American women reported consuming yogurt, while 45% of second or third generation Chinese American women consumed yogurt (Spindler and Schultz, 1996). However, there is a large variety of yogurt offered in the Chinese market nowadays. Therefore, if the result of no yogurt consumption among foreign-born first generation Chinese American women in this study could be applied to the more general population nowadays, a possible reason could be that Chinese yogurt has a different texture and taste from American yogurt.

Researchers have reported that in addition to cultural differences, unfamiliarity with dairy products might also influence intake. For example, unfamiliarity may be one of the reasons that cheese was seldom consumed by Asians (Ikeda et al., 1994; Spindler and Schultz, 1996).

In summary, consumption of some dairy products, such as yogurt, might be affected by the taste and texture of such products in the US market. Yogurt that tastes like Chinese yogurt may be more attractive to Chinese in US. Familiarity might increase the consumption of some types of dairy products, such as cheese and lactose-free milk. In addition, Chinese Americans of different generations may prefer different characteristics for the same dairy products (i.e., fat content of milk). However, sample sizes of the above studies are small. More information should be collected before drawing conclusions about the Chinese American population.

## **Factors Influencing Food Related Behaviors**

### ***Family Interactions and Food Choice Behaviors***

Among factors influencing food related behaviors, social influence has gained interest recently. For a long time, nutrition education efforts targeting Western European cultures have focused on women, because they were believed to be the family 'gatekeepers' who are responsible for menu planning, shopping, and cooking (De Bourdeaudhuij, 1997). However, meals have always involved all family members. Research suggests that other family members such as the husband and children also have a powerful influence on food choice behaviors (Charles and Kerr, 1988; Pill and Parry, 1989, De Bourdeaudhuij, 1997). Avoiding conflict within the household was often found to be more important than the introduction of a healthful diet (Anderson et al., 1995; Backett, 1992; Backett et al., 1994). In the study by Kirk and Gillespie (1990), mothers indicated that they tried to avoid mealtime conflicts by adjusting foods served according to family



members' preferences. Researchers have also found that nutrition education interventions involving parents showed more desirable results than school-based interventions involving no parents (Nader et al., 1989; Madsen et al., 1993). A barrier to milk consumption in a group of Asian preadolescent and adolescent females was the limited expectation for drinking milk within families. Milk was associated with bone strength which was considered more important for boys than for girls (Auld et al., 2002). Therefore, it is important to know how different family members view proposed food changes and how subsequent changes are negotiated and implemented within the family unit.

Recently, family members emerged as an important factor to consider in studies of food choice behaviors. Some studies suggested that the preference of fathers plays an important role in shaping households' dietary patterns, followed by preferences of children (Pill and Parry, 1989; De Bourdeaudhuij, 1997). De Bourdeaudhuij (1997) concluded that mothers could succeed in changing the household's dietary pattern if these changes were acceptable to their husbands and, to a lesser degree, their children. If fathers introduced the healthful foods, their wives were more willing to accept them, because women were more concerned about family members' health, especially the health of their children (De Bourdeaudhuij, 1997). Parents can further affect their children's dietary patterns in at least five ways: controlling food availability and accessibility, controlling meal structure, food modeling, food socialization practices, and food-related parenting style (Nicklas et al., 2001). Food related parenting styles in Caucasian parents have been classified into permissive, authoritarian, and authoritative style (Birch and Fisher, 1995). These styles may or may not be applicable in other ethnic groups (Nicklas et al., 2001).

Influence over food choice in the family also varies by the types of products or product groups. Children were more likely to influence the decision on the food products that were important to them (Foxman et al., 1989; Roberts, 1981). For example, changing unhealthy snacks or candy, important food items for children, generated more resistance than changing

unhealthful foods served at main meals (Crockett et al., 1989; De Bourdeaudhuij and Van Oost, 1998).

Most of the studies that investigated family interaction involved children or adolescents and their parents. Young adults are a comparatively independent population, since many of them live alone or with their friends. However, a few studies that investigated young adults and their parents suggested that their food choices, food preferences, attitudes, or intentions were somehow associated with those of their parents (Van Gundy, 2002; Stafleu et al., 1995). In the study of Stafleu et al. (1995), 97 young adult women aged 20 to 30 years old, their mothers and grandmothers were interviewed in the Netherlands. The authors found that although they were not living with their mothers and grandmothers, young adult women and their middle-aged mothers resembled each other on food habits. In this study, the correlation for food preference between young adult women and their mothers was comparable to the correlation for food preference between children and their parents reported in a meta-analysis (Borah-Giddens and Falciglia, 1993). It is surprising, since researchers believed that when people get older, they might be influenced by people other than their parents. Stafleu et al. (1995) suggested that this could be explained by the high contact frequency between young adult women and their mothers (17 times/month). This may also be due to all the food dishes and recipes traded back and forth between generations.

The concept of family plays a very important role in Chinese people's life. Shon and Ja (1982) explained that views of family interaction are affected by Confucianism and Buddhism, which emphasize family unity instead of the independence of individuals. In traditional Chinese families, the father is the leader of the whole family. He provides economic support for the family and makes decisions on important issues, such as children's education and finances. In traditional families, the mother views her central role as taking good care of both her husband and children. Males were valued more than females in traditional Chinese families, because males

supplied the labor force in agricultural enterprises. The oldest son is expected to be a role model for the behaviors of his younger brothers and sisters and to assume more responsibilities.

Children have the obligation to respect and obey their parents in a traditional family. Modern Chinese families have changed (Yan, 2003). For example, the difference between the familial status of males and females is not obvious any more. Husband and wife usually make major decisions together. Wives usually make food purchase and food preparation decisions more frequently than husbands. Despite these changes, the traditional assignment of roles and rules among family members may still be observed in some current Chinese families (Yan, 2003), especially among first generation families. Understanding the responsibilities of family members in traditional and modern Chinese families can help researchers further illuminate family interaction among Chinese family members.

Although the influence of family roles and interaction on food choice behaviors has been examined empirically in Caucasians, there appear to be few studies examining the situation in Asian or Chinese families. One study of Park et al. (2003) showed that acculturation of mothers influenced eating behaviors of Korean American families in California. For example, families of less acculturated mothers ate out less frequently, and had higher preferences for Korean foods than did families of more acculturated mothers (Park et al., 2003). In Chinese American households, several generations of adults and/or children may be living together. They may have different risk perceptions, motivations, preferences, points of view, and lactase activity levels. Family interactions may become important depending on what food is being introduced. Therefore, it is important to know how family members negotiate or modify their food choice behaviors in the household setting.

### ***Peer Influence and Food Choice Behaviors***

Besides family interactions, peer influence, a factor that has been investigated by researchers, might also have an influence on food choice behaviors. Birch and others conducted a series of studies and showed that peers had a significant influence on children's food preferences (Birch, 1980; Birch et al., 1980). For example, Birch (1987) found that the most efficient way to introduce children to a disliked food was to let them eat the food at a table with other children who like that food. However, there is scant information on peer influence on young adults and adults' food related behaviors. Several studies stated that 'friends' are reported to be one of the most frequently used and trusted sources for nutrition and healthy eating information in adults (Worsley and Lea, 2003; Biloukha and Utermohlen, 2001), although experimental studies produced unclear results. Rozin et al. (2004) investigated the influence on food preferences of assigned or self-selected freshman roommates who have lived in a room for seven months. The results showed that although self-selected roommates had a higher correlation on food preference than assigned roommates, the influence of roommates on food preference was minimal. The authors suggested that although roommates used the same dining service, they were probably not eating together (Rozin et al., 2004). It is also worth noting that roommates might not always be best friends. Feunekes et al. (1998) studied similarity in fat and food intake among family members and friends in the Netherlands. In each family, an adolescent child, his/her parents, and for each of them, a best friend, were recruited. Family interviews, focus groups, and questionnaires were conducted. The authors found that friends did not seem to have a significant influence on fat intake of adolescents and adults. Fat intakes of friends were not significantly correlated. Consumption of milk or whitener used in coffee and some snacks (i.e., hamburger and low-fat cookies for fathers and their friends; meat products for mothers and their friends; low-fat cheese and french fries for children and their friends) were similar (Feunekes et al., 1998).

However, the authors stated that they used correlation coefficients to assess influence among friends. Not all influences would lead to a significant correlation coefficient in intake; the enhancing and opposing social influences might reach a balance (Feunekes et al., 1998).

Overall, peer influence on food related behaviors of young adults and adults are not well understood. This influence is hard to assess because people may not want to admit that their behaviors are influenced by others and it is hard to eliminate the influences of other social factors (i.e., media). The question of how much peer influence there is on food related behaviors is still open for investigation.

### ***Sex and Marital Status Differences in Food Choice Behaviors***

In addition to social influences, sex and marital status have an influence on food choice behaviors as well. There are sex differences in food choices as well as in attitudes and beliefs about food choices, and in health behaviors (Wardle et al., 2004; Umberson, 1992; Lonquist et al., 1992; Conner, 1994). For example, women are more likely than men to report healthier behaviors, such as avoiding high-fat foods, eating fruit and other fiber-containing foods, and limiting salt intake (Wardle et al., 2004). Marital status also has an influence on health behaviors, because people attempt to influence family members' health behaviors in order to keep them healthy (Umberson, 1992). For example, Woo et al. (1999) concluded that married Chinese women have a higher consumption of vegetables and fish and a higher intake of vitamin D and iron than single Chinese women in Hong Kong. Therefore, when investigating food choices and health behaviors, participants were usually studied separately by sex and/or marital status.

### ***Lactose Intolerance and Dairy Product Consumption***

Many factors influence dairy product intake. Among all the factors, lactose intolerance and its real or perceived symptoms after consuming dairy products have been an important reason for maldigestors to limit dairy products. Common lactose intolerance symptoms include abdominal pain, bloating, diarrhea, and excessive flatulence (Swagerty et al., 2002). Avoiding dairy products will probably make lactose intolerant people more intolerant to lactose, because colonic bacteria will not be adapted to the fermentation of lactose (Savaiano, 2003). Many professionals recommend that lactose intolerant individuals restrict milk consumption (Savaiano, 2003).

However, lactose intolerant people need not give up dairy products in their diet. Researchers have suggested strategies to help these people increase their dairy product intake. The strategies include consuming small amount of dairy products with meals; eating dairy products with low lactose levels or consuming those that can be tolerated easily, such as hard cheeses and yogurt; using lactose digestive aids; and consuming dairy products daily to increase colonic bacterial fermentation (Jackson and Savaiano, 2001; Savaiano, 2003). Several double-blind studies found that most lactose intolerant people could tolerate 1 cup (240 ml) of chocolate drink containing the same amount of lactose (12 g) as 1 cup of milk (Rorick and Scrimshaw, 1979; Haverberg et al., 1980; Unger and Scrimshaw, 1981). Another double-blind, randomized, crossover study showed that most individuals with lactose intolerance could tolerate two cups of milk total per day when taken in small servings with meals (Suarez et al., 1997). Other studies found that lactose intolerant women could obtain about 1500 mg of calcium from a dairy-rich diet without major obstacles (Suarez et al., 1998; Perman and Dudley, 1998). Continuous consumption of dairy products/lactose resulted in increased tolerance in both children and adults

because of enhanced colonic metabolism of lactose (Johnson et al., 1993; Hertzler and Savaiano, 1996; Pribila et al., 2000).

## **Previous Education Programs**

### ***Nutrition Education Interventions in Chinese Americans and Chinese in China***

Because of cultural and language barriers, Chinese Americans are a hard-to-reach population for non-Chinese nutrition educators in the United States. By searching the Science Citation Index (SCI), the author only found two studies conducted to change the health related behaviors of Chinese Americans. In one study, a community-based nutrition education program was designed based on the PROCEDE model to improve the general dietary behaviors of Chinese-American college students (Sun et al., 1999). The researchers reported that after the 6-month program, the intervention group significantly improved diet and health related knowledge, food preparation skills, self-reported ability to seek positive social support and resist negative social support, and general self-reported dietary behavior. In another study, an individually tailored educational intervention was designed to promote healthy weight in 8-to-10-year-old Chinese American children (Chen et al., 2008). After the intervention, the researchers observed significant improvement in usual food choices, physical activity, and nutrition and activity knowledge over time. Neither of these studies reported any detailed results on dietary behavior/food choice improvement.

The SCI search identified many nutrition education interventions designed to improve the health related behaviors of people in China. Six interventions were conducted in Taiwan with three targeting children and adolescents (Huang et al., 2007; Chen et al., 1997; Ma and Contento, 1997) and another three targeting adults (Yeh et al., 2005; Yeh et al., 2002; Jiang et al., 1999). A

15-week nutrition education program was administered in Taiwan elementary schools to reduce student's fat intake. It failed to have any effect on intention and behaviors (Ma and Contento, 1997). The other two programs (6 and 12 sessions) successfully reduced the weight of children and/or adolescents (Huang et al., 2007; Chen et al., 1997). Two of the other three interventions were conducted among young adults (nursing students and high-risk hypertensive freshmen). Both programs showed improvement in nutrition, exercise, and blood pressure in high-risk hypertensive freshmen (Yeh et al., 2005; Yeh et al., 2002). Another intervention significantly improved the diabetes self-care techniques among participants with type 2 diabetes through an advanced education program (Jiang et al., 1999). Most of these interventions showed positive changes, however, some of them did not use an experimental design with both an intervention and a control group.

Three interventions were conducted in Mainland China. Two were conducted among school students. Xia et al. (2004) implemented an 18-month program in six schools in Zhejiang Province and reported improved nutrition and health status of students, parents, and school staff. Liu et al. (2007) conducted the Happy 10 program and successfully increased the average energy expenditure and duration of physical activity among students in the intervention school. In a work site intervention program, the intervention group achieved a significant decrease in their salt intake and blood pressure, compared to the control group (Wu et al., 1999).

An osteoporosis prevention program conducted in Hong Kong will be described in the followed section.



### *Osteoporosis Prevention Programs*

Several short-term osteoporosis prevention programs have increased calcium and vitamin D intake (Walker and Ball, 1993; Rolnick et al., 2001; Tussing and Chapman-Novakofski, 2005, Davis et al., 2006; Chan et al., 2005; Manios et al., 2007).

Walker and Ball (1993) conducted a short intervention in New Zealand by giving 50 women information aimed at increasing calcium intake through the use of three leaflets (“Osteoporosis – a matter of concern for all women”, “How does your calcium stack up”, and “Low fat cheeses”). These women were on a low-fat diet and 41 out of 50 women were postmenopausal before the intervention. A 120-item food frequency questionnaire was used to measure nutrient intakes before and three months after the intervention. The results showed that these women significantly increased their calcium intake from  $696 \pm 254$  mg to  $937 \pm 317$  mg per day, while maintaining their total energy, fat, and saturated fat intake after the intervention. The increase in calcium intake was mainly due to the increase in consumption of low fat dairy products, particularly skim milk. This simple intervention significantly increased calcium intake, probably because participants were mainly postmenopausal and were already motivated to adjust dietary choices and follow a fat-reduced diet. Therefore, these women may have responded to the intervention more readily than a normal volunteer group. However, the researchers did not employ a comparison group to control the confounding variables that might also influence the increase in calcium intake.

Rolnick and others (2001) conducted an experimental controlled study to evaluate if osteoporosis education, with and without bone mineral density (BMD) testing, initiates lifestyle changes and pharmaceutical treatment to prevent osteoporosis. In the study, 508 women, aged 54-65, were randomly assigned to either an “education only” group (n=301) or an “education plus BMD” group (n=207). Another 187 women served as controls. The “education only” group

attended a 2-hour lesson on osteoporosis prevention. The “education plus BMD” group also received a BMD test of their forearm in addition to the 2-hour lesson. During the 2-hour lesson, women in both groups learned about osteoporosis, lifestyle factors to improve bone health, risks and benefits of Hormone Replacement Therapy (HRT) and alternative osteoporosis prevention therapies. Six months after the education, the “education only” and “education plus BMD” group significantly increased their calcium and vitamin D intake, compared with the control group. Women in the “education plus BMD” group were three times more likely to report starting HRT than those in the “education only” group. In the “education plus BMD” group, women with lower BMD were likely to increase vitamin D intake than those with higher BMD. However, the researchers did not use a quantitative instrument to measure calcium and vitamin D intake.

Tussing and Chapman-Novakofski (2005) designed and tested an 8-week intervention based on the Health Belief Model and Theory of Reasoned Action. These lessons were offered twice: fall and spring (the schedule of the lesson plan is unknown). Each lesson consisted of a short lecture, hands-on activities, and related handouts. Lesson topics covered osteoporosis, risk factors, calcium intake, supplements, vitamin D, lactose intolerance, recipes, and treatments of osteoporosis. Dietary calcium intake measured by a FFQ significantly increased from  $644 \pm 383$  mg/day at pretest to  $821 \pm 372$  mg/day at posttest for 42 women who completed the lessons. This intervention achieved a significant increase in calcium intake probably because the researchers conducted focus groups before the intervention to evaluate the needs of their participants. However, the researchers did not use a control group.

Davis et al. (2006) conducted six 1-hour intervention lessons with 47 older adults. The design of this intervention was guided by a cognitive-behavioral perspective. Lessons were composed of lectures and hands-on activities. Topics covered osteoporosis, physical activity, fall prevention, nutrition and nutritional supplements, medicines and calcium supplements, and a summary. Participants significantly increased osteoporosis-risk reduction behaviors, such as

eating foods high in calcium, taking calcium supplements, taking fall precautions, and exercises, immediately after the program. However, the researchers did not use a control group and did not measure the change in calcium intake using a quantitative questionnaire.

Manios and others (2007) conducted an experimental controlled study with 75 post-menopausal women. These women were randomly assigned to either an intervention or a control group. The intervention group attended a bi-weekly nutrition education program for 5 months. The program focused on osteoporosis prevention through promoting healthier diet (calcium and vitamin D) and lifestyle (physical activity). The program was designed based on the Health Belief Model and the Social Cognitive Theory. Women in the intervention group increased their calcium intake from  $681.6 \pm 209.9$  to  $1248.5 \pm 625.6$  mg/d after the program. Calcium intake of the control group did not change much. However, we only know that presentation and discussion was used in the education sessions. We do not know if they used other educational methods to increase self-efficacy in adopting a healthier diet and lifestyle.

Chan and colleagues (2005) conducted an osteoporosis prevention intervention in Hong Kong with a randomized controlled design. The objective of this study was to evaluate the effect of this intervention on adoption of four specific osteoporosis-prevention related behaviors. Participants were randomly assigned to either the control (n=21) or the intervention group (n=20). The control group did not receive any education or consultations. The intervention women attended a 45-minute education session, followed by two phone consultations within one month after the education session. Topics were related to the four behaviors (consumption of soya foods, milk, vitamin D, sunlight exposure, and exercise). Immediately after the phone consultations, participants in the intervention group self-reported increased exercise, consumption of soya foods, milk, and vitamin D/sunlight exposure compared to those in the control group. However, this intervention design was not based on a theoretical model. In addition, the

researchers only used global questions to measure consumption of soya foods, milk, and vitamin D.

Most the above-mentioned osteoporosis prevention programs were not well-designed. In general, weaknesses of these interventions included the lack of a control group in the experimental design, lack of theoretical model(s) as a guide for the intervention, and lack of a validated questionnaire(s) to measure the target behaviors (i.e., calcium intake).

In spite of these disadvantages, some elements of interventions could inspire future researchers and be applied to their studies. Lessons learned from these short-term osteoporosis prevention programs are: a) a randomized controlled experimental design should be used to control confounding variables (Chan et al., 2005; Manios et al., 2007); b) theoretical model(s) can help educators identify concepts that need to be emphasized in the intervention (Tussing and Chapman-Novakofski, 2005; Davis et al., 2006); c) knowledge about barriers to behavioral change obtained by pre-intervention qualitative studies (i.e., focus groups) provides the educators ideas to develop strategies for the intervention (Tussing and Chapman-Novakofski, 2005); d) active learning style and hands-on activities may be effective educational methods (Tussing and Chapman-Novakofski, 2005; Davis et al., 2006); and e) BMD testing, especially a low BMD result, may stimulate behavioral changes (Rolnick et al., 2001).

## **Study Rationale and Theoretical Models**

### ***Study Rationale***

Chinese Americans are the largest Asian population in the United States. Generally they have low bone mineral density and high risk of osteoporosis. One of the reasons for their low bone mineral density and high risk of osteoporosis is likely to be their low calcium intake.

Among all calcium sources, dairy products are considered a good source of calcium due to their high calcium content and calcium bioavailability. After immigration, Chinese Americans significantly increased consumption frequency of some dairy products, such as low fat milk, cheese, yogurt, and ice cream. However, sufficient dairy products are still lacking in their diet. Their low dairy product consumption might be attributed to unfamiliarity with dairy products, lack of products tailored specifically for the Asian population, lactose intolerance, food preference, and dietary habits. Other calcium sources in the diet of Chinese Americans include calcium-fortified orange juice and soy beverages, calcium-rich vegetables, and beans. However, their calcium intake is still lower than the Dietary Reference Intake for their age. Considering a recent study showing that calcium-rich food has a better effect on bone mineral density than calcium supplements, Chinese Americans should increase their calcium intake mainly through calcium-rich foods in order to reduce their risk of osteoporosis.

To introduce calcium-rich foods into Chinese American's diet, family interaction should be considered. Besides the wife, the husband and children also have a powerful influence on food choice behaviors. Mothers may consider maintaining a positive social environment to be more important than introducing healthful food. The concept of family is of greater importance than individual gratification in Chinese people's life. Therefore, it is important to study how family members negotiate different food preferences and make food choices for shared meals, before a nutrition education intervention to increase calcium intake can be designed.

This study is composed of three steps. In the first step, we used focus groups to explore the factors influencing adult Chinese Americans' dairy product consumption. The questions of particular interest to us were a) how family members and friends influence food choices and b) how sex and marital status affect the factors influencing dairy consumption. In the focus groups, we interviewed young, unmarried adult men and women as well as older, married men and women. By separating the focus group participants according to sex and marital status, we were

able to identify different factors associated with dairy product consumption for males vs. females and single vs. married people. From the results of the first step, we learned that family members had an important influence on food choices for both married and single adults. In the second step, we examined the family food system and the influence of family members on food choices in more depth. We interviewed both husband and wife in 20 Chinese American families and learned about their family food system, family members' food preferences, and possible meals into which calcium-rich foods could be introduced. Based on the information from the first two steps, we designed the final step, a nutrition education intervention. Considering that Chinese American women have a higher risk of osteoporosis than men, we chose married Chinese American women with a child/children as our target to tap into possible increased risk perception of osteoporosis among peri-menopausal and early menopausal women. Our final step was designed to increase Chinese American mothers' calcium and vitamin D intake through food sources. Recipes introduced in the intervention were chosen based on the information about meal and snacking patterns from the second step.

### ***Theoretical Models***

The three steps proposed above were conducted based on theoretical models. Theoretical models help researchers effectively design interview questions and nutrition education interventions. The objective of the first step (the focus groups) was to investigate dairy product consumption of adult Chinese Americans and the reasons associated with their consumption or non-consumption. We used a model of individual behavior to design the focus group questions since we held discussions with only one member of a household or family. The Health Belief Model, the Trans-theoretical Model with stages of change, and the Theory of Planned Behavior are models of individual health behavior. The Health Belief Model has been used to explain

change in, and maintenance of, health related behaviors, such as cigarette smoking behavior and AIDS-related behaviors, and as guidelines for nutrition education interventions (Strecher and Rosenstock, 1997). The Trans-theoretical Model (stages of change) proposes that behaviors change through a series of five stages: pre-contemplation, contemplation, preparation, action, and maintenance. Precontemplation is the stage where one has no intention to change behavior in the foreseeable future. Contemplation is the stage where one is aware of the problem and is seriously thinking about changing behavior but has not yet made a commitment to take action. Preparation is the stage where one intends to take action in the next month. Action is the stage where one modifies the behavior in order to overcome their problem. Maintenance is the stage where one works to prevent relapse and strengthens the gains attained during the action stage. This model has been used in areas such as cigarette smoking, alcohol and substance abuse (Prochaska et al., 1997). After reviewing these models, we chose the Theory of Planned Behavior to guide the first step (the focus groups). This theory will be described in more details in the following section. The objective of the second step (couple interviews) was to investigate the family food system and the influence of family interaction on food choices. We used a model of interpersonal health behavior to guide the couple interviews. Social Networks, Social Support Concepts, and Social Cognitive Theory are models of interpersonal health behavior. Social Networks and Social Support Concepts explain the structure, processes, and functions of social relationships and have been used to guide health education interventions (i.e., designed to increase the social support for high risk pregnant women and designed to increase mammography screening in African American women) (Heaney and Israel, 1997). Since the reciprocal determinism principal, a component of Social Cognitive Theory, is more appropriate for research on family interaction, we decided to use this as the theoretical basis for the couple interviews. The objective of the third step (the intervention) was to increase calcium intake in Chinese American mothers and to evaluate the effect of the intervention. The intervention focused on increasing calcium-rich food

intake at breakfast, lunch, snacks, and desserts, which are not influenced as much by family members' preferences as are dinners. We decided to use a model of individual behavior to design the nutrition education lessons. Since information collected in the first step was considered when designing the intervention and Theory of Planned Behavior was used in the first step, this theory was selected as a theoretical guide for the final intervention.

#### Theory of Planned Behavior

The Theory of Planned Behavior has been successfully used to explain nutrition behaviors, such as dairy product consumption, milk consumption, weight loss, and mother's intention to limit frequency of infant's sugar intake (Kim et al., 2003; Park and Ureda, 1999; Schifter and Ajzen, 1985; Beale and Manstead, 1991). This suggests the Theory of Planned Behavior could provide a framework for understanding the beliefs that explain consumption or non-consumption of dairy products in Chinese American population. According to this theory, one's behavior is determined by one's behavioral intention, which is influenced by three factors: attitude toward the behavior, subjective norm, and perceived behavioral control. Attitude toward the behavior is one's favorable or unfavorable attitude toward the performance of that behavior. This factor is further explained by two beliefs: the consequences of performing the behavior and evaluation of these consequences. The second factor, subjective norm, reflects whether one's social environment supports or does not support one's performance of the behavior. This factor is further influenced by two beliefs: what one's family, friends, or health professionals think one should do or should not do and one's motivation to comply with them. The third factor, perceived behavioral control, reflects how easy or difficult it is for one to perform some behavior. It is affected by perceived likelihood of facilitating or constraining conditions and the perceived effect of these conditions in performance of some behavior (Park and Ureda, 1999; Montano et al., 1997).



Figure 1-1 shows a proposed relationship between the three explanatory factors and dairy product consumption.

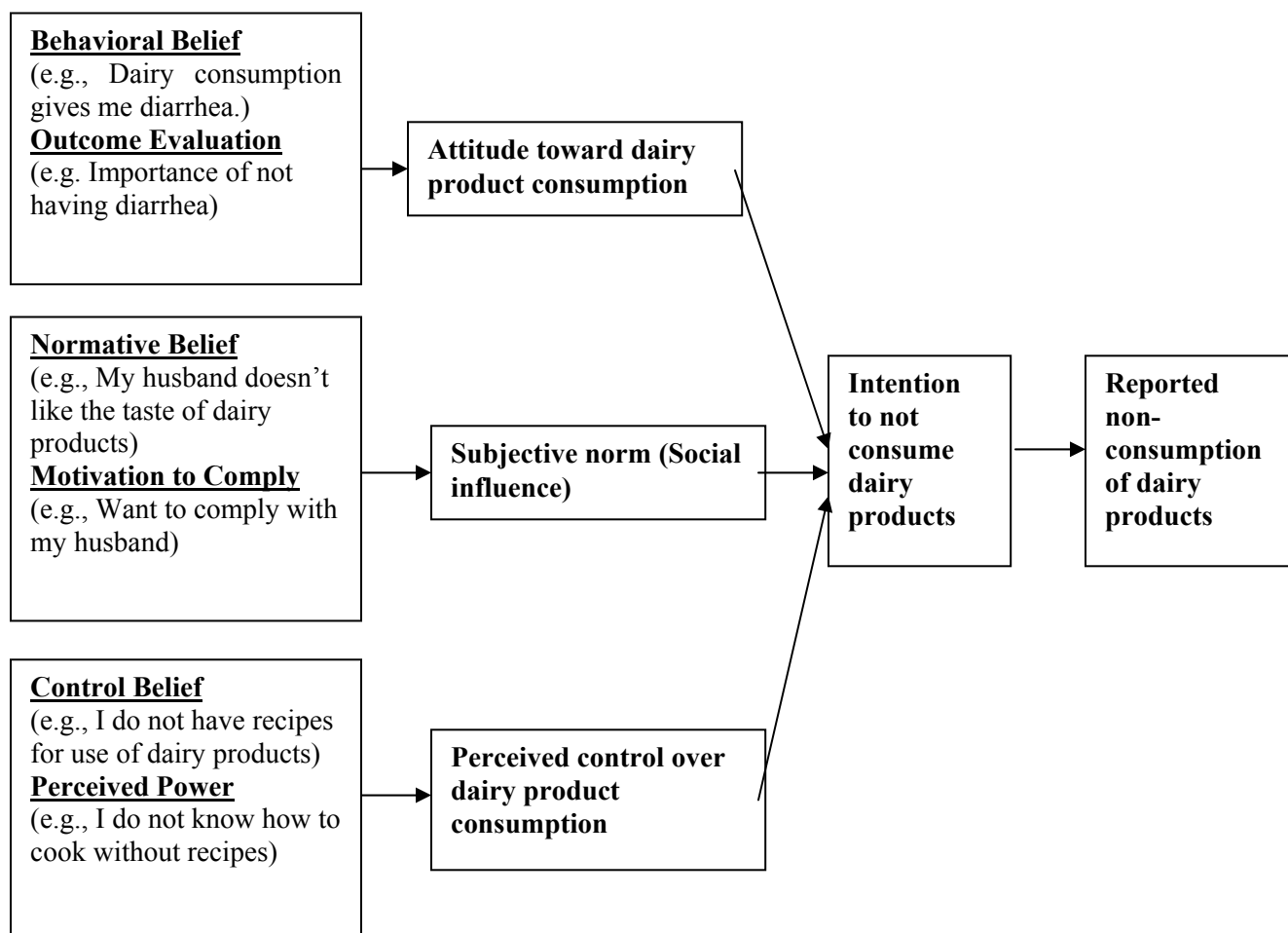


Figure 1-1: Theoretical framework of the Theory of Planned Behavior for explaining dairy product non-consumption.

#### Social Cognitive Theory and Reciprocal Determinism Model

Social Cognitive Theory explains both the psychosocial factors affecting health behaviors and strategies for changing these behaviors (Baranowski et al., 1997). Therefore, it can provide a theoretical basis for understanding the psychosocial factors associated with Chinese Americans' food choices.

Social Cognitive Theory includes a series of concepts: the environment, situation, behavioral capability, expectations, expectancies, self-control, observational learning, reinforcements, self-efficacy, emotional coping responses, and reciprocal determinism. In reciprocal determinism, three factors (people's behavior, environmental factors, and people's personal characteristics) influence each other (Baranowski et al., 1997). See Figure 1-2. A change in one factor is influenced by the other two factors; the change in one factor will also affect the status of the other two factors. In addition, the interaction among these three factors is different for different persons and different behaviors being studied.

Reciprocal determinism has been used by nutrition educators to explore or change people's behavior, within the context of both the environment and the individuals populating that environment, rather than assuming individuals are isolated from their environment (Edmundson et al., 1996a; Baranowski et al., 1993; Kirby et al., 1995). In the study of Edmundson et al. (1996a), the researchers used Social Cognitive Theory, including the concept of reciprocal determinism, to plan and implement a school-based intervention (the CATCH program) in order to improve the dietary and physical activity behaviors of children and adolescents. The study involved 96 schools (40 control schools and 56 intervention schools) at four study sites. Among 56 intervention schools, 28 schools received only the school-based intervention, while the remaining 28 schools received both the school-based intervention and the home-based intervention. The intervention focused on personal, environmental, and behavioral factors. The approaches related to reciprocal determinism were behavioral modeling, skills education, self-performance, reinforcement, eliciting social support, goal setting, social norm setting, and improved availability of conditions for the performance of the behaviors, such as accessible physical education equipment and low-fat food choices in the school cafeteria. The results of the study showed that the CATCH program significantly improved dietary knowledge, dietary intentions, self-efficacy, usual food choice, and perceived social reinforcement for healthy dietary

behaviors. Results of the first year data showed that the school-plus-home based intervention had a significantly greater influence on intentions to eat healthy foods and usual food choices than the school based intervention. Dietary knowledge and perceived social support for healthful food choices were slightly, but not significantly, higher in the school-plus-home based intervention than in the school-based intervention (Edmundson et al., 1996b). However, results of three years' data showed that the only significant difference between the effect of the school-based intervention and the school-plus-home based intervention was the effect on dietary knowledge. Students in the school-plus-family intervention had significantly higher scores on dietary knowledge than students in the school-based intervention (Edmundson et al., 1996a). The authors considered that the powerlessness of the family component of the intervention might be due to two reasons: a) several behaviors targeted by CATCH might need longer and greater family involvement and b) parents might not have been sufficiently involved in the family program (Edmundson et al., 1996a).

In contrast to the above intervention, the Treatwell 5-a-Day program found significantly greater effect of family based intervention. The Treatwell 5-a-Day program used Social Cognitive Theory on both the intrapersonal level and the interpersonal level (Sorensen et al., 1998). This program was designed to increase fruit and vegetable consumption in the US worksite population. Twenty-two worksites were randomly divided into three groups: a minimal intervention group, a worksite intervention, and a worksite-plus-family intervention. The minimal intervention group served as a control and received the core intervention that was also offered to the other two groups. Besides the core intervention, the worksite intervention group and the worksite-plus-family intervention group received 3 intervention elements designed to change individual behavior and the worksite environment. The worksite-plus-family intervention group also received a written learn-at-home program, a family newsletter, an annual family festival, and materials mailed to families. The duration of the intervention was 19.5 months. At

the end of the intervention, the worksite-plus-family intervention group increased fruit and vegetable intake by 19% (about 0.5 servings); the worksite intervention group increased fruit and vegetable intake by 7% (about 0.2 servings); and the control group did not change their fruit and vegetable intake. The authors concluded that worksite intervention involving family members is a successful method to increase fruit and vegetable consumption (Sorensen et al., 1999).

However, household support for participants who lived with others was not significantly increased in any of the three intervention groups. The increase in fruit and vegetable intake in the worksite-plus-family intervention group may be only due to the larger amount of education information and activities received by the worksite-plus-family intervention group. Most family components of the intervention, except the annual family festival, received by the worksite-plus-family group were delivered through written materials. Therefore, we do not know if these materials were actually used by family members. In addition, the increase of 0.3 serving of fruit and vegetable intake in the worksite-plus-family intervention group compared to the worksite intervention group was not practically meaningful. This small increase became statistically significant probably only due to the large sample size.

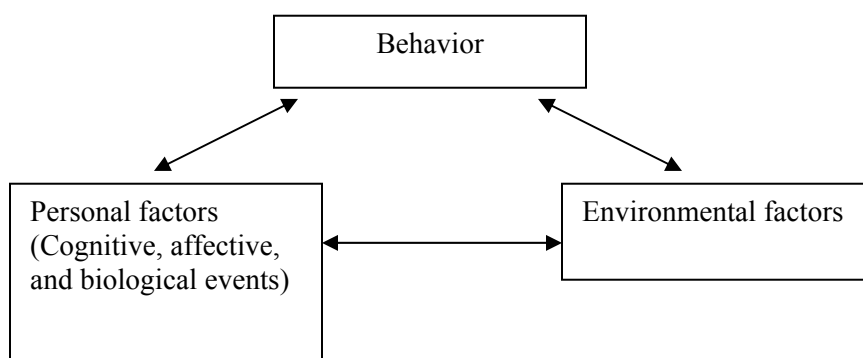


Figure 1-2: Theoretical framework of the reciprocal determinism principle.

Baranowski and Hearn (1997) expanded the reciprocal determinism concept and developed a Reciprocal Determinism Model that could be used in studies to implement family dietary change (shown in Figure 1-3). In a family, there are 2 or more family members. As shown in Figure 1-3, the relationship between family member 1 and 2 could be parent and child, sibling and sibling, or husband and wife. Each family member has his or her own personal characteristics, such as food preferences, expectations about the outcome desired, self-efficacy, and skills. These personal characteristics determine dietary behaviors and dietary behaviors reciprocally influence these personal characteristics (Baranowski, 1990).

According to this version of the model, there are three ways in which family members influence each other in dietary change: family functioning, supportive behaviors, and mechanics of food production in the home (Baranowski and Hearn, 1997). All three of these interact to provide an environment in which food choice is enacted. Family functioning is the overall pattern of family interaction and bonding whereby family members adapt to each other in order to form an intolerable to a highly pleasant family environment. Family functioning and family members' personal characteristics influence each other: family functioning reflects and shapes personal characteristics. For example, a stubborn father or child could request the same food items constantly and resist the introduction of new foods. If given into, this will reinforce the inflexibility of the father or child. The family environment is also where supportive behaviors do or do not emerge and food production occurs. Behaviors of family members can be either supportive or not supportive. Family member personal characteristics influence social support and also home food production. Social support and the mechanics of food production in the home in turn shape family member personal characteristics. The mechanics of food production covers activities from food procurement to food preparation by individuals for themselves and other family members. Food availability (what foods are bought) determines how foods are

prepared, and further determines what foods are available at home (Baranowski and Hearn, 1997).

We used Baranowski's Reciprocal Determinism Model for the couple interviews (second step) and the Theory of Planned Behavior for the focus groups (first step) and nutrition education intervention planning and implementation (third step).

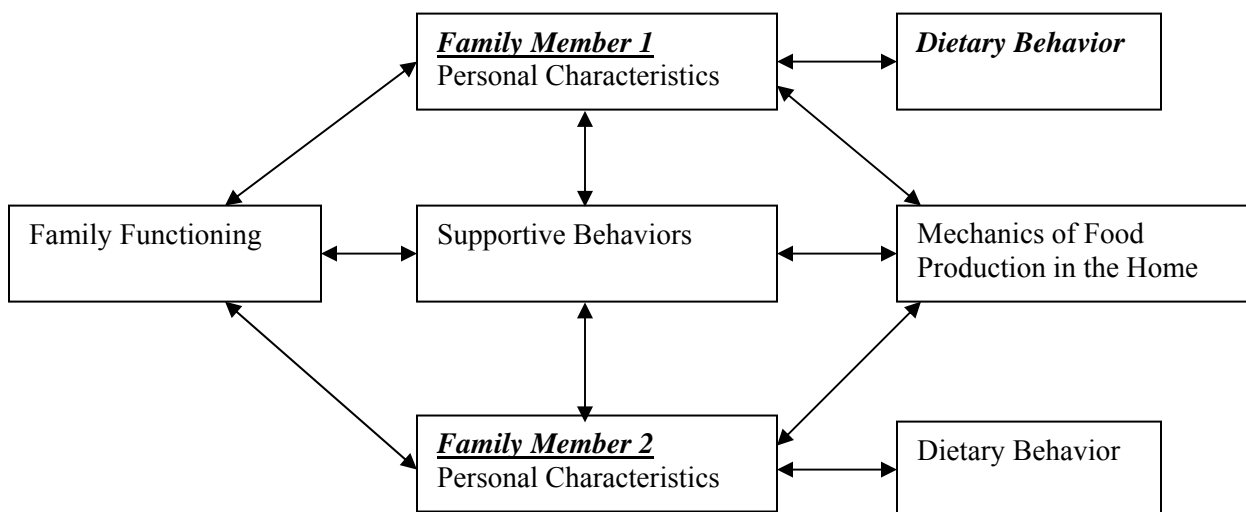


Figure 1-3: Reciprocal Determinism Model relating family and individual characteristics.

### ***Nutrition Education Intervention Hypotheses (Third Step)***

Results of the focus group interviews (first step) showed that the Theory of Planned Behavior constructs (attitudes, social influence, and perceived behavior control) influenced dairy product consumption. To maximally increase calcium intake, we needed to investigate Chinese Americans' family food system, including the use of dairy products, through couple interviews (second step). Based on the results of the first two steps, our nutrition education intervention was designed to increase Chinese American women's calcium and vitamin D intake based on the Theory of Planned Behavior. See Figure 1-4.

Figure 1-4 shows a proposed relationship between the three explanatory factors and calcium-rich food consumption.

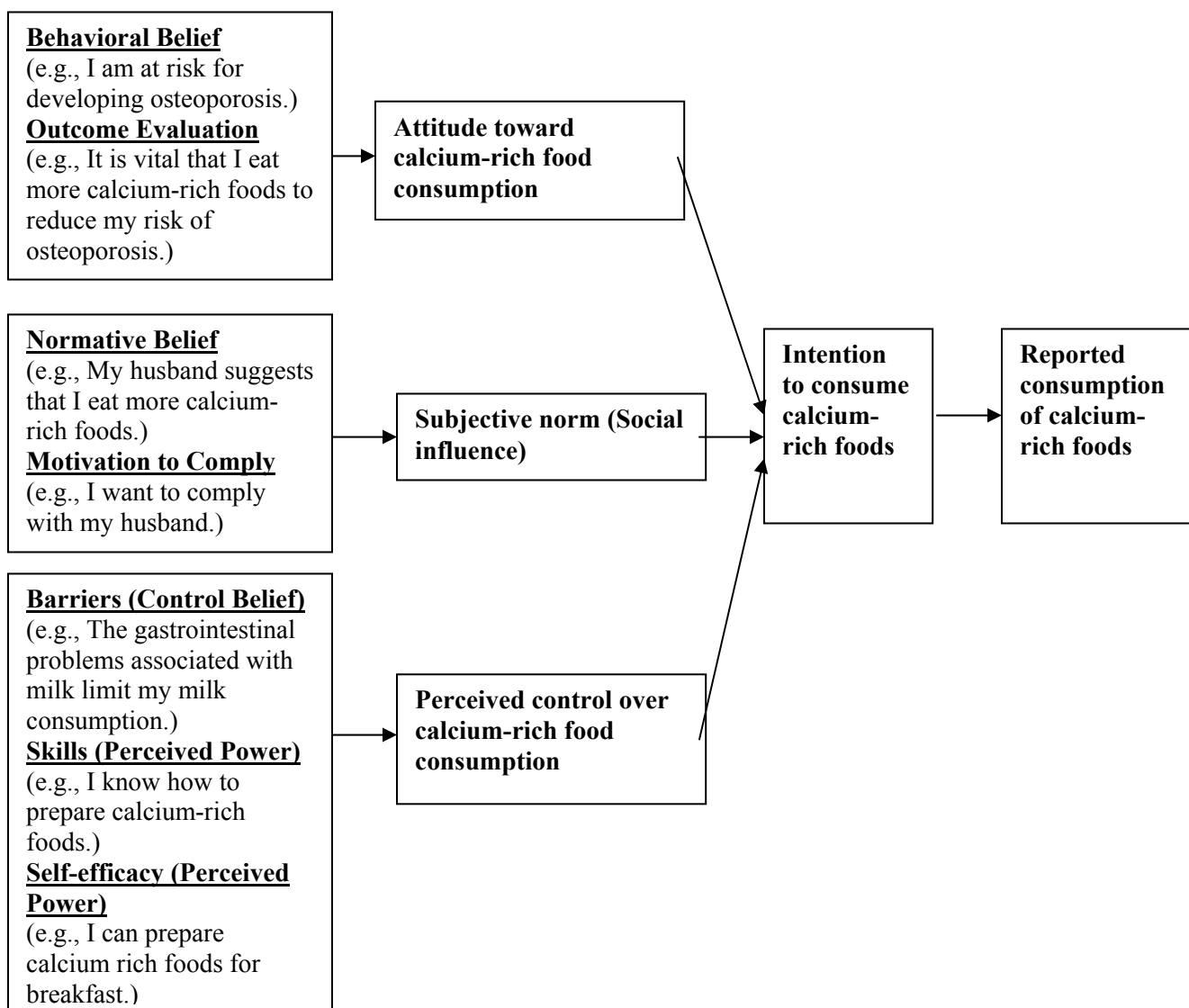


Figure 1-4: Theoretical framework of the Theory of Planned Behavior for explaining calcium-rich food consumption.

Although the intervention focused on influencing attitudes towards, and perceived behavioral control over, consuming calcium-rich foods, social support was also encouraged. Four questionnaires (an outcome questionnaire measuring theory constructs, a food frequency

questionnaire assessing calcium and vitamin D intake, a knowledge questionnaire, and a stage of change questionnaire) were used to evaluate the effect of the intervention. I expect to observe an improvement in all theory constructs, an increase in daily dietary calcium and vitamin D intake, improved knowledge, and a higher stage of change for dairy products in the experimental group. I hypothesized:

H1: Mean score of the behavioral belief scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H2: Mean score of the outcome evaluation scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H3: Mean score of the normative belief scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H4: Mean score of the motivation to comply scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H5: Mean score of the barrier scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H6: Mean score of the skill scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.



H7: Mean score of the self-efficacy scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H8: Mean score of the intention scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H9: Daily dietary calcium intake will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H10: Daily dietary vitamin D intake will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

Many previous interventions increased knowledge but did not affect behaviors, which suggested that knowledge is easier to influence through education than behaviors. The Trans-theoretical model of behavior change (stages of change) developed by Prochaska and others (1997) has been popularly used in food behavior studies. Researchers found that a higher stage of change for dairy products is associated with greater calcium intake (Gulliver and Horwath, 2001; Tucker et al., 2002; Snelling et al., 2006). Therefore, I hypothesized:

H11: Knowledge will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H12: Stage of eating more dairy products will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

Although our intervention focused on increasing all calcium-rich food intake, dairy products are still considered a major contributor to calcium intake. It is suggested that lactose

intolerance is one of the reasons for low calcium intake in Chinese population. Therefore, I hypothesized:

H13: Increase of daily dietary calcium intake will be significantly higher in self-reported lactose tolerant married Chinese American women in the experimental group than self-reported lactose intolerant married Chinese American women in the experimental group.

Risk of osteoporosis increases with age. This was covered in the nutrition education intervention. Older women may perceive more risk than younger women. Therefore, I expected to observe:

H14: Increase of daily dietary calcium intake will be positively associated with age in married Chinese American women in the experimental group.

## References

Anderson A, Milburn K, Lean M. Food and Nutrition: Helping the Consumer Understand. In: Marshall D, ed. *Food Choice and the Consumer*. London: Chapman and Hall; 1995: 105-128.

Auld G, Boushey CJ, Bock MA, Bruhn C, Gabel K, Gustafson D, Holmes B, Misner S, Novotny R, Peck L, Pelican S, Pond-Smith D, Read M. Perspectives on intake of calcium-rich foods among Asian, Hispanic, and white preadolescent and adolescent females. *J Nutr Educ and Behav*. 2002; 34:242-251.

Babbar RK, Handa AB, Lo CM, Guttmacher SJ, Shindlecker R, Chung W, Fong C, Ho-Asjoe H, Chan-Ting R, Dixon LB. Bone health of immigrant Chinese women living in New York City. *J Community Health*. 2006; 31:7-23.

Backett K. The construction of health knowledge in middle class families. *Health Educ Res*. 1992; 7:497-507.

Backett K, Davison C, Mullen K. Lay evaluation of health and health life-styles: evidence from three studies. *Br J Gen Pract*. 1994; 40:277-280.

Baran D, Sorensen A, Grimes J, Lew R, Karellas A, Johnson B, Roche J. Dietary modification with dairy products for preventing vertebral bone loss in premenopausal women: a three-year prospective study. *J Clin Endocrinol Metab*. 1989; 70:264-270.

Baron JA, Beach M, Wallace K, Grau MV, Sandler RS, Mandel JS, Heber D, Greenberg ER. Risk of prostate cancer in a randomized clinical trial of calcium supplementation. *Cancer Epidemiol Biomarkers Prev*. 2005;14(3):586-589.

Baranowski T. Reciprocal determinism at the stages of behavior change: An integration of community, personal and behavior perspectives. *Int Q Community Health Educ*. 1990; 10:297-327.

Baranowski T, Domel S, Gould R, Baranowski J, Leonard S, Treiber F, Mullis R. Increasing fruit and vegetable consumption among 4<sup>th</sup> and 5<sup>th</sup> grade students – results from focus groups using reciprocal determinism. *J Nutr Educ*. 1993; 25:114-120.

Baranowski T, Hearn MD. Health behavior interventions with families. In: Gochman DS, ed. *Handbook of Health Behavior Research IV. Relevance for Professionals and Issues for the Future*. New York, NY: Plenum Press; 1997:303-323.

Baranowski T, Perry CL, Parcel GS. How individuals, environments, and health behavior interact; social cognitive theory. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:153-178.

- Beale D, Manstead A. Predicting mothers' intentions to limit frequency of infants' sugar intake: Testing the theory of planned behavior. *J Appl Soc Psychol.* 1991; 21:409-431.
- Biloukha OO, Utermohlen V. Healthy eating in Ukraine: attitudes, barriers and information sources. *Public Health Nutr.* 2001; 4: 207-215.
- Birch LL. Effect of peer model's food choices and eating behaviors on pre-schoolers food preferences. *Child Dev.* 1980; 51:489-496.
- Birch LL. Children's food preferences: Developmental patterns and environmental influences. *Ann Child Dev.* 1987; 4:171-208.
- Birch LL, Fisher JA. Appetite and Eating Behavior in Children. In: Gaull GE, ed. *The Pediatric Clinics of North America: Pediatric Nutrition.* Philadelphia, PA: W. B. Saunders; 1995:931-953.
- Birch LL, Zimmerman SI, Hind H. The influence of social-affective context on the formation of children's food preferences. *Child Dev.* 1980; 51:856-861.
- Borah-Giddens J, Falciglia GA. A meta-analysis of the relationship in food preferences between parents and children. *J Nutr Educ.* 1993; 25:102-107.
- Chan GM, Arlot ME, Delmas PD, Meunier PJ. Effect of dairy products on bone and body composition in pubertal girls. *J Pediatr.* 1995; 126:551-556.
- Chan MF, Ko CY, Day MC. The effectiveness of an osteoporosis prevention education programme for women in Hong Kong: a randomized controlled trial. *J Clin Nurs.* 2005; 14(9): 1112-1123.
- Charles N, Kerr M. *Women, Food and Families.* Manchester University Press, Manchester; 1988.
- Chen JL, Weiss S, Heyman MB, Vittinghoff E, Lustig R. Pilot study of an individually tailored educational program by mail to promote healthy weight in Chinese American children. *J Spec Pediatr Nurs.* 2008; 13(3):212-222.
- Chen W, Chen SC, Hsu HS, Lee C. Counseling clinic for pediatric weight reduction: Program formulation and follow-up. *J Formos Med Assoc.* 1997; 96(1): 59-62.
- China Animal Husbandry Industry Website. The quick development of Chinese dairy product industry. Available at <http://www.china-ah.com/news/2004/06/18/34146.html>. Accessed January 31, 2009.
- Chiu JF, Lan SJ, Yang CY, Wang PW, Yao WJ, Su IH, Hsieh CC. Long-term vegetarian diet and bone mineral density in postmenopausal Taiwanese women. *Calcif Tissue Int.* 1997; 60:245-249.
- Conner M. Accounting for gender, age and socioeconomic differences in food choice. *Appetite.* 1994; 23:195.
- Crockett S, Mullis R, Perry CL, Luepker RV. Parent education in youth-directed nutrition intervention. *Prev Med.* 1989; 18:475-491.

Davis GC, White TL, Yang A. A bone health intervention for older adults living in residential settings. *Res Nurs Health*. 2006; 29 (6): 566-575.

De Bourdeaudhuij I. Perceived family members' influence on introducing healthy food into the family. *Health Educ Res*. 1997; 12:77-90.

De Bourdeaudhuij I, Van Oost P. Family members' influence on decision making about food: differences in perception and relationship with healthy eating. *Am J Health Promot*. 1998; 13:73-81.

DeSimone DP, Stevens J, Edwards J, Shary J, Gordon L, Bell NH. Influence of body habitus and race on bone mineral density of the midradius, hip and spine in aging women. *J Bone Miner Res*. 1989; 4:827-830.

Edmonston B, Passel JS. Immigration and ethnicity: The integration of America's newest arrivals. Washington, DC: The Urban Institute Press; 1994.

Edmundson E, Parcel GS, Feldman HA, Elder J, Perry CL, Johnson CC, Williston BJ, Stone EJ, Yang M, Lytle L, Webber L. The effect of the child and adolescent trial for Cardiovascular health upon psychosocial determinants of diet and physical activity behavior. *Prev Med*. 1996a; 25:442-454.

Edmundson E, Parcel GS, Perry CL, Feldman HA, Smyth M, Johnson CC, Layman A, Bachman K, Perkins T, Smith K, Stone E. The effects of the child and adolescent trial for cardiovascular health intervention on psychosocial determinants of cardiovascular disease risk behavior among third-grade students. *Am J Health Promot*. 1996b; 10:217-225.

Feunekes GIJ, de Graaf C, Meyboom S, van Staveren WA. Food choice and fat intake of adolescents and adults: Associations of intakes within social networks. *Prev Med*. 1998; 27: 645-656.

Foxman E, Tansuhaj P, Ekstrom K. Adolescents' influence in family purchase decisions: a socialization perspective. *J Business Res*. 1989; 18:159-172.

Gerrior S, Bente L. Nutrient Content of the U.S. Food Supply. 1909-1994. Home Economics Research Report No. 53. Washington, DC: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1997.

Giovannucci E, Rimm EB, Wolk A, Ascherio A, Stampfer MJ, Colditz GA, Willett WC. Calcium and fructose intake in relation to risk of prostate cancer. *Cancer Res*. 1998; 58:442-447.

Gulliver P, Horwath CC. Assessing women's perceived benefits, barriers, and stage of change for meeting milk product consumption recommendations. *J Am Diet Assoc*. 2001; 101(11):1354-1357.

Harvard School of Public Health. Calcium & milk. Available at <http://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/calcium-full-story/index.html>. Accessed January 31, 2009.

Haverberg L, Kwon PH, Scrimshaw NS. Comparative tolerance of adolescents of differing ethnic backgrounds to lactose-containing and lactose-free dairy drinks. I. Initial experience with a double-blind procedure. *Am J Clin Nutr.* 1980; 33:17-21.

Heaney CA, Israel BA. Social networks and social support. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice.* 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:179--205.

Heaney RP. Calcium, dairy products and osteoporosis. *J Am Coll Nutr.* 2000; 19:83S-99S.

Heaney RP. Calcium Supplementation and Incident Kidney Stone Risk: A Systematic Review. *J Am Coll Nutr.* 2008; 27:519-527

Heaney RP, Dowell MS, Rafferty K, Bierman J. Bioavailability of the calcium in fortified soy imitation milk, with some observations on method. *Am J Clin Nutr.* 2000;71(5):1166-9.

Hertzler SR, Savaiano DA. Colonic adaptation to daily lactose feeding in lactose maldigesters reduces lactose intolerance. *Am J Clin Nutr.* 1996; 64:232-236.

Ho SC, Leung PC, Swaminathan R, Chan C, Chan SSG, Fan YK, Lindsay R. Determinants of bone mass in Chinese women aged 21-40 years. II. Pattern of dietary calcium intake and association with bone mineral density. *Osteoporosis Int.* 1994; 4:167-175.

Hu JF, Zhao XH, Jia JB, Parpia B, Campbell TC. Dietary calcium and bone density among middle-aged and elderly women in China. *Am J Clin Nutr.* 1993; 58:219-227.

Huang SH, Weng KP, Hsieh KS, Ou SF, Lin CC, Chien KJ, Liu PY, Ho TY. Effects of a classroom-based weight-control intervention on cardiovascular disease in elementary-school obese children. *Acta Paediatr Taiwan.* 2007; 48(4):201-206.

Ikeda JP, Mitchell RA, Brown G, Turner B, West E. Identifying and overcoming barriers to milk and milk production consumption among California Asian-Americans. In *Dietitians, Captains of the Future, Program Booklet.* 1994. California Dietetic Association Annual Meeting, Poster Session 29 April, 1994.

Jackson RD, LaCroix AZ, Gass M, Wallace RB, Robbins J, Lewis CE, Bassford T, Beresford SA, Black HR, Blanchette P, Bonds DE, Brunner RL, Brzyski RG, Caan B, Cauley JA, Chlebowski RT, Cummings SR, Granek I, Hays J, Heiss G, Hendrix SL, Howard BV, Hsia J, Hubbell FA, Johnson KC, Judd H, Kotchen JM, Kuller LH, Langer RD, Lasser NL, Limacher MC, Ludlam S, Manson JE, Margolis KL, McGowan J, Ockene JK, O'Sullivan MJ, Phillips L, Prentice RL, Sarto GE, Stefanick ML, Van Horn L, Wactawski-Wende J, Whitlock E, Anderson GL, Assaf AR, Barad D. Calcium plus vitamin D supplementation and the risk of fractures. *N Engl J Med.* 2006; 354(7):669-683.

Jackson KA, Savaiano DA. Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *J Am Coll Nutr.* 2001; 20:198S-207S.

- Jiang YD, Chuang LM, Wu HP, Shiau SJ, Wang CH, Lee YJ, Juang JH, Lin BJ, Tai TY. Assessment of the function and effect of diabetes education programs in Taiwan. *Diabetes Res Clin Pract.* 1999; 46(2): 177-182.
- Johnson AO, Semanya JG, Buchowski MS, Enwonwu CO. Adaptation of lactose maldigesters to continued milk intakes. *Am J Clin Nutr.* 1993; 58:879-881.
- Kim KW, Reicks M, Sjoberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav.* 2003;35:294-301.
- Kirby SD, Baranowski T, Reynolds LD, Taylor G, Binkley D. Children's fruit and vegetable intake – socioeconomic, adult-child, regional, and urban-rural influences. *J Nutr Educ.* 1995; 27:261-271.
- Kirk MC and Gillespie AH. Factors affecting food choices of working mothers with young families. *J Nutr Educ.* 1990; 22:161-168.
- Koh KA, Sesso HD, Paffenbarger RS Jr, Lee IM. Dairy products, calcium and prostate cancer risk. *Br J Cancer.* 2006;95(11):1582-1585.
- Kristal AR, Stanford JL, Cohen JH, Wicklund K, Patterson RE. Vitamin and mineral supplement use is associated with reduced risk of prostate cancer. *Cancer Epidemiol Biomarkers Prev.* 1999; 8:887-92.
- Lau EMC. Osteoporosis in Asians – the role of calcium and other nutrients. *Challenges of Modern Medicine.* 1995; 7:45-54.
- Lauderdale D, Kuohung V, Chang SL, Chin MH. Identifying older Chinese immigrants at high risk for osteoporosis. *J Gen Intern Med.* 2003; 18:508-515.
- Lee MM, Lee F, Ladenla SW, Mike R. A semiquantitative dietary history questionnaire for Chinese Americans. *Ann Epidemiol.* 1994a; 4(3):188-197
- Lee MM, Wu AW, Whittemore AS, Zheng S, Gallagher R, Teh C, Zhou L, Wang X, Chen K, Ling C, Jiao D, Jung D, Paffenbarger RS. Comparison of dietary habits, physical activity and body size among Chinese in North America and China. *Int J Epidemiol.* 1994b; 23: 984-990.
- Liao EY, Wu XP, Deng XG, Huang G, Zhu XP, Long ZF, Wang WB, Tang WL, Zhang H. Age-related bone mineral density, accumulated bone loss rate and prevalence of osteoporosis at multiple skeletal sites in Chinese women. *Osteoporos Int.* 2002; 13:669-676.
- Lips P. Vitamin D physiology. *Prog Biophys Mol Biol.* 2006; 92(1):4-8.
- Liu AL, Hu XQ, Ma GS, Cui ZH, Pan YP, Chang SY, Zhao WH, Chen CM. Report on childhood obesity in China (6) Evaluation of a classroom-based physical activity promotion program. *Biomed Environ Sci.* 2007; 20(1):19-23.
- Liu X, Zhao X, Xu L. Food sources of calcium and iron in the diet of Beijing elderly. *Wei Sheng Yan Liu.* 2004; 33:336-338.

- Lonnquist LE, Weiss GL, Larsen DL. Health value and gender in predicting health protective behavior. *Women Health*. 1992; 19:69-85.
- Lv N, Brown JL, Liu BF. Factors influencing dairy product consumption of Chinese Americans in Pennsylvania. *Topics In Clinical Nutrition*. 2007; 22: 259-271.
- Lv N, Cason K. Dietary pattern change and Acculturation of First Generation Chinese Americans in Pennsylvania. *Journal of the American Dietetic Association*. 2004; 104: 771-778.
- Ma FC, Contento IR. Development and formative evaluation of a nutrition education curriculum aimed at reducing fat intake in Taiwan elementary students. *J Nutr Educ*. 1997; 29 (5): 237-243.
- MacKelvie KJ, McKay HA, Khan KM. Lifestyle risk factors for osteoporosis in Asian and Caucasians girls. *Med Sci Sports Exerc*. 2001; 33:1818-1824.
- Madsen J, Sallis JF, Rupp JW, Senn KL. Process variables as predictors of risk factor changes in a family health behavior changes program. *Health Educ Res*. 1993; 8:193-204.
- Manios Y, Moschonis G, Katsaroli I, Grammatikaki E, Tanagra S. Changes in diet quality score, macro- and micronutrients intake following a nutrition education intervention in postmenopausal women. *J Hum Nutr Diet*. 2007;20:126-31.
- Melton LJ III. Adverse outcomes of osteoporotic fractures in the general population. *J Bone Miner Res*. 2003; 18:1139-41.
- Miller GD, Jarvis JK, McBean LD. Handbook of dairy foods and nutrition. 2nd ed. Boca Raton, FL: CRC Press LLC; 2000:4.
- Montano DE, Kasprzyk D, Taplin SH. The theory of reasoned action and the theory of planned behavior. In: Glanz K, Lewis FM, Rimer BK, eds. Health behavior and health education: Theory, research, and practice. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:85-112.
- Nader PR, Sallis JF, Patterson TL, Abramson IS, Rupp JW, Senn KL, Atkins CJ, Roppe BE, Morris JA, Wallace JP, Vega WA. A family approach to cardiovascular risk reduction: results from the San Diego Family Health Project. *Health Educ Q*. 1989; 16:229-244.
- Napoli N, Thompson J, Civitelli R, Armamento-Villareal RC. Effects of dietary calcium compared with calcium supplements on estrogen metabolism and bone mineral density. *Am J Clin Nutr*. 2007; 85(5):1428-1433.
- National Academy of Sciences. Dietary Reference Intakes (RDIs), 1997-1998. Available at <http://www.utexas.edu/courses/ntr311/nutinfo/RDIchart.html>. Assessed January 31, 2009.
- National Osteoporosis Foundation. America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation. Washington, DC; 2002.
- Neilson LA. A qualitative exploratory study of food consumption behaviour of Chinese Canadians [dissertation]. Guelph, Ontario, Canada: The University of Guelph; 1995.



- Newman JM, Linke R. Chinese immigrant food habits: A study of the nature and direction of change. *R Soc Health J*. 1982; 102(6):268-271.
- Nicklas TA. Calcium intake trends and health consequences from childhood through adulthood. *J Am Coll Nutr*. 2003; 22:340-356.
- Nicklas TA, Baranowski T, Baranowski JC, Cullen K, Rittenberry L, Olvera N. Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption. *Nutr Rev*. 2001; 59:224-235.
- Nilas L, Christiansen C. Bone mass and its relationship to age and the menopause. *J Clin Endocrinol Metab*. 1987; 65:697-702.
- Pan WH, Lee MMS, Yu SL, and Huang PC. Foods predictive of nutrient intake in Chinese diet in Taiwan: II. Vitamin A, vitamin B1 vitamin B2, vitamin C and calcium. *Int J Epidemiol*. 1992; 21:929-934.
- Park K, Ureda JR. Specific motivation of milk consumption among pregnant women enrolled in or eligible for WIC. *J Nutr Educ Behav*. 1999; 31:76-85.
- Park SY, Paik HY, Skinner JD, Ok SW, Spindler AA. Mothers' acculturation and eating behaviors of Korean American families in California. *J Nutr Educ Behav*. 2003; 35:142-147.
- Perman JA, Dudley BS. Dairy products: try them – you'll like them? *Am J Clin Nutr*. 1998; 68:995-996.
- Pill R, Parry O. Making changes - women, food and families. *Health Educ J*. 1989; 48:51-54.
- Pribila BA, Hertzler SR, Martin BR, Weaver CM, Savaiano DA. Improved lactose digestion and intolerance among African-American adolescent girls fed a dairy-rich diet. *J Am Diet Assoc*. 2000; 100:524-528.
- Prochaska JO, Redding CA, Evers KE. The transtheoretical model and stages of change. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:60-84.
- Pun KK, Chan LWL, Chung V, Wong FHW. Calcium content of common food items in Chinese diet. *Calcif Tissue Int*. 1991; 48:153-156.
- Renner E, Hermes M, Stracke H. Bone mineral density of adolescents as affected by calcium intake through milk and milk products. *Int Dairy J*. 1998; 8:759-764.
- Roberts M, Wortzel L, Berkeley R. Mothers' attitudes and perceptions of children's influence and their effect on family consumption. *Adv Consumer Res*. 1981; 8:730-735.
- Rodriguez C, McCullough ML, Mondul AM, Jacobs EJ, Fakhrabadi-Shokoohi D, Giovannucci EL, Thun MJ, Calle EE. Calcium, dairy products, and risk of prostate cancer in a prospective cohort of United States men. *Cancer Epidemiol Biomarkers Prev*. 2003; 12:597-603.

- Rolnick SJ, Kopher R, Jackson J, Fischer LR, Compo R. What is the impact of osteoporosis education and bone mineral density testing for postmenopausal women in a managed care setting? *Menopause*. 2001; 8:141-148.
- Rorick MH, Scrimshaw NS. Comparative tolerance of elderly from differing ethnic backgrounds to lactose-containing and lactose-free dairy drinks: a double-blind study. *J Gerontol*. 1979; 34:191-196.
- Rozin P, Riklis J, Margolis L. Mutual exposure or close peer relationships do not seem to foster increased similarity in food, music or television program preferences. *Appetite*. 2004; 42: 41-48.
- Savaiano D. Lactose intolerance: A self-fulfilling prophecy leading to osteoporosis? *Nutr Rev*. 2003; 61: 221-223.
- Schifter DF, Ajzen I. Intention, perceived control, and weight loss: an application of the theory of planned behavior. *J Pers Soc Psychol*. 1985;49:843-851.
- Shon SP, Ja DY. Asian families. In: McGoldrick M, Pearce JK, Giordano J, eds. *Ethnicity and Family Therapy*. 1<sup>st</sup> ed. New York, NY: the Guilford Press; 1982:208-228.
- Snelling AM, Adams TB, Korba C, Tucker L. Stage of change algorithm for calcium intake by male college students. *J Am Diet Assoc*. 2006; 106(6):904-907.
- Sorensen G, Hunt MK, Cohen N, Stoddard A, Stein E, Phillips J, Baker F, Combe C, Hebert J, Palombo R. Worksite and family education for dietary change: the Treatwell 5-a-Day program. *Health Educ Res*. 1998; 13:577-591.
- Sorensen G, Stoddard A, Peterson K, Cohen N, Hunt MK, Stein E, Palombo R, Lederman R. Increasing fruit and vegetable consumption through worksites and families in the treatwell 5-a-day study. *Am J Public Health*. 1999; 89:54-60.
- Spindler AA, Schultz JD. Comparison of dietary variety and ethnic food consumption among Chinese, Chinese-American, and White American women. *Agric Human Values*. 1996; 13:64-73.
- Stafleu A, Vanstaveren WA, Degraaf C, Burema J, Hautvast JGAJ. Family resemblance in beliefs, attitudes and intentions towards consumption of 20 foods – a study among 3 generations of women. *Appetite*. 1995; 25: 201-216.
- Strecher VJ, Rosenstock IM. The health belief model. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:41-59.
- Suarez FL, Adshead J, Furne JK, Levitt MD. Lactose maldigesters tolerate ingestion of a dairy-rich diet containing approximately 1500 mg calcium/day. *Am J Clin Nutr*. 1998; 68:1118-1122.
- Suarez FL, Savaiano DA. Diet, genetics, and lactose intolerance. *Food Technol*. 1997; 51:74-76.

Suarez FL, Savaiano D, Arbisi P, Levitt MD. Tolerance to the daily ingestion of two cups of milk by individuals claiming lactose intolerance. *Am J Clin Nutr.* 1997; 65:1502-1506.

Sun WY, Sangweni B, Chen J, Cheung S. Effects of a community-based nutrition education program on the dietary behavior of Chinese-American college students. *Health Promot Internation.* 1999; 14:241-249.

Swagerty DL, Walling AD, Klein R. Lactose intolerance. *Am Fam Physician.* 2002; 65:1845-1850.

Tian HG, Nan Y, Hu G, Dong QN, Yang XL, Pietinen P, Nissinen A. Dietary survey in a Chinese population. *Eur J Clin Nutr.* 1995; 49:26-32.

Tucker LJ, Snelling AM, Adams TB. Development and validity of a stage of change algorithm for calcium intake for college female students. *J Am Coll Nutr.* 2002; 21:530-535.

Tussing L, Chapman-Novakofski K. Osteoporosis prevention education: Behavior theories and calcium intake. *J Am Diet Assoc.* 2005; 105 (1): 92-97.

Umberson D. Gender, marital status and the social control of health behavior. *Soc Sci Med.* 1992; 34:907-917.

Unger M, Scrimshaw NS. Comparative tolerance of adults of differing ethnic backgrounds to a lactose-free and lactose-containing dairy drink. *Nutr Res.* 1981; 1:227-233.

U.S. Census Bureau a. Census 2000 Summary File 1, Matrices P3, P4, PCT4, PCT5, PCT8, and PCT11. QT-P3. Race and Hispanic or Latino: 2000. Available at [http://factfinder.census.gov/bf/?\\_lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=01000US.html](http://factfinder.census.gov/bf/?_lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=01000US.html). Accessed January 31, 2009.

U.S. Census Bureau b. Census 2000 Summary File 1 (SF 1) 100-Percent Data. QT-P3. Race and Hispanic or Latino: 2000. Available at [http://factfinder.census.gov/bf/?\\_lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=04000US42.html](http://factfinder.census.gov/bf/?_lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=04000US42.html). Accessed January 31, 2009.

Van Gundy K. Gender and intergenerational transmission of alcohol use patterns: An analysis of adult children in Moscow. *Subst Use Misuse.* 2002; 37: 65-87.

Walker J, Ball M. Increasing calcium intake in women on a low-fat diet. *Eur J Clin Nutr.* 1993; 47:718-723.

Walker MD, Babbar R, Opotowsky A, McMahon DJ, Liu G, Bilezikian JP. Determinants of bone mineral density in Chinese-American women. *Osteoporos Int.* 2007; 18:471-478.

Wardle J, Haase AM, Steptoe A. Gender differences in food choice: the contribution of health beliefs and dieting. *Ann Behav Med.* 2004; 27:107-116.

Weaver CM. Calcium bioavailability and its relation to osteoporosis. *Proc Soc Exp Biol Med.* 1992; 200:157-160.

Weaver CM. Calcium. In: Bowman BA, Russell RM, eds. *Present Knowledge In Nutrition*. 8<sup>th</sup> ed. Washington, DC: ILSI Press; 2001:273-280.

Weaver CM, Proulx WR, Heaney R. Choices for achieving adequate dietary calcium with a vegetarian diet. *Am J Clin Nutr*. 1999; 70:543S-548S.

Whiting SJ, Wood RJ. Adverse effects of high-calcium diets in humans. *Nutr Rev*. 1997; 55 (1): 1-9.

Woo J, Leung SSF, Ho SC, Sham A, Lam TH, Janus ED. Influence of educational level and marital status on dietary intake, obesity, and other cardiovascular risk factors in a Hong Kong Chinese population. *Eur J Clin Nutr*. 1999; 53:461-467.

Worsley A, Lea E. Consumers' personal values and sources of nutrition information. *Ecol Food Nutr*. 2003; 42:129-151.

Wu X, Cao T, Zhu Y. Effects of dietary pattern modification on blood pressure over in a work site intervention program. *Zhonghua Xinxueguanbing Zazhi*. 1999; 27(1):22-25.

Wu XP, Liao EY, Zhang H, Dai RC, Shan PF, Cao XZ, Liu SP, Jiang Y. Determination of age-specific bone mineral density and comparison of diagnosis and prevalence of primary osteoporosis in Chinese women based on both Chinese and World Health Organization criteria. *J Bone Miner Metab*. 2004; 22:382-391.

Xia SC, Zhang XW, Xu SY, Tang SM, Yu SH, Aldinger C, Glasauer P. Creating health-promoting schools in China with a focus on nutrition. *Health Promot Int*. 2004; 19 (4): 409-418.

Yan YX. *Private life under socialism: love, intimacy, and family change in a Chinese village, 1949-1999*. Stanford, CA: Stanford University Press; 2003: 91-102.

Yeh L, Chen CH, Wang CJ, Wen MJ, Fetzer SJ. A preliminary study of a healthy-lifestyle-promoting program for nursing students in Taiwan. *J Nurs Educ*. 2005; 44(12): 563-565.

Yeh L, Lu FH, Wang CJ. A preliminary study on the health promotion outcomes of high-risk hypertensive freshmen. *Kaohsiung Journal of Medical Sciences*. 2002; 18(11): 557-565.

Zhang Q, Ma GS, Zhu K, Zhang CY, Foo LH, Fraser DR, Greenfield H. Dairy products consumption and calcium intakes of Chinese urban adolescent girls. *Asia Pac J Clin Nutr*. 2004; 13:S83.

## Chapter 2

### **Factors influencing dairy product consumption of Chinese Americans in Pennsylvania<sup>1</sup>**

#### **Abstract**

Factors influencing Chinese Americans' dairy consumption were determined from eight focus groups, stratified by marital status and sex, conducted with a script based on the Theory of Planned Behavior. Participants ate only  $1.5 \pm 1.1$  servings of dairy daily. Their consumption was influenced by taste and convenience (personal attitudes), preferences and advice of family members and friends (subjective norm), and many barriers (perceived behavioral control). Dairy products preferred fit into breakfast, snacks, or were ingredients in fast foods. Participants lacked ability to cook with dairy products to different degrees. Barriers to consumption included traditional dietary habits, unfamiliarity with many dairy products, high price, and unacceptable taste and fat content. Strategies to address these findings are suggested.

#### **Introduction**

Dairy products provide important nutrients and health benefits. They are a good source of calcium and vitamin D (Gerrior and Bente, 1997; Miller et al., 2000). Recommended intakes of dairy products are associated with reduced risk of osteoporosis (Heaney, 2000; Renner et al., 1998), hypertension (Nowson et al., 2005; Sacks et al., 2001), and colon cancer (Miller et al., 2000; Kampman et al., 2000). In addition to calcium and vitamin D, dairy products also supply potassium, magnesium, and vitamin A that were low in the diets of American adults and children,

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according to Dietary Guidelines for Americans 2005 (US Department of Health and Human Services and US Department of Agriculture, 2005).

Despite the health value of dairy products, consumption has dropped at least partly due to increasing competition from soft drinks (Vartanian et al., 2007; Rampersaud et al., 2003) and supplements (Dawson-Hughes et al., 2002; Radimer et al., 2004). Current dairy product intake of most Americans is below the Dietary Guideline recommendations of 3 servings per day (US Department of Health and Human Services and US Department of Agriculture, 2005; Fulgoni et al., 2004). The United States is becoming more multicultural due to immigration and dairy products now need to appeal to more cultural groups. The US Asian population, the majority of whom are Chinese (US Census Bureau, 2000a), has grown to a significant market sector. In 2000, there were about 2.4 million Chinese Americans in the United States, having increased by 50%, since 1990 (US Census Bureau, 2000b). This increase in the Chinese American population makes it timely for health professionals to explore their dairy intake and risk of osteoporosis.

Chinese immigrant's dietary patterns often lack dairy products. Although Chinese Americans increase their dairy product consumption after immigration (Lee et al., 1994; Lv and Cason, 2004), they still do not consume recommended amounts of dairy products (MacKelvie et al., 2001; Jackson and Savaiano; 2001; Auld et al., 2002). In addition, Chinese Americans have a comparatively high risk of osteoporosis. A study of 300 Chinese American women aged 40 to 90 years in New York City reported an osteoporosis rate of 55% (Babbar et al., 2006). Another study conducted among 469 Chinese Americans in Chicago's Chinatown found that more than half the people aged 60 years or older were at high risk for osteoporosis because of extremely low bone density (Lauderdale et al., 2003). Osteoporosis causes serious disability and increased medical cost in the US (National Osteoporosis Foundation, 2002; Melton, 2003) despite the fact that increasing calcium and vitamin D intake can reduce one's risk. Consuming recommended amounts of dairy products is an efficient way to reduce this risk because of their high calcium

content and bioavailability, enrichment with vitamin D, and comparatively low price (Nicklas, 2003). Therefore, health educators have recommended that Chinese Americans consume more dairy products (Jackson and Savaiano, 2001). However, little is known of Chinese American views of dairy products and their consumption. When little information is available, focus groups are an efficient way to gather data.

Theoretical models can help researchers design effective focus group interview questions. The Theory of Planned Behavior (TPB) has been successfully used to explain various health behaviors (Park and Ureda, 1999; Giles et al., 2004; Stokes et al., 2006). A model composed of the TPB constructs explained about 50% of the variation in milk consumption among pregnant women, with beliefs about “quenching thirst” and “taste” being important predictors (Park and Ureda, 1999). TPB constructs explained about 72% of the variation in intention to donate blood, with self-efficacy and perceived control being the important predictors (Giles et al., 2004). A focus group study designed using the TPB suggested that attitudes and peer influence could be important precursors to adolescents’ oral health practices (Stokes et al., 2006). According to this theory, one's behavior is determined by one's behavioral intention, which is influenced by three factors: attitude toward the behavior, subjective norm, and perceived behavioral control (Park and Ureda, 1999). Sex and marital status also have an influence on food choices and health behaviors (Wardle et al., 2004; Umberson, 1992). We conducted focus groups, using the TPB as the theoretical framework. Our objectives were to investigate the factors associated with Chinese Americans’ dairy product consumption and how sex and marital status might influence these factors.

## **Methods**

The authors' University Institutional Review Board approved the data collection methods.

### ***Participants***

Adults were recruited to represent one of four possible demographic groups (single females, married females, single males, and married males) and to capture any difference in their perceptions. Participants had to meet the following criteria: a) first or second generation Chinese Americans, b) 21 to 65 years old, c) contributes to grocery shopping (serving as 'go-for', helper, or shopper), and d) buys or eats dairy products at least once a month. The last criterion allowed us to capture a range of consumption. We used in-person meetings and presentations at Chinese schools, Chinese churches, and Chinese grocery stores in the Philadelphia, Pittsburgh, and State College areas for recruitment. Of 147 people who expressed interest, 131 were qualified. After the location and time for the focus groups were set, 61 adults who were available at the specific date and time and lived within 30 miles of the focus group location were invited and, of these, 60 adults attended the focus groups.

### ***Instruments***

Participants completed a demographic questionnaire and a food frequency questionnaire (FFQ) after securing informed consent. The 14-item FFQ, used to measure dairy product intake in the past six months, was modeled after that used by Kim et al (Kim et al., 2003). Ten food items in this FFQ were obtained from Block's FFQ whose validity and reliability were moderate to high (Boucher et al., 2006; Kim et al., 2002; Subar et al., 2001). Four dishes made with milk



or cheese were added to capture more intake. The demographic questionnaire measured age, household composition, education, participants' self-perceived lactose intolerance status, and year immigrated.

### ***Focus Group Procedure***

The focus group questions were developed and organized around four topics that addressed the three constructs of the TPB. Packages of dairy products were used to facilitate the discussion of two topics. Table 2-1 shows the topics, questions, and dairy products displayed. The focus group procedure was pre-tested with 8 Chinese students at the authors' university. Based on their feedback, minor changes were made in the script and the wording and formatting of the FFQ.

Eight focus groups were conducted, two with each demographic group, with 5 to 9 participants per discussion. These were held in meeting rooms in Chinese schools, churches, and a community organization in Pittsburgh (n=2 focus groups), Philadelphia (n=4 focus groups), and State College (n=2 focus groups). Four focus groups were conducted in Mandarin and four in English, reflecting participants' preference. Each discussion lasted about 2 hours. Participants completed the instruments prior to the discussion.

Two trained moderators took turns conducting the discussions using a script of open-ended questions (plus probes such as "Tell me more about that", "What do you like/dislike about it", "Anything else", "What kind of fruit flavor", "You mean...", and "What made you think so") as outlined in Table 2-1. Discussions were audio taped while the assistant moderator took notes. Participants received a cash gift at the end of the session. Moderators were trained through review of focus group manuals, observing and discussing procedures with experienced focus group moderators and conducting the pre-test session.

Table 2-1: Focus group topics, questions, and dairy products displayed.

Topics	Focus group questions
<b>Reasons for acceptance/rejection of dairy products<sup>a</sup></b>	<ul style="list-style-type: none"> <li>- Which ones do you buy or eat?</li> <li>- What are your reasons for buying or eating them?</li> <li>- Which of these don't you buy or eat?</li> <li>- What are the reasons for not buying or eating these?</li> </ul>
<b>Influence of family members<sup>a</sup></b>	<ul style="list-style-type: none"> <li>- How do the likes and dislikes of family members affect your use of dairy products?</li> <li>- What do your children seem to like about those dairy products that you buy?</li> <li>- What do other adults in your household like about those dairy products you buy?</li> <li>- What do your children seem to dislike among this group?</li> <li>- What do other adults in your household dislike about any of these?</li> <li>- Whose opinion carries the most weight in your decision to buy?</li> <li>- How well do US dairy products fit into meals or dishes served in your home?</li> </ul>
<b>Desired dairy products<sup>b</sup></b>	<ul style="list-style-type: none"> <li>- What would make any of these products more appealing to you?</li> </ul>
<b>Information channel<sup>a</sup></b>	<ul style="list-style-type: none"> <li>- When new dairy products designed for Chinese tastes are produced, how would you like to learn about them?</li> </ul>

<sup>a</sup> Dairy products displayed: reduced fat milk, whole fat milk, chocolate milk, UHT milk, lactose free milk, canned milk, organic milk, yogurt, yogurt drink, ice cream, frozen yogurt, American cheese, cottage cheese, shredded cheese, pudding.

<sup>b</sup> No dairy products displayed.

### *Data Analysis*

Qualitative data: The audiotapes were transcribed verbatim. Thematic analysis with constant comparison was conducted using each group session as the unit of analysis (Glaser and Strauss, 1967). The senior researcher generated a thematic coding list that reflect the constructs of the TPB, based on two focus group transcripts from one demographic group. Two graduate researchers then coded the remaining focus group transcripts independently using the coding list and adding to it as themes emerged. The senior researcher checked themes using purposefully selected focus group scripts. Ultimately themes were enlarged or subsumed as supra themes

evolved within groups. Reliability was established using Holsti's (1969) formula. The agreement ranged from 0.8 to 0.92, showing that the coding list was reliable. Disagreements were discussed and new or adjusted coding categories applied to all transcripts. Data were tagged and then interpreted using Folio View (version 4.4, 2003, NextPage Inc, Lehi, UT), an information-processing program. One graduate researcher wrote thematic summaries for married males and females and the other for single males and females. The senior researcher crosschecked these summaries and then final summaries of each marital/sex group and commonalities across groups were written.

Quantitative data: Demographic and food frequency data were analyzed using the SPSS system (version 10.0 for windows, 1999, SPSS Inc, Chicago, IL). Demographic questions were described using descriptive statistics. In the FFQ, number of servings of each dairy product consumed per day was calculated by multiplying frequency by amount. Table 2-2's footnote lists all products and their standard serving sizes. Then, total number of servings of dairy products consumed per day was calculated.

## **Results**

### ***Participant Characteristics***

Demographic information is shown in Table 2-2. Perhaps because the topic was dairy products, most participants who volunteered were not lactose intolerant.

These Chinese Americans consumed  $1.5 \pm 1.1$  servings of dairy products per day mainly as fluid cow's milk (0.6 servings/day), sliced cheese or cheese cubes (0.2 servings/day) and ice cream (0.2 servings/day). Males ( $1.8 \pm 1.3$ ) consumed significantly more servings of dairy products per day than females ( $1.1 \pm 0.8$ ) ( $F=5.440$ ;  $df=1$ ;  $p=0.023$ ). The dairy products each

sex/marital status group reported on the FFQ were those identified as preferred in the focus group discussion with one exception. Although married and single women preferred yogurt drink and yogurt respectively, they reported consuming almost none on the FFQ.

Table 2-2: Demographic information (n = 60).

	Total (n=60)	Married Male (n=16)	Married Female (n=13)	Single Male (n=17)	Single Female (n=14)
Number of discussions	8	2	2	2	2
Age	34.2 ± 8.4	37.1 ± 7.5	42.4 ± 5.1	31.5 ± 7.0	26.5 ± 3.9
Years since immigration	16.1 ± 9.2	11.1 ± 6.2	16.5 ± 3.7	18.5 ± 13.0	18.4 ± 8.6
# of people who have child(ren)	22	10	12	0	0
Living arrangement					
With partner	31 (51.7%)	16 (100%)	13 (100%)	1 (5.9%)	1 (7.1%)
With parents	11 (18.3%)	2 (12.5%)	2 (15.4%)	1 (5.9%)	6 (42.9%)
With siblings	1 (1.7%)	0	0	0	1 (7.1%)
With roommates	5 (8.3%)	0	0	2 (11.8%)	3 (21.4%)
Alone	16 (26.2%)	0	0	13 (76.5%)	3 (21.4%)
Education					
Some college	4 (6.7%)	0	2 (15.4%)	0	2 (14.3%)
Vocational/technical school graduate	1 (1.7%)	0	1 (7.7%)	0	0
College graduate	15 (25.0%)	2 (12.5%)	5 (38.5%)	2 (11.8%)	6 (42.9%)
Graduate school	35 (58.3%)	13 (81.3%)	4 (30.8%)	12 (70.6%)	6 (42.9%)
Post graduate	5 (8.3%)	1 (6.3%)	1 (7.7%)	3 (17.6%)	0
Lactose intolerant					
Yes	6 (10.0%)	0	2 (15.4%)	2 (11.8%)	2 (14.3%)
No	43 (71.7%)	11 (68.8%)	11 (84.6%)	12 (70.6%)	9 (61.3%)
Don't know	11 (18.3%)	5 (31.3%)	0	3 (17.6%)	3 (21.4%)
No. of servings of dairy products consumed daily <sup>a</sup>	1.5±1.1	2.1±1.4	1.3±1.0	1.5±1.1	0.9±0.5

<sup>a</sup> 14 products in the FFQ are Fluid cow' milk as a beverage (any fat level) – 1 8-oz glass; Instant breakfast milkshakes like Carnation, diet shakes like Slimfast, or liquid supplements like Ensure – 1 packet/can; Cow's milk on cereal – 1 8-oz cup; Half & Half (e.g. coffee, whipped cream) – 2 tablespoons; Cheese, sliced or in cubes (e.g. cheese on pizza) – 1 slice or 1 oz; Cottage or ricotta cheese – 1/2 cup; Yogurt – 1 8-oz cup; Yogurt drink – 1 8-oz bottle; Ice cream, ice milk, frozen yogurt – 1 scoop or 1/2 cup; Ice cream bars or cones – 1 bar or cone; Mashed potatoes made with milk – 1 cup; Pudding made with milk – 1 4-oz cup; Cream soup made with milk – 1 cup; Macaroni & cheese – 1 cup. Note: For mashed potatoes, pudding and cream soup, the participant could respond to 'if you never made X with milk, please check 'never.'

### ***Thematic Findings***

Our findings are organized to reflect components of attitudes, subjective norm, and perceived behavioral control, reflecting the TPB. Findings common to demographic groups and then any differences are highlighted under each construct.

#### **Attitude toward Dairy Product Consumption**

Quality (taste and texture), nutrition, and convenience drove choices of both married and single adults. Attitudes towards taste and nutrition of dairy products differed somewhat between men and women while attitudes toward convenience did not differ between married and single adults.

**Quality.** When shown a range of dairy products, participants indicated taste was the prime reason for liking certain dairy products (e.g., yogurt, ice cream, etc.). Married men liked whole fat milk and American cheese because whole fat milk tasted better than reduced fat milk, which was compared to “beer without alcohol” and American cheese was “not too cheesy”. Single men also liked American and shredded cheese. In contrast, married and single women preferred reduced fat milk. But married women’s second favorite was yogurt drink while that of single women was American cheese. Both married adults and single women liked the taste of yogurt drink, but single men did not. Married women also preferred fluidly texture of yogurt drink, suggesting the texture was “similar to that of Chinese yogurt.” However single adults preferred the chewy texture of regular yogurt, describing yogurt drink as “too condensed for a drink and too watery for a yogurt”.

All four demographic groups liked ice cream. Among all adults, taste preference outweighed health concerns when choosing ice cream and, among some married and single male adults, when choosing whole fat milk. One single man said, “I guess I see it [ice cream] as a treat. It’s not like the other food. This is something, you know, I want to treat myself.” One

married man noted, “I eat it not because I am concerned about the health issues. Just because it feels cold and tastes good.” Although ice cream’s high fat content appeared to concern some single adults, they still ate ice cream while controlling their total fat intake. Single men chose to “make up for it by drinking 2%”, while single women addressed this concern by consuming ice cream less frequently. One single woman said, “I am eating it like a couple times a month. It’s OK.”

**Nutrition.** Beliefs about calcium content (milk, yogurt, and American cheese) and general health benefits (milk) influenced Chinese adults’ dairy product selection. However, some married women mistakenly thought ice cream was a good source of calcium. Married and single women chose reduced fat milk because they were “afraid of gaining weight”. However, married men did not worry about the fat level, believing that exercise and “being skinny” would offset these calories. Indeed, some single men in one focus group choose whole milk, ice cream and American cheese because they felt the fat or calories in them were needed. One single man said, “I need fat.” Another single man noted, “I eat it (American cheese) for calories.” Dairy product selection was also influenced by the presence of beneficial live cultures in yogurt. Married adults described yogurt as “easy to digest”. Besides beliefs in health benefits, these Chinese adults also felt processing (pasteurization temperature of UHT milk or production of lactose free milk) decreased nutrient content and thought the hormone content of milk posed a risk. One married man said, “Well, since it is high temperature pasteurization and probably vacuum package, the process has probably destroyed a lot of nutrients.” One married woman noted, “I think American girls grow mature very early. Does it have to do with drinking milk? Many researchers said there was a connection.” Married adults were also concerned about the presence of preservatives in the UHT milk.

**Convenience.** Married adults and single women indicated that yogurt drink packaging allows one to “grab and go” for breakfast or lunch, and “take it as a drink” whereas single men

considered yogurt convenient for the former reason. In addition to yogurt, single men considered American cheese, shredded cheese, and ice cream convenient. American cheese is used widely in the fast foods they consume. Ice cream can be eaten anytime as a dessert or snack. Single men who lived alone preferred the perceived longer storage life of reduce fat milk and individually packaged American cheese slices. Married adults viewed large size packages of shredded cheese as inconvenient while single men who lived alone viewed large size packages of milk and cottage cheese as inconvenient. One married woman said, “Sometimes I am hungry for it (shredded cheese). For example, like you said, put some in salad. But we couldn't finish it every time. It is a large package.” One single man noted, “It [cottage cheese] always goes bad before I even finish it. Then I have to throw it out. So it's just one of the things I don't consume fast enough even though I do like it with canned peaches and beets.”

### **Subjective Norm**

Family members and friends were important social influences on food choice of all adults. However, the degree of importance of family members vs. friends varied between married and single adults.

***Family influence.*** Dairy products most preferred by married adults were those preferred by their family members, except reduced fat milk, which was only preferred by married women. Some married men indicated that if grandparents are around, they influence food choices as well. One married man said, “The elderly have some influence on it. Whatever they like, we will just buy.” Another married man noted, “Sometimes, my parents go shopping with my wife. They choose whatever they like.” Married participants reported the wife or couple usually did the major grocery shopping. Some married men did ad hoc (go-for) purchases as needed. While wives made many of the food buying decisions, both husband's and wife's preferences were considered when purchasing dairy products. Buying foods liked by both pleased both. One married woman said, “My husband does eat ice cream, only the vanilla flavor. Nothing else. Kids

like it too. So I always buy vanilla flavor. I buy other flavor ice cream for myself, 'cause I don't like vanilla ice cream.”

However, children's preferences were the most important influence on married adults' choice of dairy products because adults' preferences were more flexible than children's. One married woman said, “Kids are the center of our concerns. Kids like ice cream, and then we will buy it. They want snacks, and then we buy yogurts, which are convenient. My kids like tacos, so we try to make them with shredded cheese. They like mashed potatoes, and we need shredded cheese too.”

Some married women in one focus group indicated that parents could sometimes influence children's choices as well. One married woman said, “But we also influence them. For example, if adults don't introduce pudding or other snack to their diet, they won't have the habit to eat them either. So, they will eat them occasionally, not frequently.” Another married woman noted, “But there is a large variety of yogurt. Some of them contain a lot of colorants, additives, and artificial flavors. We need to control what they eat now and then. Kids only pick whatever looks beautiful and fancy. You just tell them that they can't buy those, especially those with fancy package.”

Both sexes reported that lack of support from their spouse, especially if based on dislike, discouraged people from trying new dairy products. One married woman said, “Sometimes I bought some foods and my husband disliked them. I just put them in there and waited to throw them away at the end. My husband dislikes this very much. So, I am discouraged. I am afraid of trying.”

Parents had significant influence on food choices of single adults including dairy products. Single women indicated sometimes, as children, they had to eat certain foods because their parents, especially their father, said so. One single woman said, “I think why I would eat cheese is because my father said it's good, so I need to eat cheese.” Single adults living at home



reported that, although mothers always grocery shopped, they sometimes helped and they now often eat whatever their mother buys. One single woman said, "...my mom is lactose intolerant. She buys lactose free milk. So I just drink that." One single man noted, "I eat what she buys." Single men reported that when living with family, one thinks about "who else would finish a product"; therefore they had to buy foods that others would eat. Some single women reported their parents were not adventuresome shoppers and avoided unfamiliar products or products they did not like (i.e., sweetened dairy products, cheese, etc.). Not surprisingly, single adults who now live alone felt their own opinions were most important in making choices.

***Friends.*** Both married and single adults considered friends as important sources of information and a friend's recommendation could result in their trying a new food. One married man said, "If I like a dairy product, I will recommend it to my friends at cell meeting. Friends recommendation is a very important channel." One single woman noted, "If we know some people who have tried it before and recommended it, we will buy it." In addition, single adults will change their usual food behaviors when considering friends or significant other's preference and recommendations. One single man said, "You know whenever my fiancé comes to town and she always wants to go to the [store] and gets stuff, [since] I don't make sure that ice cream is part of my shopping list." Another single man noted, "The only time I buy them (American cheeses) is during football season, when we do tailgating, because friends demand cheese on their burgers. I won't do it for myself, but I would buy it. Have it available for them..." Friends' influence at social activities was significant also. One single woman said, "Lots of times when I am with friends, its something fun to do. We are all like 'oh, lets go eat some ice cream'."

### **Perceived Behavioral Control**

This included fit in daily food pattern, skills, barriers to eating more dairy products, and enabling factors. Although there were commonalities, demographic groups did differ in some aspects of behavioral control.

*Fit in daily food pattern.* Most adults described dairy products as snacks (i.e., ice cream and yogurt), beverages (i.e., milk and condensed milk added to tea), fast food components when eating out (i.e., cheese), or breakfast items (i.e., milk on cereal). Single adults also ate dairy products as desserts (i.e., ice cream). Past level of dairy consumption and its current availability influenced present use and fit. Single adults who grew up in the US reported they ate dairy product “almost all the times”, so it fit well in their current food pattern. Dairy product choice now favored things eaten before. One single man said, “I was the one who was born here... It's just inside a lot of foods that you eat.” Some single adults reported that they “grew up drinking milk”. Single adults who immigrated to the US at a later time reported poorer fit of dairy products in their diet. One single man said, “My thought is if you primarily eat Chinese, there is no such thing for Chinese eating dairy products in their meals... So, (for my case) very rarely (dairy).” Another single man noted, “Just milk, ice cream and yogurt, these dairy products fit in. But still can't serve as meal. In my main meal, I won't use them. Just as snacks.” Compared to single adults, married adults seldom ate dairy products when they were young because these were not as available in China then. One married woman said, “When we were in China, if we wanted to buy milk, we had to get up very early to wait in the line.” One married man noted, “There was few milk products in Mainland China (then)...My family had milk delivered to our house daily, but only one small bottle for the whole family.” However, after immigration, the variety and convenience of US dairy products facilitated fit into their diet. One married woman said, “Compared to in China, the amount (of dairy consumption) is larger than before. It is convenient (in US).” One married man noted, “I am westernized. I don't like to cook, so I just eat cheese and drink milk.”

*Skills.* While married men and single women lacked skills to use dairy in cooking, married women and single men did use dairy as ingredients in some dishes. The wife's cooking skills were important among married participants as no married man indicated doing any cooking.

Some married women indicated that certain dairy products had specific uses: a) milk to make steamed buns and cook with Chinese vegetables; b) condensed milk in baking, in tea, “as a dipping for strawberry”, and to eat with bread; c) shredded cheese to make pizza, mashed potatoes, tacos, creamy soup, and spaghetti; and d) American cheese to make sandwiches. However, married women reported cooking with dairy products very infrequently. One married woman said, “Sometimes I use milk to cook with Chinese cabbage. But very rare.” A few single men with some cooking skills used dairy products like shredded cheese to prepare some Western main dishes (i.e., salad, baked ziti, spaghetti, Mexican foods). Some single women used condensed milk in beverages (i.e., tea and coffee). Generally, use of dairy in cooking was very limited in any demographic group.

*Barriers* to eating more dairy foods included the traditional Chinese dietary pattern that uses no dairy products, perceived high fat level and thus high-calorie content (i.e., chocolate milk, cheese), no familiarity with products (i.e., UHT milk, condensed milk, cheese), no need for the product (i.e., UHT, condensed and lactose free milk), high price (i.e., organic and UHT milk, cottage cheese), and unacceptable taste and texture of many dairy products (very sweet taste of chocolate milk and pudding, very watery taste of reduced fat milk, very thick texture of chocolate milk, chunky texture of cottage cheese). These adults had little interest in increasing dairy product consumption. Married men thought it was unnecessary for them to increase dairy consumption. One said, “We have enough nutrients. It's not necessary to change.” In contrast, married women considered being busy, lack of social support, and lactose intolerance symptoms as other barriers. Single women felt one could take pills instead of eating dairy products for calcium needs and were not willing to “complicate current dietary pattern” by adding dairy products. In addition, compared to married men who preferred yogurt drink because of good taste, single men avoided yogurt drinks because of the emphasis on feminine characteristics in advertising and packaging (i.e., bottle shape, package graphic design, color theme, and size). One

said, "It's got a hint of hour glass shape which is I guess what women shoot for. You know, we men don't shoot for that." Another noted, "It's only for girls."

**Enabling Factors.** Both married and single adults suggested that learning how to cook with dairy products, pleasing recipes, free taste testing, and desirable characteristics associated with a dairy product [i.e., good taste (acceptable sweetness and fruity flavors such as strawberry and pineapple or Asian flavors such as red bean, mango, and green tea), nutrition (low fat, low calories, more vitamin and minerals), low price, an appealing package] might motivate them to try dairy products. Education about benefits of dairy products and savvy advertising might motivate repeat purchases. Single adults identified advertising as a powerful persuader. Single men suggested appealing advertising would link drinking milk with success at sports, while single women suggested targeted advertising. One single man underlined the link to sports success as key, "I play a lot of sports. So you see the ads for Gatorade, you know, just like well you see the two dudes running, and this guy can run that much further...But this person drinks water and this person drinks Gatorade. So...visually I am like, ok, there we go. We gotta drink Gatorade. So I mean that totally worked for me." One single woman suggested, "Have a commercial with an Asian person on it with yogurt." Voting for education, one married woman said, "I think there is no need to change milk. People's opinion needs to be changed. You should think that you need to drink more [milk]. Milk doesn't need to be changed." Interestingly, in this sample, married adults and single men requested information on the dairy and health connection and expressed desire for more nutritious dairy products, while single women did not. Table 2-3 summarizes our findings arranged by the TPB constructs.

Table 2-3: A summary of factors important to demographic groups arranged by the TPB constructs.

<b>TPB constructs (Driving forces) – factors influencing demographic groups</b>	<b>MM<sup>a</sup></b>	<b>MW<sup>a</sup></b>	<b>SM<sup>a</sup></b>	<b>SW<sup>a</sup></b>
<b>ATTITUDE</b>				
<b>1. Quality</b>				
• Taste	X	X	X	X
• Texture of yogurt/yogurt drinks		X	X	X
<b>2. Nutrition</b>				
• Beliefs about calcium content and general health benefits	X	X	X	X
• Concern about fat content and weight gain		X		X
• Beliefs about need of fat and calories			X	
• Beliefs about benefits of live culture in yogurt	X	X		
• Beliefs that processing decreases nutrient content	X	X	X	X
• Beliefs about risk of hormone in milk	X	X	X	X
• Concerned about the presence of preservatives in the UHT milk	X	X		
<b>3. Convenience</b>				
• Convenience of yogurt/yogurt drink	X	X	X	X
• Inconvenience of large size package	X	X	X	
<b>SUBJECTIVE NORM</b>				
<b>1. Family</b>				
• Family members' likes	X	X	X	X
• Influence of children's likes	X	X		
• Influence of parent's preferences			X	X
• Lack of support from Family members	X	X		
<b>2. Friends</b>				
• Friends' recommendations and likes	X	X	X	X
<b>PERCEIVED BEHAVIORAL CONTROL</b>				
<b>1. Fit in daily food pattern</b>				
• Dairy fits into breakfast, snacks, beverages, and when eating out	X	X	X	X
• Dairy fits as dessert			X	X
• Dairy does not fit into main meals	X	X	(X) <sup>b</sup>	(X) <sup>b</sup>
<b>2. Skills</b>				
• Have ability to use dairy in cooking		X	X	
<b>3. Barriers</b>				
• Traditional Chinese dietary pattern that uses no dairy	X	X	X	X
• Perceived high fat level and thus high-calorie content	X	X	X	X
• Unfamiliar with some dairy products	X	X	X	X

• No need for certain dairy products	x	x	x	x
• High price of some dairy produces	x	x	x	x
• Unacceptable taste and texture of many dairy products	x	x	x	x
• Too busy to be concerned with dairy		x		
• No perceived need to alter dairy intake	x			x
• Calcium supplements more acceptable				x
• Perceived lactose intolerance symptoms		x		
• Unacceptable advertising and package scheme			x	
<b>4. Enabling factors</b>				
• Cooking skills for dairy products	x	x	x	x
• Pleasing recipes	x	x	x	x
• Free taste testing	x	x	x	x
• Dairy products with desirable characteristics (good taste, nutrition, low price, appealing package)	x	x	x	x
• Targeted advertising			x	x

<sup>a</sup> MM = Married men; MW = Married women; SM = Single men; SW = Single women

<sup>b</sup> Single adults who grew up in the US reported they ate dairy product “almost all the times”. Single adults who immigrated to the US at a later time reported poorer fit of dairy products in their diet.

## Discussion

This qualitative study utilized the TPB framework to investigate dairy product consumption of first and second-generation adult Chinese Americans and to learn the reasons associated with their consumption or non-consumption.

We found this sample of Chinese Americans’ dairy consumption did not meet the Dietary Guidelines recommendations (US Department of Agriculture, 2007) and their level of intake was influenced by attitude toward dairy products, subjective norm, and perceived behavioral control. Convenience and quality (taste, texture) were key influences on attitudes towards acceptable products. They considered milk, yogurt, and cheese to be good calcium sources and thus nutritionally valuable, but for most, taste dictated choice of milk fat level and preference for ice cream. Only women expressed concern about high fat content of whole milk and made choices to

control this. This is consistent with other studies showing consumers would not trade taste for health (Patch et al., 2005; Wansink and Chan, 2001) and that sex affects concern about fat intake (Wardle et al., 2004).

Within subjective norm, family members and friends were important social influences on food choice of all adults, as noted in other ethnic groups (Park and Ureda, 1999; Patch et al., 2005). Nutrition education interventions have used schools and worksites as a venue to distribute information to families and peer groups (Ma and Contento, 1997; Xia et al., 2004; Campbell et al., 2002) and similar approaches might work for Chinese Americans. Family members had more influence on food choice of married adults while friends' influence was stronger for single adults, unless they lived with their parents. In married families, children's preferences were considered most important when food shoppers chose dairy products, which partially agrees with findings in Western European families where children had more influence on high calorie snacks (De Bourdeaudhuij and Van Oost, 1998). In addition to children's preferences, food shoppers also considered both adults' preferences for dairy products. This theme was consistent with other studies indicating that introduction of foods into a family depended on the overall acceptance by all family members (Patch et al., 2005; Brown and Miller, 2002). While young adults living at home appear to bow to parent's choices or please themselves if they live alone, once Chinese Americans marry and have children, the focus of food choices changes to pleasing family food preferences, as noted elsewhere (Beagan and Chapman, 2004).

Limited fit into the daily food pattern, poor cooking skills, many barriers, no perceived need to change intake and weak enabling factors lowered behavioral control of dairy product consumption. Each sex/marital status group lacked skills to cook with dairy products to different degrees. For most, preferred dairy products fit into breakfast or snacks or were eaten in purchased fast food and required no skill or very simple skills to prepare and eat. Only single men appeared to have the freedom and the skills necessary to cook dairy based main dishes.

Most adults, even women who had some cooking skills, felt the traditional Chinese dietary pattern was not mutable in their families and discouraged use of dairy products in main dishes. While they suggested the enabling factors of good recipes, tasting of unfamiliar products, acceptable sweetness, fruity or Asian flavors, availability, low price, and advertising *might* convince them to eat more dairy products, increasing dairy product consumption was not seen as necessary. However, participants', especially young adults', emphasis on the influence of advertising indicates that social marketing media campaigns tailored to Chinese cultural norms could be a way to influence perceptions of need for dairy product intake. Social marketing has been used in many public health campaigns to promote behavioral changes (Grier and Bryant, 2005). For example, a school-based intervention successfully used social marketing skills, such as product positioning, taste testing, point-of purchase-advertising, sales promotion, and a slogan, to increase the consumption of low-fat milk in three elementary schools in a Latino neighborhood (Wechsler, 1998).

Thus, valuing taste and convenience over nutrition, balancing conflicting preferences of family members, and poor behavioral control work together to lower behavioral intent to alter dairy intake patterns within this sample, regardless of sex or marital status. Two studies on dairy products found similar results. Perceived behavioral control was significantly associated with milk and dairy product consumption among Caucasian and African American pregnant women (Park and Ureda, 1999) and Caucasian and African American older adults (Kim et al., 2003). In addition, Park and Ureda (Park and Ureda, 1999) found that spousal influence was a significant predictor of milk consumption. However, Kim et al. (2003) did not find this social influence, probably because many older adults live alone and have less contact with family and friends.

Health educators need to consider the cultural food preferences, social influences, traditional dietary habits, skills, and barriers when designing appropriate interventions to increase dairy product consumption and calcium intake among Chinese populations. Low calcium intake



is one of the correctable risk factors for osteoporosis and fractures. Therefore, helping Chinese populations fit more dairy products into their traditional dietary patterns is important to osteoporosis prevention.

Study limitations include use of a small convenience sample of well-educated, first and second generation Chinese Americans, many of whom claimed to be lactose tolerant. More research is needed with more representative groups of married and single Chinese American adults that include more lactose intolerant individuals.

### **Implications for Research and Practice**

Despite of these limitations, results obtained through this qualitative study do illustrate the utility of the TPB as a framework in identifying factors that need modification to increase behavioral intent. Although it is challenging to increase Chinese American dairy consumption, even if lactose tolerant, health educators can focus on altering attitudes, increasing skills, and reducing barriers within the framework of Chinese cultural food preferences, social influences, and traditional dietary habits. Based on these findings, health care professionals such as dietitians, nutritionists, and nutrition educators should consider –

- Using social marketing campaigns that feature Asian spokes persons and link selected dairy products to better health or performance (for younger adults) or to convenience and desired taste (for older adults). Advertising needs to be tailored to the target audience, because young men in this sample were sensitive to the feminine/masculine tilt of dairy product advertising. Using such campaigns in worksites or communities where Chinese Americans cluster can alter attitudes toward the value of dairy products to health.
- Motivating Chinese Americans to change dietary behaviors by increasing their consciousness about osteoporosis. Free bone scans could be offered through Chinese American

social groups to increase awareness of their low bone mineral density and risk of osteoporosis.

Motivation and inspiration are needed to overcome the cultural hurdles.

- Introducing Chinese Americans to unfamiliar dairy products by offering tasting sessions. For example, lactose free milk could be introduced to those who are lactose intolerant. Dairy products that meet the expectations of convenience and satisfy personal preferences should also be targeted. These Chinese Americans wanted dairy products with qualities that appeal to Chinese (i.e., appropriate sweetness and fruity or Asian flavors). Once they enlarge their horizons by tasting, information about the effect on health might be of more interest.

- In cooperation with Chinese informants, developing simple breakfast or snack recipes using dairy products that fit into the traditional Chinese dietary pattern and having them evaluated by all household members. Recipes that are liked by *all* family members are most likely to be accepted. For young adults living on their own, these new recipes could be tested and then offered at sports events and health clubs.

- Teaching Chinese Americans, especially Chinese American women, skills needed to balance taste, calcium content, and fat content when choosing or cooking with dairy products. For example, adding supplemental nonfat dry milk to low fat or non-fat milk might increase milk and/or calcium consumption (i.e., a tablespoon of non-fat dry milk added to an 8-ounce cup of milk provides an extra 55 mg of calcium). This will not raise concerns about fitting more fluid milk into their dairy food pattern. In addition, low-fat or non-fat milk supplemented with non-fat dry milk may taste better than the original and address their concern about the “watery” taste of reduced fat milk.

## References

Auld G, Boushey CJ, Bock MA, et al. Perspectives on intake of calcium-rich foods among Asian, Hispanic, and white preadolescent and adolescent females. *J Nutr Educ and Behav.* 2002;34:242-251.

Babbar RK, Handa AB, Lo CM, et al. Bone health of immigrant Chinese women living in New York City. *J Community Health.* 2006;31:7-23.

Beagan BL, Chapman GE. Family influences on food choice: context of surviving breast cancer. *J Nutr Educ Behav.* 2004;36:320-326.

Boucher B, Cotterchio M, Kreiger N, et al. Validity and reliability of the Block98 food-frequency questionnaire in a sample of Canadian women. *Public Health Nutr.* 2006;9:84-93.

Brown JL, Miller D. Couple's gender role preferences and management of family food preferences. *J Nutr Educ Behav.* 2002;34:215-223.

Campbell MK, Tessaro I, DeVellis B, et al. Effects of a tailored health promotion program for female blue-collar workers: Health Works for Women. *Prev Med.* 2002;34:313-323.

Dawson-Hughes B, Harris SS, Dallal GE, et al. Calcium supplement and bone medication use in a US medicare health maintenance organization. *Osteoporos Int.* 2002;13:657-662.

De Bourdeaudhuij I, Van Oost P. Family members' influence on decision making about food: Differences in perception and relationship with healthy eating. *Am J Health Promot.* 1998;13:73-81.

Fulgoni VL III, Huth PJ, DiRienzo DB, et al. Determination of the optimal number of dairy servings to ensure a low prevalence of inadequate calcium intake in Americans. *J Am Coll Nutr.* 2004;23:651-9.

Gerrior S, Bente L. Nutrient Content of the U.S. Food Supply. 1909-1994. Home Economics Research Report No. 53. Washington, DC: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1997.

Giles M, McClenahan C, Cairns E, et al. An application of the theory of planned behaviour to blood donation: the importance of self-efficacy. *Health Educ Res.* 2004;19:380-391.

Glaser BG, Strauss AL. The discovery of grounded theory: strategies for qualitative research. Chicago, IL: Aldine de Gruyter; 1967.

Grier S, Bryant CA. Social marketing in public health. *Annu Rev Public Health.* 2005;26:319-39.

Heaney RP. Calcium, dairy products and osteoporosis. *J Am Coll Nutr.* 2000;19:83S-99S.

Holsti OR. Content analysis for the social sciences and humanities. Reading, MA: Addison-Wesley; 1969.

- Jackson KA, Savaiano DA. Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *J Am Coll Nutr*. 2001;20:198S-207S.
- Kampman E, Slattery ML, Caan B, et al. Calcium, vitamin D, sunshine exposure, dairy products and colon cancer risk (United States). *Cancer Causes Control*. 2000;11:459-466.
- Kim J, Chan MM, Shore RE. Development and validation of a food frequency questionnaire for Korean Americans. *Int J Food Sci Nutr*. 2002;53:129-142.
- Kim KW, Reicks M, Sjoberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav*. 2003;35:294-301.
- Lauderdale DS, Kuohung V, Chang SL, et al. Identifying older Chinese immigrants at high risk for osteoporosis. *J Gen Intern Med*. 2003;18:508-515.
- Lee MM, Wu AW, Whittemore AS, et al. Comparison of dietary habits, physical activity and body size among Chinese in North America and China. *Int J Epidemiol*. 1994;23:984-990.
- Lv N, Cason K. Dietary pattern change and Acculturation of First Generation Chinese Americans in Pennsylvania. *J Am Diet Assoc*. 2004;104:771-778.
- Ma FC, Contento IR. Development and formative evaluation of a nutrition education curriculum aimed at reducing fat intake in Taiwan elementary students. *J Nutr Educ*. 1997;29:237-243.
- MacKelvie KJ, McKay HA, Khan KM. Lifestyle risk factors for osteoporosis in Asian and Caucasians girls. *Med Sci Sports Exerc*. 2001;33:1818-1824.
- Melton LJ III. Adverse outcomes of osteoporotic fractures in the general population. *J Bone Miner Res*. 2003;18:1139-41.
- Miller GD, Jarvis JK, McBean LD. Handbook of dairy foods and nutrition. 2nd ed. Boca Raton, FL: CRC Press LLC; 2000:4.
- National Osteoporosis Foundation. America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation. Washington, DC; 2002.
- Nicklas TA. Calcium intake trends and health consequences from childhood through adulthood. *J Am Coll Nutr*. 2003;22:340-356.
- Nowson CA, Worsley A, Margerison C, et al. Blood pressure change with weight loss is affected by diet type in men. *Am J Clin Nutr*. 2005;81:983-989.
- Park K, Ureda JR. Specific motivations of milk consumption among pregnant women enrolled in or eligible for WIC. *J Nutr Educ Behav*. 1999;31:76-85.
- Patch CS, Tapsell LC, Williams PG. Overweight consumers' salient beliefs on omega-3-enriched functional foods in Australia's Illawarra region. *J Nutr Educ Behav*. 2005;37:83-89.

Radimer K, Bindewald B, Hughes J, et al. Dietary supplement use by US adults: Data from the National Health and Nutrition Examination Survey, 1999-2000. *Am J Epidemiol.* 2004;160:339-349.

Rampersaud GC, Bailey LB, Kauwell GP. National survey beverage consumption data for children and adolescents indicate the need to encourage a shift toward more nutritive beverages. *J Am Diet Assoc.* 2003;103:97-100.

Renner E, Hermes M, Stracke H. Bone mineral density of adolescents as affected by calcium intake through milk and milk products. *Int Dairy J.* 1998;8:759-764.

Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. *N Engl J Med.* 2001;344:3-10.

Stokes E, Ashcroft A, Platt MJ. Determining Liverpool adolescents' beliefs and attitudes in relation to oral health. *Health Educ Res.* 2006;21:192-205.

Subar AF, Thompson FE, Kipnis V, et al. Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires - The eating at America's table study. *Am J Epidemiol.* 2001;154:1089-1099.

Umberson D. Gender, marital status and the social control of health behavior. *Soc Sci Med.* 1992;34:907-917.

U.S. Census Bureau. Census 2000 Summary File 1 (SF 1) 100-Percent Data. QT-P3. Race and Hispanic or Latino: 2000a. Available at [http://factfinder.census.gov/bf/\\_lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=04000US42.html](http://factfinder.census.gov/bf/_lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=04000US42.html). Accessed March 26, 2007.

U.S. Census Bureau. Census 2000 Summary File 1, Matrices P3, P4, PCT4, PCT5, PCT8, and PCT11. QT-P3. Race and Hispanic or Latino: 2000b. Available at [http://factfinder.census.gov/bf/\\_lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=01000US.html](http://factfinder.census.gov/bf/_lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=01000US.html). Accessed March 26, 2007.

US Department of Agriculture. MyPyramid Plan. Available at <http://www.mypyramid.gov/mypyramid/index.aspx>. Accessed April 1, 2007.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans, 2005. 6th ed. Washington, DC: U.S. Government Printing Office; 2005.

Vartanian LR, Schwartz MB, Brownell KD. Effects of Soft Drink Consumption on Nutrition and Health: A Systematic Review and Meta-Analysis. *Am J Public Health.* 2007;97: 667-675.

Wansink B, Chan N. Relation of soy consumption to nutritional knowledge. *J Med Food.* 2001;4:145-150.

Wardle J, Haase AM, Steptoe A. Gender differences in food choice: the contribution of health beliefs and dieting. *Ann Behav Med.* 2004;27:107-116.

Wechsler H, Basch CE, Zybert P, et al. Promoting the selection of low-fat milk in elementary school cafeterias in an inner-city Latino community: Evaluation of an intervention. *Am J Public Health.* 1998;88:427-433.

Xia SC, Zhang XW, Xu SY, et al. Creating health-promoting schools in China with a focus on nutrition. *Health Promot Int.* 2004;19:409-418.

### Chapter 3

## Chinese American family food systems: Impact of Western influences<sup>2</sup>

### Abstract

**Objective:** To investigate the family food system in first generation Chinese American families.

**Design:** Qualitative interviews using Reciprocal Determinism constructs to understand influences on food choices.

**Setting:** Weekend Chinese schools in Pennsylvania.

**Participants:** Twenty couples with at least one child aged 5 or older enrolled in a Chinese school in one of three sites in Pennsylvania.

**Phenomenon of Interest:** Factors influencing adoption of Western foods.

**Analysis:** Thematic analysis with constant comparison of interview transcripts and descriptive statistics of demographic data. Families were divided into ‘modified’ and ‘traditional’ patterns based on degree of parental retention of the Chinese dinner pattern.

**Results:** Many Chinese American families consumed convenient American foods at breakfast while they ate mainly Chinese foods for lunch and dinner. Most parents reported their children were picky eaters and learned to prefer Western foods to traditional Chinese foods in institutional settings. Conflicts arose with children’s requests for Western foods disliked by their parents. Parents were especially frustrated about their children’s refusal to eat vegetables. Most struggled to control children’s food choices with inconsistent rules and inequitable rule enforcement at dinner. The father’s view of the importance of the Chinese dinner pattern had the most impact on its retention in the face of children’s demands.

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***Conclusions and implications:*** Chinese American parents established rules backed by parental power to maintain Chinese meal pattern. They appear to need guidance to identify healthful Western foods that satisfy children's preferences while preserving their vegetable intake.

## **Introduction**

Since 1990, the number of Chinese Americans in the US has increased 50% mostly due to immigration, reaching about 2.4 million in 2000 (US Census Bureau, 2000). Chinese account for 23.7% of Asian Americans and are the largest Asian population in the US (US Census Bureau, 2000). Immigrants bring cultural expectations that influence their family food system, which in turn might affect their health status (Kelleher et al., 2006; Darmon and Khat, 2001; Haber, 1997). For instance, a culturally-entrenched reliance on a meat and potatoes diet high in saturated fat among European immigrants has implications for coronary heart disease and illustrates how resistant certain cultural food patterns are to change (Kelleher et al., 2006). Traditional Chinese food patterns focus on vegetables, fruits, meat, and either rice or wheat products with few if any dairy products. This traditional pattern provides less total fat, saturated fat, cholesterol, and calcium than the typical American dietary pattern, and could result in a lower risk of coronary heart disease and a higher risk of osteoporosis (Sun et al., 1999; Jackson KA, Savaiano, 2001). A cross-sectional survey suggested that while this traditional dietary pattern endured in a convenience sample of first generation Chinese immigrants, consumption of less desirable Western foods increased (Lv and Cason, 2004). This may partly explain why Chinese living in the US have higher rates of heart disease and some kinds of cancers than those living in Asia (Campbell et al., 1998; LeMarchand et al., 1997; Yu et al., 1991). However, the prevalence



of osteoporosis is similar for Chinese in the US and in China (Wu et al., 2003; Lauderdale et al., 2003).

In a preliminary study (Lv et al., 2007), we observed that first generation parents and even young, second generation, single adults upheld traditional Chinese food patterns and that family member food preferences appeared to affect willingness to alter food choices as seen by others (Brown and Miller, 2002; De Bourdeaudhuij, 1997). However, in depth data on the Chinese American family food system (the whole process of shopping, preparing, and serving foods) and factors that affect decision making in this process are unavailable. Such data are needed to plan relevant nutrition interventions to reduce the chronic disease risk that emerges on immigration. When information on a family process like management of food choices is lacking, qualitative interviews are a useful tool to gather data.

Theoretical models can provide an effective framework for the design of interview questions. In Social Cognitive Theory, Bandura proposed the concept of ‘reciprocal determinism’ to illustrate how an individual’s behavior, their personal characteristics, and their surrounding environment interact with each other (Baranowski et al., 1997). This concept has been successfully used to explore people’s behavior, within the context of both the environment and the individuals populating that environment, rather than assuming individuals are isolated from their environment (Baranowski et al., 1993; Kirby et al., 1995). Baranowski and Hearn (1997) focused on the family unit as a defined environment and proposed specific family interaction factors or influential behaviors to explain family dietary patterns: family functioning, supportive behaviors, and mechanics of food production in the home. All 3 of these interact with personal characteristics to influence food choices within the family environment. We used this model as our framework to investigate the Chinese American family food system and factors that affect decision making about family food choices.

Although reaching Chinese American families may be a challenge (Sworts and Riccitelli, 1997), Chinese people do cluster in communities upon arrival in the US (Yu, 1995) and many first generation families enroll their children several hours a week in weekend Chinese schools in an effort to maintain Chinese culture and language skills. These schools can provide access to this target audience. Our objective was to examine the food system of a sample of first generation Chinese American families in order to understand what influences food choices and thus dietary intake after immigration. To do this, we conducted couple interviews based on constructs in Baranowski's Reciprocal Determinism Model.

## **Methods**

The Pennsylvania State University Institutional Review Board (IRB) approved the study before data collection.

### ***Participants***

A convenience sample of 20 couples (n=40 individuals) was recruited in-person from Chinese schools in Pittsburgh (3 couples), State College (2 couples) and the Philadelphia area (15 couples). All Chinese schools that the authors could identify in these areas were visited [Philadelphia area (6), Pittsburgh (1), State College (1)]. After an email solicitation yielded no volunteers, recruitment was accomplished by visiting each Chinese school to invite parents who were waiting for their children during class time (about a 2-hour period), to participate in an interview about their family food system. The number of couples recruited from each Chinese school was based on the student body size. The general rule was that one couple was recruited from schools with 75 students or less; 2 couples from those with 76-150 students; 3 couples from

those with 151-299; and 4 couples from those with 300 students or more. In State College, to give the rural area better representation, we recruited 2 couples even though the student body size of the school is only 70. The recruiter approached every fifth parent from entry in the waiting area while classes were in session. Participants had to meet the following criteria: a) Both parents first generation Chinese with at least one child, age 5 years old or older (to insure capture of children's impact on family food choices) and enrolled in the selected Chinese school; b) 21 to 65 years old; c) family ate dinner together at least 4 times a week; and d) both parents willing to be interviewed. Twenty-three out of 40 parents approached expressed interest and 20 were qualified and agreed to participate.

### ***Instruments***

According to the Circumplex Model of Marital and Family Systems (Olson and Gorall, 2003), family flexibility, cohesion, and communication are 3 dimensions that describe family functioning. Family flexibility is expressed through altering or maintaining roles, rules, and power. Communication facilitates family flexibility and cohesion. Because cohesion is used to describe family members' emotional bonding, family flexibility and communication are more relevant for food choice studies. Using Baranowski's Reciprocal Determinism Model (Baranowski T, Hearn, 1997), couple interview questions were developed to address personal *characteristics*, *dietary behavior* as typical meal and snack patterns, *family functioning* [using the flexibility (expressed through roles, rules and power) and communication dimensions of the Circumplex Model of Marital and Family Systems (Olson and Gorall, 2003)], *supportive behaviors*, and *mechanics of food production in the home*. Table 3-1 shows the constructs and final questions in the semi-structured interview. A draft couple interview guide was pre-tested with 4 local Chinese parental couples and revised accordingly. Interviewer training included

reviewing qualitative interview texts, discussing procedures with experienced interviewers, and conducting the pre-test interviews. The senior researcher guided the interviewer by reading and providing feedback on sequential transcripts.

Table 3-1: Couple interview constructs and questions.

<p><b>Couples interviewed together</b>  <b>Constructs:</b> Typical meal (and snack) patterns and Mechanics of food production in the home  - How is food shopping handled in your family?  - How food is prepared in a typical weekday? We can go through meal by meal (breakfast, lunch, dinner, snacks, desserts, and beverage).  - How do meals on weekends differ from those eaten during the week?</p>
<p><b>Couples interviewed separately</b>  <b>Constructs:</b> Family functioning, Personal characteristics, and Supportive behaviors  <b>Roles</b>  - How much of the actual work of shopping and cooking do you do day-to-day?  <b>Power</b>  - How much influence do you feel you have on the choice of foods served at family main meals?  - Whose food likes and dislikes mainly determine the choice of snacks?  - If you liked something and your partner did not like it, how would it affect what is offered at dinner?  - How would it affect what is available for a snack?  - If you liked something and your children did not like it, would it affect what is offered at dinner? As a snack?  <b>Flexibility</b>  - How easy is it to introduce new Chinese foods or dishes into family meals?  - What about the introduction of a Western-style main dish into family meals?  - How willing are you to change what is served at family meals?  - What about your partner? Your children? Your parents? <sup>a</sup>  <b>Rules</b>  - What rules does your family have about foods?  - What rules does your family have about introducing new foods into family meals?  <b>Communication</b>  - How were these rules about foods (served, banned, refused, adopted, etc.) established?</p>

<sup>a</sup> Asked only if an elderly was present in the household.

### ***Couple Interview Procedure***

Interviews were conducted at participants' homes (n=9); in empty classrooms while participants waited for their children at Chinese schools (n=10); and in a meeting room at a community library (n=1). All interviews were conducted in Mandarin (participants' preference) and each lasted about 1.5 hours.

After securing informed consent, each couple was interviewed together and then each partner individually, with order determined by a coin toss. Each parent completed a demographic questionnaire while his or her partner was being interviewed in another private room. One interviewer conducted all the interviews using a script containing the questions listed in Table 3-1 plus probes and the interviews were audio taped. Each couple received a \$30 cash gift after completing the interview.

### ***Data Analysis***

The audiotapes were simultaneously translated from Mandarin into English and transcribed by the graduate researcher who conducted the interviews and is a native Mandarin speaker. A scholar fluent in Mandarin and English checked 15 randomly-selected sets of questions and answers in 3 interviews to confirm the appropriateness of the translation and transcription. Thematic analysis with constant comparison was conducted (Glaser and Strauss, 1967). The senior researcher generated an initial thematic coding list based on 2 couple interview transcripts. The graduate researcher then coded these 2 transcripts independently using the coding list and added to it as topics emerged. Initial coding list reliability was established by comparing the degree of agreement (Holsti, 1969) between independent coding of 2 randomly chosen English transcripts twice (Comparison 1: 84.1% and 87.7% and comparison 2: 81.1% and 82.8%

agreement respectively). Disagreements were resolved. The coding list was adjusted and the final coding scheme was applied by hand to all interviews. The senior and the graduate researcher independently wrote summaries for each construct in each interview, compared the summaries, solved disagreements, and wrote the overall thematic summaries.

These couples were further divided into 2 groups, ‘modified meal plan (MMP)’ (n=10 couples) and ‘traditional meal plan (TMP)’ (n=10 couples). TMP families met the following criterion: both parents ate only Chinese dishes at dinner at home. Families who did not meet the above criterion were assigned to the group with MMP. The reliability of this grouping was established by comparing the results between independent grouping assignments of all transcripts by 2 graduate researchers (85% agreement rate). This study documented use of many foods in the family food system. This report focuses on data relevant to day-to-day meal management.

## **Results**

This was a mostly dual income, well-educated sample representing middle-aged parents (see Table 3-2) with higher education levels than the general Chinese immigrant population (US Census Bureau, 2006). Most participants had immigrated to the US when they were adults to pursue educational training and now held white-collar jobs. On average, parents in the families with MMP had lived about 4-5 years longer in the US than those in the families with TMP. All children, except 4 who came to the US at grade-school age, were born and schooled in the US. Three families had elderly<sup>3</sup> living in the household.

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<sup>3</sup> Elderly means an older aunt or in-law living with the couple.

Table 3-2: Demographic characteristics (n = 20 couples).

	Total sample (n=20 couples)		'Modified' pattern (n=10 couples)		'Traditional' pattern (n=10 couples)	
	Mean	Range	Mean	Range	Mean	Range
Age of women (years)	41.4	33-54	42.1	35-49	40.7	33-54
Age of men (years)	43.6	35-54	44.7	41-53	42.5	35-54
No. of children in each family	1.8	1-3	2.0	1-3	1.6	1-3
Age of children (years)	10.8	0.8-23	11.7	6-23	9.8	0.8-23
No. of children born in US in each family	1.5	0-3	1.7	1-3	1.3	0-3
Husband's length of US residence (years)	17.1	7-28	19.8	11-28	14.4	7-28
Wife's length of US residence (years)	16.0	7-27	18.0	10-27	14.0	7-26
No. of years married (years)	16.2	7-28	17.0	10-25	15.4	7-28
	<b>Number</b>	<b>%</b>	<b>Number</b>	<b>%</b>	<b>Number</b>	<b>%</b>
No. of families with working women	16	80%	9	90%	7	70%
No. of families with working men	20	100%	10	100%	10	100%
No. of families with elderly	3	15%	1	10%	2	20%
<b>Men's education <sup>a</sup></b>						
Some college or vocational training	1	5%	1	10%	0	0%
Graduate or professional school	15	75%	8	80%	7	70%
Postdoctoral work	4	20%	1	10%	3	30%
<b>Women's education <sup>a</sup></b>						
Some college or vocational training	2	10%	2	20%	0	0%
Four-year Bachelor's degree	5	25%	2	20%	3	30%
Graduate or professional school	13	65%	6	60%	7	70%
<b>Annual household income</b>						
\$50,000-\$74,999	6	30%	2	20%	4	40%
\$75,000-\$100,000	4	20%	3	30%	1	10%
Over \$100,000	10	50%	5	50%	5	50%

<sup>a</sup> The seven original options were "11th grade or less"; "High school diploma (12th grade) or GED"; "Some college or vocational training"; "Graduate of vocational/technical school"; "College graduate (4 year Bachelor's Degree)"; "Graduate or professional school (Masters, Ph.D. MPA, JD)"; and "Postgraduate work". Only the options chosen by participants were reported in the table.

Although Baranowski's Reciprocal Determinism Model and the Circumplex Model of Marital and Family Systems were used to develop interview questions, the thematic findings were organized into 3 major themes – family member personal characteristics, family dietary pattern, and family flexibility, similar to Bandura's original reciprocal determinism concept. In the following, we discuss each of these themes plus relevant sub-themes and note differences between the families with MMP and with TMP where evident.

### ***Family Member Personal Characteristics***

#### **Food Preferences**

The contrast between parents' preferences for Chinese foods and children's preferences and demands for specific Western foods was a prominent feature of these interviews. Many parents did not like most Western main dishes (i.e., macaroni & cheese, hot dogs) requested by children. One father with TMP said, "When we shop for foods, we would also buy those semi-manufactured Western foods for them (children), such as barbecue chicken and chicken nuggets... We (adults) seldom eat those foods... I don't eat any of those foods." One mother with MMP noted, "Our kids like Western dishes better than Chinese dishes. But we have already formed our dietary habits. It is hard to change. We can eat Western dishes once or twice a week. We can't eat it often." However, many parents in the group with MMP learned to accept some Western foods (i.e., salad, pasta) or snacks (i.e., coffee cakes, donuts, brownies, cookies, chips). One of these fathers said, "Everybody likes to eat pasta. It is similar to Chinese noodles. We always remember to cook this dish."

In contrast, many children preferred Western foods (i.e., chicken nuggets, spaghetti, and macaroni & cheese) and snacks (i.e., chips, cookies, soda) to traditional Chinese dishes. Ninety



percent of the families in this sample had at least one child who was picky<sup>4</sup> about vegetables, especially Chinese vegetables, and sometimes other foods (i.e., Chinese noodles, dumplings, steamed pork with anchovy). Many parents reported that their children had learned to like some problematic Western foods and snacks after enrollment in American daycare, kindergarten, or school. One mother said, “After they went to daycare...they started to like American foods... As I said, they like to eat sandwiches, pizza, and this kind of food.”

### **Personal Flexibility**

This was evaluated based on the question “how willing are you to change what is served at family meals” plus two probes. Regardless of group, nearly all mothers were willing to change what was served at family dinners (personally flexible), while all fathers in the families with TMP were not (personally inflexible). One personally flexible mother said, “I am willing to (change what is served at family meals)... because everybody likes new foods. They are tired of eating the routine foods everyday.” One personally inflexible father said, “I am used to our current diet. It is good. I don’t want to try new foods, because I am afraid they don’t taste good or I am not used to eating them.” Six fathers in the families with MMP were willing to change what was served at family meals by serving new foods while the remaining fathers were not. Families with 2 personally flexible parents incorporated more Western dishes (i.e., pizza, spaghetti, steak, and salad) in dinners than those with none or only one. However, on further probing to clarify if this flexibility applied equally to Western and Chinese dishes, it became clear that flexibility was generally limited to new Chinese recipes. While all personally flexible parents were willing to serve new Chinese dishes, only a few parents were willing to cook new Western dishes from scratch. Because most personally flexible mothers felt cooking Western dishes was difficult,

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<sup>4</sup> Picky is a term used by these participants. It meant consistently refusing to eat familiar (and unfamiliar) foods, resulting in eating a narrow range of foods.( Dovey et al., 2008)

despite self-described good cooking skills, those willing to serve Western foods preferred manufactured heat-and-serve (semi-manufactured) Western dishes.

Many parents in both groups reported that their children were not willing to try new foods, despite their liking of certain Western foods. Some were only willing to consider new Western foods, while rejecting Chinese items. One mother noted, “It is easy for my kids to accept new Western dishes, but not easy for them to accept new Chinese dishes.” Some mothers reported that children were more flexible at older ages and started to like Chinese foods when they grew older. One mother said, “Kids are more considerate when they get older. Our son (age 13) is more likely to try new foods than our daughter (age 6).” One father noted, “When our oldest daughter (age 20) was at her age (younger daughter, age 8), she didn’t eat Chinese foods... When she was older, she started to like Chinese foods.”

### ***Family Dietary Pattern***

Family members’ food preferences and personal flexibility influenced the family dietary pattern, i.e., meal content pattern and some individual food choices. Interviewees stressed the importance of retaining the traditional Chinese dinner pattern even as Western foods were adopted for breakfast and snacks.

Both types of families had similar breakfast and snack patterns. Most families ate Western breakfast, such as cereal, breads, bagels, waffles, pies, brownies, and cakes with milk or orange juice. However, about half of the families still ate some traditional Chinese breakfasts, such as stewed spiced eggs, steamed buns, or porridge.

Many parents, especially men, reported eating few snacks (nuts, dried fruits, crackers, or cookies). However, some parents ate Western snacks like coffee cakes, cookies, and chips.

Parents reported that children took snacks, such as chips, soda, candy, and cookies, to school/daycare and/or ate them after they got home.

Patterns began to diverge at lunch and dinner. Nearly two thirds of parents in this sample took dinner leftovers for lunch while the remainder ate out choosing either Western foods (i.e., salad, sandwiches, soup, and fast foods) or Asian restaurants. In contrast, all children ate Western foods provided by schools or taken from home (i.e., sandwiches, mini-pizza, cereal, and bread with butter and cream cheese).

All families reported the dinner pattern was vegetables and meat or seafood together with a starch (rice, noodles, steamed buns). In the families with TMP, neither parent was willing to eat Western foods as dinner at home. While two-thirds of these families did not serve Western foods for dinner, instead offering Chinese dishes the children liked in addition to serving the Chinese foods liked by parents, several families with TMP had given up resisting children's demands for Western dishes. Although these parents felt that the Western foods their children liked (i.e., barbecue chicken, chicken nuggets, French fries, and pizza) were not healthful, they served these semi-manufactured foods to them while the adults ate only Chinese foods. In contrast, families with MMP adopted Western foods that everyone ate in the family dinner pattern to different degrees. Some families adopted one Western dish (i.e., salad, pasta), while others served several Western foods demanded by children (i.e., pizza, lasagna, macaroni & cheese, steak with salad and potatoes, beef fajitas, spaghetti, and pasta) to the whole family at different frequencies, ranging from 'occasionally' to 2-3 times a week. Regardless of group, parents who took dinner leftovers for lunch were the most resistant to introducing Western foods into the family dinner pattern.

These families also ate out at various frequencies (from once every 3 months to twice a week), mainly on weekends. Interestingly, more families with TMP than MMP took their children to American fast food restaurants repeatedly to satisfy their children's desire for these foods.

However, most parents reported not eating the fast foods, instead eating Chinese foods when they returned home.

### ***Family Flexibility***

Family flexibility was examined through discussion of family roles, rules, and power. “Roles” addressed food shopping, preparation, and mechanics of food production in the home. “Communication” was not our major focus although intra-couple communication patterns did emerge when parents described how they learn each other’s food preferences. “Communication” as noted and “supportive behaviors” were woven into “Power”.

### **Roles**

Food shopping patterns were similar across groups. Four shopping patterns emerged: done mainly by wife (n=8) or husband (n=1); done mainly by husband and wife together (n=6); and partners traded off the food shopping (n=5). Since preserving the Chinese dinner pattern was still a priority, they shopped based on an ingrained pattern of matching meat and vegetables that reflected the family food preferences. Most families visited 3-4 local supermarkets every week to purchase different things (i.e., vegetables and fruits at one store; meat at another store). They also shopped at Chinese or Korean grocery stores to buy particular Chinese items, such as soy sauce, rice, and Chinese vegetables. However, most adults still found limited vegetable variety in the US, which resulted in dropping certain dishes out of family menus.

Food preparation pattern was also similar between groups. Adults usually fixed their own breakfasts. Mothers usually prepared breakfast for children. Because of time pressure, foods had to be quick and convenient. Dinner preparation on weekdays followed 4 patterns: wife (n=13) or husband (n=2) prepared, husband and wife shared preparation (n=3), or elderly female prepared

(n=2). These patterns reflected traditional women's roles, who was a better cook or who cared about taste, and time pressure. One husband said, "We have different assignments in our family. XX (wife) works inside of house. I work more outside of house, such as working in the backyard, fixing the house, this kind of work. She doesn't work on these, just like I don't do any household chores inside of the house." Time pressure encouraged some parents to share cooking. Patterns on weekends were similar to those on weekdays, except that most families had time to cook more elaborate meals or more dishes on weekends.

### **Rules**

Food rules discussed here were the guidelines that shaped the family dietary pattern. When asked "what rules does your family have about foods?", most parents initially denied that they had any rules. However, in previous or further discussion, most families freely described rules they used to define the acceptable dinner pattern, restrict foods or ingredients, govern refusing foods, and adopt new foods. These rules were similar in both groups of families.

***Acceptable dinner pattern.*** All families required that meat and vegetables be served for dinners, although the number of dishes and additional components (i.e. salads, seafood, soup, and soy based) varied. One mother said, "From the nutrition balance point of view, I think we need to have both meat and vegetables." The number of vegetable dishes varied from 1 to 3, depending on time pressure. Although most ate rice, noodles, or steamed buns in addition, few mentioned this as a requirement.

***Restricted foods & ingredients.*** Most families restricted some foods, including fatty foods (i.e., pork braised in brown sauce, whole fat milk, deep-fried foods, organ meats, red meats, cheese, and butter), preserved meat, and junk/sweet foods (i.e., chips, soda, chocolate, and sugar coated cereal). Some parents limited the amount bought and how much and when children could eat snack foods. One mother said, "We don't buy very fatty foods... We stopped cooking it (pork braised in brown sauce)... We seldom buy very greasy and unhealthy snacks, such as chips and

Coke.” Some also restricted foods based on ingredients (i.e., no artificial ingredients) or production (organic rather than conventional). Others controlled the use of oil, particular spices, or salt (sodium) in cooking.

***Refusing foods.*** The range of application and degree of firmness of rules about refusing foods varied among these families. Uncommon foods, such as shiitake mushroom, bitter melon, black agarics, bean soup, cornmeal porridge, or spicy dishes, could be refused by children. Most parents struggled to make children eat at least some vegetables using specious arguments, enforcing consumption of minimal amounts, offering bribes or hiding the vegetables in the starch or soup served. As a result, some couples had established the rule that healthful foods, such as meat, soy products, fruits, and especially vegetables, could not be refused. However, these rules were lenient or not consistently applied to everyone and every food group. In this sample, a majority of families allowed anyone to refuse a food after trying it but some only allowed parents to refuse a food. One father said, “Adults don’t have to eat the foods we dislike... If my daughter says she doesn’t want to eat vegetables today, I don’t think it is good. She has to eat some vegetables.” Another father noted, “Only I can refuse to eat salad...My son cannot refuse to eat salad. We would tell him ‘you have to eat it and vegetables are good for your health.’” Only 2 families in this sample established firm, equitable rules on at least vegetables. One father said, “We can’t refuse to eat. I always told our daughter that ‘If you don’t like it, you can eat less, but you can’t refuse to eat. If you refuse to eat, it hurts the cook.’” The other father noted, “If someone doesn’t like a dish, he or she can refuse to eat, as long as it is not vegetables.” These families had more success dealing with picky eaters. One couple reported using a “thanks bite” rule (the child had to eat 3 bites to thank the mother for cooking the dish), which lessened this problem – “A lot of times he started to like a food after trying several bites.”

***Adoption of new foods.*** Most couples reported that only foods liked by the majority (including one parent) or all family members were adopted, although a few indicated a particular

child liking a food could instigate its adoption. While taste was a primary concern, most families in this sample also required that the new food be ‘nutritious’ (i.e., organic or natural, not deep fried, low cholesterol, high protein or fiber, vegetables) and/or convenient to make.

### **Power to Influence Food Choices**

We evaluated power to influence dinner choices based on how the food preparer balanced family members’ preferences (i.e., what was still served when there was conflict among family members’ preferences).

Initially, husbands and wives had learned each other’s food preferences early in their relationship by discussing or observing their partner’s choices or behaviors at meals. One wife said, “Sometimes after I cook, I would ask him whether he likes it or not. He would tell me...I could tell which dish he ate a lot and which dish he didn’t touch.” Cooks, mainly wives, would adjust seasoning or cooking methods to match partners’ tastes and, over time, couples gravitated to similar preferences based on trial and error. One wife who learned many cooking skills from her husband noted, “My husband ... is from an army family, so his words are powerful...My mom was good at cooking. We had a lot of dishes before I got married. We ate whatever we like. But after we got married...I had to change my eating habits.” When children grew old enough to have preferences, their desires were generally governed by whose preferences dominated dinner choices.

Dinner power patterns were similar in the 2 groups. In 11 families, both parents had more influence on main meal choices than children. One wife said, “XX (son) doesn’t eat certain foods. If we (adults) want to eat these foods, I would make them. I wouldn’t give up making these foods just because our son doesn’t like them.” Among some of these families, mothers made automatic accommodation for the fathers’ preferences. In 7 other families, mothers pleased the husband’s preferences first and then children’s preferences and considered their own preferences least important. One mother said, “When I cook...I would consider whether my husband and kids like

it or not... The purpose of my cooking is to let them like the foods. If they didn't like the foods I cook, I would feel like my cooking wasn't worth anything." These mothers would eliminate dishes disliked by children or cook extra dishes to please husbands and children. One father said, "We have 3 dishes, including one everybody likes, one I like, and one the kids like." In 2 other families, children's preferences dominated the family food pattern and the degree of adoption of Western foods depended on whether the child preferred these. Children's preference for Chinese foods ensured retention of Chinese dishes.

Influence of family member preferences on snack choices was also similar between the 2 groups. Power to influence snack choices was determined from parent reports of how snack preferences were satisfied when shopping. Although many parents tried to limit children's consumption of unhealthful snacks (i.e., chips, candies, chocolate, and soda), a majority reported that children's preferences or children's and one adult's preferences together dominated the snacks purchased. One father said, "If kids like to eat certain snacks, eventually we have these snacks at home, such as popcorn and certain types of cookies." Another father noted, "I should say kids' and XX (wife)'s preferences mainly determine the choice of snacks... People who like to eat snacks always choose what they like. We (husband and grandma) just follow them or eat whatever is available." In a few families, although the wife considered everybody's preferences and nutrition needs, her preferences determined most snacks bought for both children and husband. One of these wives said, "If the food is harmful to health, I would forbid him (husband) to buy. But if I like a certain food, I would buy it myself... kids like popcorn. I try not to let them eat popcorn... I also try not to let them eat potato chips. I try to limit Pepsi, Coke and stuff." In the other families, all family members' preferences were equally considered. One father noted, "We get our own snacks. When shopping, we pick our own snacks. Everybody needs to finish the snacks he or she buys. Sunflower seeds and pistachio are the snacks that we share."



## Discussion

We initiated this qualitative study to better understand the food systems of first generation Chinese American families in order to design a nutrition intervention.

In the reciprocal determinism concept, Bandura proposed that personal and environmental factors influenced the family dietary pattern. Among personal characteristics, these parents' preferences for Chinese foods ensured having traditional Chinese meat and vegetable dishes as dinner and limited parents' flexibility around adoption of Western foods. Among the family environmental factors, father's power to determine dinner content proved to be an important influence on the family dietary pattern and was one of the major determinants of speed of adoption of Western foods into dinner. If the mother felt the same way, the parents generally resisted children's demands for Western foods. Although mothers were more sensitive to their children's demands, only if the father changed his personal preferences and flexibility about meal choices, were Western foods served to everyone at dinner.

Bandura's reciprocal determinism concept suggested a bi-directional relationship between personal characteristics, dietary behavior, and environmental factors. Lunch dietary behaviors influenced family members' food preferences and thus family flexibility. Parents' and children's differing preferences for Western vs. Chinese foods resulted in conflict at dinners, especially around vegetables. Most parents utilized family rules and power to continue to serve vegetables which supported the principle of repeated exposure and role modeling that can impact children's food choices. They appeared to allow children greater freedom around snacks and fast food meals to balance the restrictions imposed on dinner choices.

Some of our findings about children's preferences, family member roles, and power were similar to those of others. Most children refused to try unfamiliar foods (neophobia) and/or eat certain familiar foods, especially vegetables (picky), a common trait among children (Cooke et

al., 2003; Dovey et al., 2008). Like Northern European families, more mothers were involved in food chores than fathers (Lake et al., 2006; Harnack et al., 1998). Most mothers were struggling to serve as nutritional gatekeepers while meeting role expectations that foods please husbands as well as children. In this study, either father's or both adults' food preferences had greater influence on family dinner patterns than children's preferences, except for snacks, in agreement with others (Brown and Miller, 2002; De Bourdeaudhuij, 1997; De Bourdeaudhuij and Van Oost, 1998; Roberts et al., 2003).

Adults' food habits appear extremely resistant to change, apparently due to food patterns established early in their life (Kelleher et al., 2006; Lee et al., 1994; Lawton et al., 2008). Lawton et al. (2008) found that South Asian immigrants in Britain retained traditional food habits, especially at dinner, to maintain their cultural identity. This may also play a role in our sample. While most of these parents retained Chinese dinner patterns and many ate dinner leftovers for lunch, their breakfast now included many American convenience foods, some of questionable nutritional value. Chau et al. (1990) found a similar dietary pattern for lunches and dinners among elderly female Chinese immigrants.

Study limitations include use of a small convenience sample of better educated, mainly dual earner Chinese American families recruited from Chinese schools in Pennsylvania. As a cross-sectional study, the process of Western culture influencing the family food system was based on respondents' long-term recall and may not be replicated in a larger more representative sample. However, this study identified intra-family factors that appear to influence Chinese immigrants' meal patterns. Nutrition educators and researchers who work with recently immigrated Chinese American families should consider these factors when designing nutrition education programs or research instruments.

## Implications for Research and Practice

This study indicates that member food preferences, internal family functioning, and the family internal and external environment all influence family food practices and ultimately dietary intake of Chinese American immigrants.

Additional research is needed with more diverse groups to verify the following research questions in the broader population of Chinese American families: Do parents use leniency in snacks and visits to fast food restaurants to encourage following dinnertime rules? What is the role of communication within families both in relation to establishing food choices and altering them? How can flexibility around food choices that enhance nutrition be established? How can roles, rules, and power be altered to encourage this flexibility? While Reciprocal Determinism might be a useful framework to explore the family food system, efforts to better understand flexibility in food choice may require the application of other theoretical frameworks in future research studies.

In terms of future nutrition education efforts, intra-family factors (member food preferences, rules, and power) and the family internal and external environment should be considered:

1. *Balancing member food preferences*: Some parents need help to recognize unhealthy food and identify more healthful Western foods that satisfy both parents' and children's preferences and parents' desire for good nutrition. Chinese American mothers may welcome a culturally based program that highlights the good aspects of their traditional dietary pattern and shows alternatives to questionable Western foods.

2. *Establishing effective rules*: Chinese American parents may need guidance to establish and maintain effective food rules that improve children's vegetable intake. One mother used the "thanks bite" rule and had some success, indicating that this rule may work to encourage children

to try and accept healthful foods, because respecting one's parents and the cook is a Chinese value. A few families who had firm and democratic rules about refusing old or trying new foods had more success dealing with 'picky' children. This suggests the importance of equitable rules that support parental modeling.

3. *Maintaining parents' power*: Both parents', especially father's, significant power over the family meal pattern suggests that fathers should be involved in the nutrition education effort to improve family's healthful eating habits. Healthful dietary behaviors are easier to adopt once fathers accept them.

4. *Preserving the internal environment*: Parents should be advised to continue to present Chinese dishes not currently liked by children with encouragement to taste. Although some did this, too often the disliked dishes were dropped. Continual exposure is likely to lead to eventual acceptance by children.

5. *Controlling the external environment*: Chinese schools, where both parents and children cluster, may be a good place to help parents prepare for the consequences of children's exposure to Western foods and to take proactive steps to limit the negative impact. These might include sending healthful snacks to school with children, purchasing only certain Western snacks, establishing rules about dinner content that everybody follows, and discussing menus and foods with food service officials of their children's schools.

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## References

- Baranowski T, Domel S, Gould R, et al. Increasing fruit and vegetable consumption among 4th and 5th grade students – results from focus groups using reciprocal determinism. *J Nutr Educ*. 1993;25:114-120.
- Baranowski T, Hearn MD. Health behavior interventions with families. In: Gochman DS, ed. *Handbook of Health Behavior Research IV. Relevance for Professionals and Issues for the Future*. New York, NY: Plenum Press; 1997:303-323.
- Baranowski T, Perry CL, Parcel GS. How individuals, environments, and health behavior interact; social cognitive theory. In: Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:153-178.
- Brown JL, Miller D. Couple's gender role preferences and management of family food preferences. *J Nutr Educ Behav*. 2002;34:215-223.
- Campbell TC, Parpia B, Chen J. Diet, lifestyle, and the etiology of coronary artery disease: The Cornell China study. *Am J Cardiol*. 1998;82:18T-21T.
- Chau P, Lee H, Tseng R, Downes NJ. Dietary habits, health beliefs, and food practices of elderly Chinese women. *J Am Diet Assoc*. 1990;90:579-580.
- Cooke L, Wardle J, Gibson EL. Relationship between parental report of food neophobia and everyday food consumption in 2–6-year-old children. *Appetite*. 2003;41:205-206.
- Darmon N, Khlal M. An overview of the health status of migrants in France, in relation to their dietary practices. *Public Health Nutr*. 2001;4:163-172.
- De Bourdeaudhuij I. Perceived family members' influence on introducing healthy food into the family. *Health Educ Res*. 1997;12:77-90.
- De Bourdeaudhuij I, Van Oost P. Family members' influence on decision making about food: Differences in perception and relationship with healthy eating. *Am J Health Promot*. 1998;13:73-81.
- Dovey TM, Staples PA, Gibson EL, Halford JC. Food neophobia and 'picky/fussy' eating in children: a review. *Appetite*. 2008;50:181-93.

- Glaser BG, Strauss AL. *The Discovery of Grounded Theory: strategies for qualitative research*. Chicago, IL: Aldine de Gruyter; 1967.
- Haber B. The Mediterranean diet: a view from history. *Am J Clin Nutr*. 1997;66:S1053-S1057.
- Harnack L, Story M, Martinson B, Neumark-Sztainer D, Stang J. Guess who's cooking? The role of men in meal planning, shopping, and preparation in US families. *J Am Diet Assoc*. 1998;98:995-1000.
- Holsti OR. *Content analysis for the social sciences and humanities*. Reading, MA: Addison-Wesley; 1969:140.
- Jackson KA, Savaiano DA. Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *J Am Coll Nutr*. 2001;20:198S-207S.
- Kelleher CC, Lynch JW, Daly L, et al. The "Americanisation" of migrants: Evidence for the contribution of ethnicity, social deprivation, lifestyle and life-course processes to the mid-20th century Coronary Heart Disease epidemic in the US. *Soc Sci Med*. 2006;63:465-484.
- Kirby SD, Baranowski T, Reynolds LD, Taylor G, Binkley D. Children's fruit and vegetable intake – socioeconomic, adult-child, regional, and urban-rural influences. *J Nutr Educ*. 1995;27:261-271.
- Lake AA, Hyland RM, Mathers JC, Rugg-Gunn AJ, Wood CE, Adamson AJ. Food shopping and preparation among the 30-somethings: whose job is it? (The ASH30 study). *Br Food J*. 2006;108:475-486.
- Lauderdale D, Kuohung V, Chang SL, Chin MH. Identifying older Chinese immigrants at high risk for osteoporosis. *J Gen Intern Med*. 2003;18:508-515.
- Lawton J, Ahmad N, Hanna L, Douglas M, Bains H, Hallowell N. et al. 2008. We should change ourselves but we can't: Accounts of food and eating practices among British Pakistanis and Indians with type 2 diabetes. *Ethn Health*. 2008;13:305-319.
- Lee MM, Wu AW, Whittemore AS, et al. Comparison of dietary habits, physical activity and body size among Chinese in North America and China. *Int J Epidemiol*. 1994;23:984-990.
- LeMarchand L, Wilkens LR, Kolonel LN, Hankin JH, Lyu LC. Associations of sedentary lifestyle, obesity, smoking, alcohol use, and diabetes with the risk of colorectal cancer. *Cancer Res*. 1997;57:4787-4794.
- Lv N, Brown JL, Liu BF. Factors influencing dairy product consumption of Chinese Americans in Pennsylvania. *Top Clin Nutr*. 2007;22:259-271.
- Lv N, Cason K. Dietary pattern change and Acculturation of First Generation Chinese Americans in Pennsylvania. *J Am Diet Assoc*. 2004;104:771-778.
- Olson DH, Gorall DM. Circumplex Model of Marital and Family Systems. In: Walsh F, ed. *Normal Family Processes*. 3<sup>rd</sup> ed. New York, NY: Guilford Press; 2003:514-548.

Roberts BP, Blinkhorn AS, Duxbury JT. The power of children over adults when obtaining sweet snacks. *Int J Paediatr Dent*. 2003;13:76-84.

Sun WY, Sangweni B, Chen J, Cheung S. Effects of a community-based nutrition education program on the dietary behavior of Chinese-American college students. *Health Promot Int*. 1999;14:241-249.

Sworts VD, Riccitelli CN. Health education lessons learned: the H.A.P.I. Kids Program. *J Sch Health*. 1997;67:283-285.

Wu XP, Liao EY, Luo XH, Dai RC, Zhang H, Peng J. Age-related variation in quantitative ultrasound at the tibia and prevalence of osteoporosis in native Chinese women. *Br J Radiol*. 2003;76:605-610.

Yu CY. Who are the Chinese Americans? In: Gall S, Natividad I, editors. *The Asian American almanac: A reference work on Asians in the United States*. Detroit, MI: Gale Research; 1995:41-62.

Yu H, Harris RE, Gao YT, Gao R, Wynder EL. Comparative epidemiology of cancers of the colon, rectum, prostate, and breast in Shanghai, China versus the United States. *Int J Epidemiol*. 1991;20:76-81.

US Census Bureau. Census 2000 Summary File 1, Matrices P3, P4, PCT4, PCT5, PCT8, and PCT11. QT-P3. Race and Hispanic or Latino: 2000. Available at [http://factfinder.census.gov/bf/?lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=01000US.html](http://factfinder.census.gov/bf/?lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=01000US.html). Accessed August 26, 2008.

US Census Bureau. 2006 American Community Survey: Selected Population Profile in the United States. Available at <http://factfinder.census.gov>. Accessed November 24, 2008.

## Chapter 4

### Place of dairy products in the Chinese American family food system<sup>5</sup>

#### Abstract

This theory-based qualitative study explored how first generation Chinese American couples with children view dairy products, how they use them in *their* family food system, and how these uses impact their dietary behavior or intake. Twenty couples, recruited from weekend Chinese schools at three locations in Pennsylvania, were interviewed. Taste, texture, and use of additives and growth hormones appeared to be a more important influence on dairy food choice than lactose intolerance. In these families, parental use of food rules and power to influence food patterns affected family flexibility about dairy food use. Father's power, his views of dairy products, and his preference for Chinese-based dinners had a greater influence than those of his wife or children on the use of dairy-based dinner dishes. In contrast, choices at breakfast or lunch and for snacks were more flexible and could include dairy products. Suggestions are provided for improving dairy intake among Chinese Americans.

#### Introduction

Osteoporosis is a global public health threat to the growing population of aged adults (Babbar et al., 2006; Johnson et al., 2008). Each year, approximately 1.5 million Americans suffer fractures caused by osteoporosis and the annual medical cost is at least \$18 billion (National Osteoporosis Foundation, 2002). Among racial groups, Caucasians and Asians have the

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<sup>5</sup> Will be shortened and submitted to Journal of the American Dietetic Association.



highest risk of osteoporosis (Chiu et al., 1997; Jackson and Savaiano, 2001). Many efforts to reduce the risk of osteoporosis are aimed at Caucasians and African Americans. Asian audiences have received less attention.

Chinese Americans, the largest Asian population in the US, account for 23.7% of American Asians (US Census 2000). In 2000, 2.4 million Chinese Americans resided in the US, having increased by 50% since 1990 (US Census 2000). According to the 2006 American Community Survey, their numbers have continued to increase with 63% being foreign-born and 37% being native-born (US Census 2006). Most Chinese Americans reside in big cities with strong connections to Chinese organizations and communities (i.e., Chinatown).

After immigration, Chinese Americans appear to adopt Western dietary choices and patterns to varying degrees (Lv and Cason, 2004; Satia et al., 2000). In a cross sectional survey in Pennsylvania, Chinese Americans reported consuming lowfat milk, cheese, and yogurt 1-3 times per month compared to only a few times per year before immigration (Lv and Cason, 2004). Despite a slight increase in dairy product intake after immigration, North American Chinese men's and women's calcium intakes ( $585.7 \pm 305.8$  mg/day and  $514.0 \pm 302.0$  mg/day, respectively) are still substantially below the 1000-1200 mg/day recommended (Borugian et al., 2002). This increases their risk of osteoporosis (Jackson and Savaiano, 2001).

Although many foods provide calcium, dairy products are still considered the best natural source of calcium because of their high calcium content and high calcium bioavailability (Nicklas, 2003). Increasing dairy product consumption among Chinese Americans could help reduce the risk of osteoporosis and its associated medical costs.

Nutrition education efforts should consider how the target audience chooses and consumes dairy products in and outside the home. However, we know little about how dairy products are used in the family food system of Chinese Americans. Additionally, in Caucasian families, food preferences of parents and children, food preparer role expectations, and the

within-family power hierarchy have significant influences on various food choice and diet management behaviors (De Bourdeaudhuij and Van Oost, 1998; De Bourdeaudhuij, 1997; Brown and Miller, 2002). Similar factors may affect Chinese American food choices. Therefore, it is important to know how different family members view dairy products and how product selection and use is negotiated and implemented in shared and unshared meals within the family unit. Qualitative couple interviews involving both husband and wife who eat dinners together with their children can illuminate these intra-family influences.

The interview questions were developed using the Reciprocal Determinism Model and the Circumplex Model of Marital and Family Systems. The Reciprocal Determinism Model was developed by Baranowski and Hearn (1997) based on the reciprocal determinism concept of Bandura's Social Cognitive Theory. This model considers each individual's personal characteristics and behaviors within the family unit as a defined environment. It proposes that family functioning, supportive behaviors, and mechanics of food production in the home interact with personal characteristics to influence food choices within the family environment (Figure 4-1). The Circumplex Model of Marital and Family Systems further describes family functioning through three dimensions: family flexibility, cohesion, and communication (Olson and Gorall, 2003). Family flexibility describes flexibility in altering or maintaining roles, rules, and power. Cohesion describes family members' emotional bonding. Communication facilitates family flexibility and cohesion. Among these three dimensions, family flexibility and communication were considered relevant for food choice studies. The objective of this qualitative study was to learn how first generation Chinese American couples with children view dairy products, how they use them in their family food system, and how these impact their dietary behavior or intake.

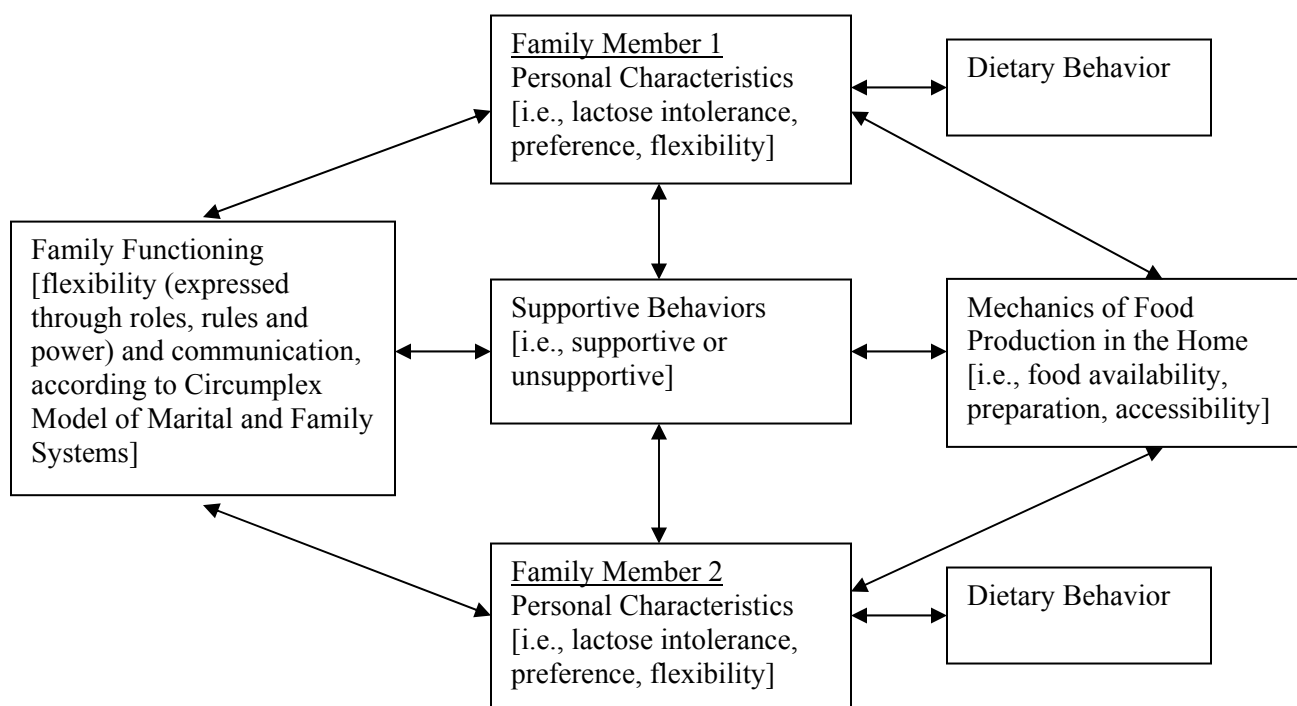


Figure 4-1: Reciprocal Determinism Model relating family and individual characteristics.

## Methods

### *Study Participant Selection*

Participants were recruited from Pennsylvania Chinese schools in Pittsburgh, State College, and the Philadelphia area. These parents enroll their children in weekend Chinese schools that meet several hours a week to maintain Chinese culture and language skills.

Recruitment was accomplished by in-person contact with parents waiting for their children during weekend school hours. The number of couples recruited from each school was based on the student body size. Please see Table 4-1 for the details. The recruiter approached the fifth parent

from the entrance and every 5<sup>th</sup> parent in order in the school waiting area and asked if they would participate in a study of Chinese American's family food system and views of dairy products. Parents were told they did not have to be dairy users to participate. Couples had to meet the following criteria: a) both first generation Chinese Americans with at least one child who was five years or older (to capture child's impact on food choices) and enrolled in the Chinese school; b) 21 to 65 years old; c) family members ate dinners together at least four times a week (to capture how family members' different preferences were balanced); and d) both parents willing to participate in the interview. Lactose status was not determined during recruitment. Among 23 couples who expressed interest, 20 couples (n=40) were qualified and interviewed.

Table 4-1: Estimated student enrolled, estimated number of parents in the waiting area, number of parents approached, number of parents interested, and number of parents qualified and interviewed at each school.

	Estimated student enrollment <sup>a</sup>	Estimated number of parents in the waiting area <sup>b</sup>	Number of parents approached	Number of parents interested	Number of parents qualified and interviewed <sup>c</sup>
<b>Philadelphia1</b>	110	14	3	2	2
<b>Philadelphia2</b>	300	37	6	4	4
<b>Philadelphia3</b>	150	20	5	3	2
<b>Philadelphia4</b>	300	42	8	5	4
<b>Philadelphia5</b>	70	10	5	1	1
<b>Philadelphia6</b>	120	25	6	2	2
<b>Pittsburgh1</b>	280	50	3	3	3
<b>State College1</b>	70	6	4	3	2

<sup>a</sup> Estimated student enrollment does not equal number of parents because many families had more than one child enrolled in the school.

<sup>b</sup> Estimated number of parents in the waiting area is much smaller than estimated student enrollment, because many parents dropped off their children and left.

<sup>c</sup> The general rule was that one couple was recruited from schools with 75 students or less; two couples from those with 76-150 students; three couples from those with 151-299; four couples from those with 300 students or more. In State College, we recruited two couples even though the student body size of the school is 70 to give the rural area better representation.

### ***Instruments***

The couple interview questions were designed and organized around five constructs of Baranowski's Reciprocal Determinism Model: *personal characteristics, dietary behavior, family functioning* [using the flexibility (expressed through roles, rules and power) and communication dimensions of the Circumplex Model of Marital and Family Systems (Olson and Gorall, 2003)], *supportive behaviors*, and *mechanics of food production in the home* (Figure 4-1) (Baranowski and Hearn, 1997). Table 4-2 shows the script questions by construct.

Table 4-2: Couple interview constructs and questions.

<p><b>Couples interviewed together</b>  <b>Construct:</b> Mechanics of food production in the home            - How is food shopping handled in your family?            - How food is prepared in a typical weekday? We can go through meal by meal (breakfast, lunch, dinner, snacks, desserts, and beverage).            - How do meals on weekends differ from those eaten during the week?  <b>Construct:</b> Dietary behaviors            - What dairy products are usually eaten at meals or snacks in your home, if any?            - What about outside of home, if any?</p>
<p><b>Couples interviewed separately</b>  <b>Construct:</b> Family functioning  <b>Roles</b>            - How much of the actual work of shopping and cooking do you do day-to- day?  <b>Power</b>            - How much influence do you feel you have on the choice of foods served at family main meals?            - Whose food likes and dislikes mainly determine the choice of snacks?            - If you liked something and your partner did not like it, how would it affect what is offered at dinner?            - How would it affect what is available for a snack?            - If you liked something and your children did not like it, would it affect what is offered at dinner? As a snack?  <b>Flexibility</b>            - How easy is it to introduce new Chinese foods or dishes into family meals?            - What about the introduction of a Western-style main dish into family meals?            - How interested would you be in eating dairy products as snacks?            - How willing are you to change what is served at family meals?            - What about your partner? Your children? Your parents? <sup>a</sup>  <b>Rules</b>            - What rules does your family have about foods?            - What rules does your family have about introducing new foods into family meals?</p>

<p>Communication</p> <ul style="list-style-type: none"> <li>- How were these rules about foods (served, banned, refused, adopted, etc.) established?</li> </ul> <p><b>Construct:</b> Supportive behaviors</p> <ul style="list-style-type: none"> <li>- How does your partner feel about the dairy products you like or dairy products in general?</li> <li>- If you wanted to buy a new dairy product, how would your partner react?</li> </ul> <p><b>Construct:</b> Personal characteristics</p> <ul style="list-style-type: none"> <li>- What dairy products do you like, if any?</li> </ul> <p>[If they eat dairy products sometimes –</p> <ul style="list-style-type: none"> <li>- What are the reasons they are eaten?</li> <li>- When selecting these dairy products – how are family member likes and dislikes weighted?</li> </ul> <p>If they do not eat dairy products –</p> <ul style="list-style-type: none"> <li>- What are your reasons for avoiding dairy products for yourself?</li> <li>- What are your reasons for avoiding dairy products for your children?]</li> <li>- If you were concerned about bone health, what role would dairy products play in addressing this?</li> <li>- How do American dairy products and Chinese dairy products compare?</li> <li>- Do you or your family member have unpleasant symptoms after eating dairy products?</li> <li>- How does this affect your use (your family member's use) of dairy products? (if still eat some)</li> <li>- What strategies have you or your family member used to reduce those symptoms?</li> </ul>
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<sup>a</sup> Asked only if a grandparent was present in the household.

The couple interview script was pilot-tested with four Chinese families in State College and minor changes were made in question wording based on their feedback. The interviewer was trained before the couple interviews through reviewing qualitative interview manuals, discussing procedures with experienced interviewers, and conducting the pilot-test interviews. The senior researcher read sequential transcripts and provided instruction and feedback on techniques.

### ***Couple Interview Procedure***

All couple interviews were conducted in Mandarin, as preferred by participants. Each discussion lasted about 1.5 hours. Interviews were conducted at participants' homes (n=9), in available Chinese school classrooms during the school hours (n=10), and in a meeting room in the community library (n=1).

After giving informed consent, each couple was interviewed together and then each partner individually. The interview was tape recorded and the sequence of individual interviews was determined by a coin toss. Each parent completed a demographic questionnaire while their partner was being interviewed in another private room. Each couple received \$30 afterwards. The Pennsylvania State University Institutional Review Board (IRB) approved all methods before data collection.

### *Data Analysis*

The audiotapes were simultaneously translated from Mandarin into English and transcribed by the interviewer who is a native Mandarin speaker. The quality of the translation and transcription was checked by a scholar fluent in Mandarin and English who reviewed 15 randomly-selected sets of questions and answers in three interviews. Thematic analysis with constant comparison was conducted (Glaser and Strauss, 1967). The senior researcher created an initial thematic coding list based on two couple interview transcripts. The junior researcher then coded these two transcripts independently using the coding list and adding to it when themes emerged. The junior and senior researcher coded two additional transcripts independently producing 84.1% and 87.7% agreement (Holsti's 1969). Another two transcripts coded by two junior researchers independently yielded 81.1% and 82.8% agreement. Decisions on coding categories were discussed and the final coding list was applied to all couple interviews by hand. The senior and the junior researcher then independently summarized each construct in each couple interview, compared the summaries, solved disagreements, and wrote the final overall thematic summary. This study explored use of many foods in the family food system. This manuscript focuses on data relevant to dairy products.

## Results

Our findings are organized using constructs from the Reciprocal Determinism Model (Figure 4-1), and presented in the order of personal characteristics, dietary behavior, followed by family functioning and supportive behaviors. “Mechanics of food production in the home” was woven into “dietary behavior” and into “roles” in “family functioning”.

### *Personal Characteristics*

The interviewees were middle-aged parents who had high education and income (See Table 4-3 for demographic characteristics). Three family households included elderly<sup>6</sup> adults in addition to children. Other parental characteristics examined included their self-reported lactose intolerance status, perceptions of taste and safety of dairy products, and their personal willingness to eat more dairy products.

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<sup>6</sup> Elderly means an older aunt or in-law living with the couple.



Table 4-3: Demographic characteristics (n=20 couples).

	<b>Mean</b>	<b>Range</b>
<b>Age of women (years)</b>	41.4±5.4	33-54
<b>Age of men (years)</b>	43.6±5.5	35-54
<b>No. of children</b>	1.8±0.6	1-3
<b>Age of children (years)</b>	10.8±4.9	0.8-23
<b>No. of children born in US</b>	1.5±0.8	0-3
<b>Husband's length of US residence (years)</b>	17.1±6.5	7-28
<b>Wife's length of US residence (years)</b>	16.0±6.6	7-27
<b>No. of years married</b>	16.2±5.8	7-28
	<b>Number</b>	<b>Percentage</b>
<b>No. of families with working women</b>	16	80%
<b>No. of families with working men</b>	20	100%
<b>No. of families with elderly</b>	3	15%
<b>Men's education <sup>a</sup></b>		
Some college or vocational training	1	5%
Graduate or professional school	15	75%
Postdoctoral work	4	20%
<b>Women's education <sup>a</sup></b>		
Some college or vocational training	2	10%
Four-year Bachelor's degree	5	25%
Graduate or professional school	13	65%
<b>Men's lactose intolerance status</b>		
Yes	3	15%
No	14	70%
Do not know	3	15%
<b>Women's lactose intolerance status</b>		
Yes	6	30%
No	14	70%
<b>Annual household income <sup>b</sup></b>		
\$50,000-\$74,999	6	30%
\$75,000-\$100,000	4	20%
Over \$100,000	10	50%

<sup>a</sup> The seven original options were “11th grade or less”; “High school diploma (12th grade) or GED”; “Some college or vocational training”; “Graduate of vocational/technical school”; “College graduate (4 year Bachelor's Degree)”; “Graduate or professional school (Masters, Ph.D. MPA, JD)”; and “Postgraduate work”. Only the options chosen by participants were reported in the table.

<sup>b</sup> The six original options were “Under \$10,000”, “\$10,000-\$24,999”, “\$25,000-\$49,999”, “\$50,000-\$74,999”, “\$75,000-\$100,000”, and “Above \$100,000”. Only the options chosen by participants were reported in the table.

### **Lactose Intolerance**

Twenty-eight out of 40 parents considered themselves lactose tolerant (Table 3). Among those reporting they were lactose intolerant (n=9), some ignored dairy products altogether, while others used strategies to reduce symptoms, such as “drinking milk before sleeping”, eating small portions, eating yogurt and cheese, “warming up milk”, drinking milk with other foods, and taking a walk after drinking milk. Only one lactose intolerant father reported drinking lactose free milk “occasionally”. Two lactose intolerant mothers, who once bought lactase pills, stopped doing this because they felt the pills were like a medicine and inconvenient. Although lactose intolerance limited those parents’ dairy intake, all of them bought dairy products for children. Only two families where the mother was lactose intolerant reported having a lactose intolerant child.

### **Perceptions of Dairy Products**

Most parents knew that dairy products could provide calcium and realized its importance to their children’s growth. However, the majority of parents did not realize the importance of calcium to adults. Some parents and two children drank soy milk from Chinese stores or home-made soy milk. These parents did not know the calcium content of soy vs. cow’s milk. One mother said, “My husband had bone fractures before. I think milk is good to him. But we don’t drink a cup of milk every day. Sometimes we drink a cup of milk every two days, because we have soy milk too.”

All parents considered milk the most convenient and cheapest dairy product for home use. Although parents drank milk mainly for nutrition, many, especially men, preferred the taste of whole fat milk to skim milk. However, some families chose 1% or 2% milk for family use to

balance taste with fat intake. Many parents liked yogurt because it is easily absorbed, convenient, and nutritious and preferred fruit flavored yogurt, such as strawberry and peach. However, some parents felt American yogurts were too sweet and had an undesirable texture. One mother said, “American yogurt contains too much sugar.” Another mother noted, “I used to eat it every day, so I got tired of it. I think it is too sticky.” Those from mainland China preferred Chinese yogurt that is thinner, sourer, and less sweet. Many parents expressed their unwillingness to eat cold yogurt as breakfast, because they required warm foods in the morning. Most parents could not accept cheese by itself, but were able to eat cheese occasionally in Western foods, like pizza, hoagies, and sandwiches. Many parents enjoyed ice cream. Most children liked many dairy products (milk, yogurt, and cheese) and Western main dishes containing dairy products (i.e., pizza, macaroni & cheese).

Perception of dairy product safety was based on microbes and ingredients. Many parents believed that American dairy products were safer (fewer microbes, no occurrence of spoilage before expiration date) than Chinese ones. One mother said, “I don’t trust Chinese dairy products...I don’t worry about the safety issue here.” One father noted, “US has stricter regulations on dairy product processing than China. In terms of safety, American dairy products are better.” However, they were concerned about undesirable ingredients (additives, growth hormones, and antibiotics) in American dairy products. Although a few parents could accept artificial flavors, many didn’t like additives in foods. Four mothers and two fathers were concerned about the growth hormones in American milk and its influence on onset of children’s puberty. One mother said, “I think our kids are little now and they will hit the growth stage very soon. Eating too much hormone is not good to their health. So I let them eat organic milk, yogurt, and eggs.” One father noted, “I have several friends or relatives. Their kids started puberty very early after drinking milk. So we knew hormone in milk was not good.” In these families, children drank organic milk due to this concern.

### **Personal Willingness to Eat More Dairy Products**

In general, most parents were satisfied with their limited dairy product intake and did not perceive a need to increase consumption. Seven (6 mothers and 1 father) out of 40 parents reported taking calcium supplements sometimes. When asked to suppose they were concerned about bone health, about half of fathers and mothers said they would consider consuming more dairy products, mainly milk and yogurt. One mother said, “If we were very concerned about our health and believed dairy products supplement calcium, we would eat more dairy products. My husband and I are not very concerned about bone health right now.” The other parents preferred taking calcium supplements to eating more dairy products. One mother noted, “We would take calcium supplements. I think we have already drunk as much milk as we can – one cup of milk.”

### ***Dietary Behavior***

These personal characteristics influenced dietary behavior. In most families, breakfasts included Western foods, such as milk, bagels, cereal, and bread, even though about half of the families still ate some Chinese breakfast foods, such as porridge and noodles. Breakfast had to be quick and convenient, so most families adopted milk as a breakfast beverage. One mother said, “Milk is a convenient and nutritious food to drink. It doesn’t take a lot of room, but is more nutritious and filling than water.” Most children and parents who were lactose tolerant drank some milk at breakfast. Lactose intolerant parents and children were more likely to drink soymilk or orange juice or eat yogurt.

Most parents reported their children ate Western lunches provided in institutional settings, where children became accustomed to eating dairy products and dairy-based main dishes (i.e., sandwiches with cheese, macaroni & cheese, and pizza). The few parents who fixed lunches for children prepared Western lunches (i.e., sandwiches with cheese, dry cereal). Twenty-eight

out of 40 parents took dinner leftovers to work for lunch, rather than eating Western foods that they did not care for. Compared to those who took dinner leftovers, parents who ate out at lunchtime learned to eat cheese in sandwiches or other fast foods. One father said, “We eat cheese on pizza. Sometimes I buy pizza or sandwiches with cheese at work.” A few parents reported eating yogurt for lunch.

Most parents reported their children ate a large variety of Western snacks, including dairy products like yogurt and cheese, after school. Some parents also ate various snacks (i.e., nuts, fruits, yogurt, crackers, or cookies) to satisfy hunger until dinner could be prepared. Some parents had learned to like Western snacks. One father said, “Cheesecake, chocolate cake, pies... I want to eat them... I have to control myself.” One mother noted, “I eat string cheese as a snack. I eat it alone. Sometimes I microwave it.”

Most parents preserved the traditional Chinese dinner pattern and refused to serve Western dishes at this meal. This traditional meal pattern includes stir-fried or stewed meat and vegetables dishes with rice, steamed buns, noodles, or porridge. Dairy products are not served or used as ingredients. However, this traditional Chinese meal pattern conflicted with children’s desire for Western dishes. Most children preferred Western foods including those made with dairy products (i.e., pizza, macaroni & cheese) over the traditional Chinese dishes parents served. Mainly due to children’s pressure, seven families adopted one or two Western dishes (i.e., burgers, manufactured macaroni & cheese, soup, pizza) that they served at different frequencies. One mother said, “Our daughter likes cheese... He [father] likes cheese too... When I make Western soup, I spread Mozzarella cheese and put it in the oven. It tastes very good.” Another three families adopted four to six Western foods into their regular dinner menu. Unlike these families who adjusted their dinner pattern, parents in the other ten families were not willing to serve Western dishes as shared dinner. Among these families, three families heated a second dinner of manufactured Western foods (i.e., chicken nuggets, hot dogs, macaroni & cheese) that

was served only to recalcitrant children. These parents had given up trying to force children to eat Chinese meals. One father said, “We mainly consider adults’ preferences when cooking. We don’t consider kids’ preferences. If we considered kids’ preferences, we couldn’t cook any Chinese foods.” Regardless of the type of dinner served, most families still ate fruits as desserts.

Eating out served to relieve the pressure on some parents to serve Western dishes. Seven families took their children to fast food restaurants once a week to satisfy their children’s desire for these foods. This had little effect on food choices of parents, as one father said, “We take our daughter to McDonald’s often... Our daughter likes foods there. Usually we let her eat something there and we adults eat after we go back home.”

### ***Family Functioning***

Dietary behavior was also influenced by family flexibility or their willingness to alter roles, rules, and power, and their degree of communication about food within and outside the family. We will discuss roles, rules, power, and communication separately.

### **Roles**

Only two families had a stay-at-home mother. In general, regardless of working status, females took more responsibility than males for food shopping and preparation. Food shopping followed four patterns: done mainly by wives (n=8) or husbands (n=1); done mainly by husbands and wives together (n=6); and partners traded off the food shopping (n=5).

Most parents completed food shopping by visiting American and Asian stores every week. Most bought dairy products together with other foods weekly at American supermarkets. A few families who consumed organic milk and yogurt bought those at specific local stores. One mother said, “All the yogurts we buy are organic yogurt. There is organic yogurt in Giant Eagle. It is convenient to buy.”

At home, breakfast and lunch required little preparation. Parents usually made their own breakfast and most mothers made breakfast for children using convenience foods on hand (i.e., milk, cereal, and bread). Mothers generally prepared lunches for children and for parents if leftovers were taken as lunch to work.

Four dinner preparation patterns emerged on weekdays: wife (n=13) or husband (n=2) prepared, husband and wife shared preparation (n=3), or elderly female prepared (n=2). Although many mothers and some fathers were competent Chinese cooks, most parents reported that finding ingredients and cooking dairy-based Western dishes was technically hard for them. Therefore, they were not willing to make these dishes from “scratch”, even though their children requested them. Some parents, who were concerned about their children’s food intake because they refused to eat Chinese dinners, preferred to buy manufactured dairy-based Western dishes, such as macaroni & cheese and pizza. Only a few mothers used dairy products as ingredients when cooking shared dinners (i.e., adding cheese to soup), if fathers also liked those foods.

### **Rules**

Most families had rules about types of food allowed as beverages, snacks, and main meals. Usually mothers had established the rules about which family members drank organic milk (i.e., children, children and father, or whole family). Some fathers or mothers established rules for the fat level of milk or amount of milk consumed by the whole family or children.

Rules regarding snacks were comparatively lenient, so everybody could obtain what he or she wanted. One mother said, “I always consider everybody’s preferences and habits. I buy snacks that kids like and I can also accept [in terms of nutrition]. I buy many different types of snacks. Everybody gets his or her snacks.” Some parents did control the types and amounts of snacks that children requested based on their criteria for nutritious snacks (i.e., no additives, low sugar, and low fat) and sometimes their budget. Because dairy products were considered healthful snacks, most parents allowed children to eat those they liked. However, a couple of mothers

limited the purchase of fancy yogurt designed for children. One mother said, “Kids like the product that is designed for kids, such as different shapes, a cup, a straw, or yogurt that comes with beans... I would let them choose one or two items that they like. But I buy the regular products in large quantities.” One mother required that children eat only organic yogurts. Another mother noted, “I control the amount of cheese our daughter eats because I think cheese is not healthy. It contains too much fat.”

Rules for main meal content were stricter. Many parents enforced a meal pattern of a meat dish (of various types), at least one vegetable, a starch, and perhaps some other Chinese dishes (soup, seafood, tofu, etc) depending on the household. Most families had rules for adopting new foods and indicated that it must be tasty, nutritious (i.e., organic or natural, low cholesterol, high protein or fiber), and convenient for them to add to their meal pattern.

### **Power**

The family power hierarchy and the cultural importance of the meal determined how family member preferences and personal willingness to eat more dairy products affected choice of dairy products for beverage, snacks, and meals, and thus dietary behavior.

When purchasing milk as a beverage, three patterns were evident: a) parents’ preferences dominated (n=6), b) all family members’ preferences were considered (n=8), or c) children’s preferences dominated (n=6). In pattern “a”, this decision was based on nutrition concerns (fat level and hormone issue) and children were reported to have no special preferences for particular milk products. One mother said, “We don’t have different preferences for fat level of milk. Usually I buy 2% milk. I think whole milk contains too much fat. But nonfat milk is too bland and doesn’t taste good. So I only buy 2% milk.” In pattern “b”, parents’ nutrition concern and family members’ food preferences were both considered. One mother noted, “He [son] likes the taste of organic milk... You know, the hormone issue. When we buy milk, we should buy milk with not much hormone. So I started to let my son drink organic milk.” Another mother noted,



“At first I bought 2% milk for the family. He [father] said 2% milk was not good for kids. So now I buy my own milk [nonfat milk] and they drink their whole fat milk.” In pattern “c”, both parents were either lactose intolerant or did not care about the taste of milk. They only considered children’s preference when purchasing milk. One mother who bought whole fat milk said, “We go by the kids’ preferences. We buy what kids like.” Milk was mainly a beverage or snack item and was not served at the culturally important family dinners, so personal preferences of all family members could be satisfied.

Since yogurt and cheese were considered healthy snacks by most parents, purchases were mainly based on balancing food preferences. Fat content of yogurt and cheese did not seem to concern parents in most families. In 11 families, children’s preferences were considered most. One mother said, “So when kids ask for yogurt and ice cream, I would buy for them without a doubt. They always ask for different flavors. I would buy all they ask for.” One father noted, “Actually, we mainly consider kids’ preferences. We [parents] are not picky about dairy products. If our daughter likes strawberry flavored yogurt, we buy strawberry flavored yogurt.” In seven families, both children’s and parents’ preferences were considered. One mother said, “Just cover them all. If someone likes this flavor; someone likes that flavor, we buy all the flavors.” Another mother noted, “Kids like Provolone cheese. I like Muenster cheese. We all like Mozzarella cheese. When I buy cheese, I buy all these types of cheese.” In two other families, parents controlled the type of yogurt or amount of cheese children consumed. Again, for snacks, most everyone’s preferences could be satisfied.

More conflicts arose around dinner patterns than around beverages and snacks. Although most children preferred Western foods, parental preference for traditional Chinese dishes at dinner generally prevailed. One father, who was the cook, said, “Kids like Western foods. I don’t consider their preferences when cooking dinner. I can decide what Chinese foods to cook.” Dinner was a culturally important meal where the parents’, and especially father’s, power to

determine the dietary pattern was exerted. One father said, “She [mother] knows what I want. So I don’t have to tell her I want Cantonese steamed fish tomorrow.” Another father, who taught his wife many cooking skills, noted, “If she [mother] wants to try new foods, she would ask me... Most of the time, she asks for my opinions.” Father’s dietary flexibility about altering the Chinese dinner pattern, his personal food preferences, and his perception of dairy-based main dishes influenced the degree of introduction of these dishes into dinner patterns. One father said, “I support her [mother] cooking new dishes, no matter whether it is a Chinese dish or a Western dish with cheese. We [father and child] would like to taste and give her our suggestions.” Another father noted, “We wanted to introduce salad into family meals, because we both like salad, especially me. There is cheese in salad.” In contrast, one father said, “We grew up in China and stayed there for more than 20 years. We have already formed a dietary habit... We don’t want to change it.” One wife noted, “I don’t know how to cook Western dishes with cheese, because my husband only eats Chinese foods. He refuses to eat all Western foods. Even if I tell him a Western dish tastes good, he wouldn’t want to eat it after I make it.”

### **Communication**

Internal and external communication facilitated family flexibility about milk as a beverage and dairy products as snacks. In most families, internal communication about food was informal and ad hoc, arising only if something new appeared or was contemplated. Sometimes children initiated informal discussion if they were asked to consume something new. One mother said, “My kids asked me, ‘why do you let me drink this kind of milk instead of the milk we drank before?’ They won’t accept it until I explain the reason.”

Other times reactive or ad hoc conversations within families were based on ideas from external sources, particularly friends, the media, and health professionals. Friends, an important influence, could provide information that caused parents to rethink their beverage and snack food choices. One father said, “So I buy organic milk based on this consideration. I got this

information through discussion with friends and neighbors.” Another father noted, “We drink 2% milk now, because friends said it was good.” Informal communication arose after parents brought these ideas home. Friends also influenced children’s food choices. One mother said, “After he [son] saw friends eating certain foods, he wanted those foods too. He doesn’t like yogurt very much, but he asked for yogurt recently, because his friends ate yogurt.”

These parents also indicated that media (internet, books, newspapers, magazines, and radio) was the major information source. One mother said, “Sometimes I get some information from Internet, TV...I would talk with my family members about the benefits of some foods, such as this kind of milk.”

Health professionals were another source of information and conversation. Both fathers and mothers brought expert opinions home. These opinions influenced the accuracy of parent’s perceptions of dairy products. For example, based on the doctor’s advice, parents in two families gave their children 2% milk and one mother restricted her son’s milk intake. She said, “Kids at my son’s age [age 6] shouldn’t drink more than two cups of milk. If they drink more than two cups of milk, they would get more calcium than they need. The extra calcium will deposit in kids’ kidneys.” When parents could not reach a clear conclusion through discussion, they also tended to seek professional advice. Some fathers required information about benefits and the recommended amount of dairy products from trustworthy but unspecified authorities for action. One father said, “We need an authority to tell us the information about dairy products...She [mother] said one extra cup of milk more than a certain amount is too much. I don’t think so.” Several parents also indicated that they might consume more dairy products if professionals (doctors or nutrition experts) recommended this. Only one father disagreed with their pediatrician’s advice that they did not have to control children’s organic skim milk consumption. The father dismissed the pediatrician’s advice and limited the children’s milk intake to three cups a day in the home.

### *Supportive Behaviors*

Family members' behavior could support or not support dairy product consumption. Behaviors differed around dairy product use at dinner, at lunch, or as snacks and beverages.

Support for consumption of dairy-based Western foods differed at dinner and lunch. At dinner, although all parents felt dairy products were important for children's development, many parents were not willing to cook or serve dairy-based main dishes. One father said, "If kids don't like the [Chinese] foods I cook, they can mix rice with the liquid in the dish." Most parents usually limited if and how often dairy-based Western dishes were served and the venue used (side dishes, take out) so that the Chinese meal pattern was preserved for the parents. One mother said, "I would buy pizza or foods from Burger King for them... I take out foods for them from Burger King twice a month." At lunch, children's desire for dairy-based Western foods was satisfied by eating school lunch or taking the Western food they like to school. One father noted, "Kids bring lunch to school sometimes. We buy several kinds of bread, ready to eat meat, and some vegetables... When we bring sandwiches to school or work, we add some cheese to sandwiches." In contrast, many wives planned for dinner leftovers so the parents could avoid Western foods, thus supporting the traditional Chinese meal pattern.

Regardless of lactose intolerance status, all parents supported children's consumption of dairy products (milk, yogurt, and cheese) as snacks and beverages. One mother said, "We have yogurt at home all the time... My daughter's opinion is important on yogurt purchase, because she consumes more yogurt than all of us." Parents either supported or did not care about each other's interest in dairy products as snacks and beverages. One father said, "She [mother] supports me trying new dairy products. One time, she went to a friend's home and tasted one kind of cheese. She thought that cheese tasted good. She bought that cheese." Another father noted, "She

[mother] wouldn't care. She may not even know I have been eating one dairy product for a couple of years. She doesn't eat dairy products. She doesn't care what dairy products I buy."

## **Discussion**

This study examined how dairy products fit into the overall family food system in a sample of first generation Chinese American families, something few previous studies have explored.

For a long time, nutrition education efforts targeting Western European cultures have focused on women, because they were believed to be the family 'gatekeepers' who were responsible for menu planning, shopping, and cooking (De Bourdeaudhuij, 1997; Harnack, et al., 1998) and thus controlled food choices. In this study, we interviewed both parents using Baranowski's Reciprocal Determinism Model together with the Circumplex Model of Marital and Family Systems as a guide, as opposed to interviewing only the female "gatekeepers". This helped us understand how all member personal characteristics, family rules, power, and communications affected dietary behavior.

The Reciprocal Determinism Model suggested that personal characteristics would have an influence on dietary behavior. Many efforts to increase calcium intake through dairy product consumption have focused on ways to 'get around' lactose intolerance. Since it is assumed that many Chinese Americans are lactose intolerant, we expected this would be a major problem. Surprisingly, in this sample, lactose intolerance did not seem to be the major barrier to parents' dairy intake, perhaps because only one third of these parents self identified as lactose intolerant. Even most of the lactose intolerant parents still consumed small amounts of dairy products using some strategies to handle adverse reactions recommended by others (Jackson and Savaiano, 2001; Savaiano, 2003). In contrast to lactose intolerance, taste, texture, and use of additives and growth

hormones appeared to be a major influence on dairy product choice as found by others (Lv et al., 2007, Kim et al., 2003; Park and Ureda, 1999).

According to the Reciprocal Determinism Model, family functioning interacts with personal characteristics to influence dietary behavior. With the help of the Circumplex Model of Marital and Family Systems, our analysis indicated that parental use of food rules and power to influence food patterns affected family flexibility about dairy product use. This flexibility was most limited for the culturally important dinners. A strictly enforced dinner pattern rule and parental power, especially that of the father, to determine the extent of use of dairy-based dishes at dinner helped retain the Chinese meal pattern. This pattern also limited milk intake by parents and children as milk was not compatible with Chinese dinners. The father's power over dinner choices was not significantly affected by a more limited role in food shopping and preparation. So father's power to influence family dinner choices (which was generally greater than that of his wife or children) allowed his personal preferences for meal patterns to dominate at dinners. Only if he liked dairy based dishes were they served at dinners. In contrast, choices at breakfast, lunch, beverages, and snacks were more flexible and it was possible to include dairy products, possibly because these were not shared meals. Others also reported that breakfast was the first meal to be Westernized (Satia et al., 2000) and in comparison, dinner was much more resistant to Western influences (Chau et al., 1990).

The Circumplex Model of Marital and Family Systems also helped us understand that communication facilitated flexibility around acceptable dairy products mainly through formulation and execution of new rules. External communication influenced the rule formulation while internal communication facilitated execution of new rules, which could alter family members' dietary behavior, especially that of children.

In summary, using these two theories as a guide for developing the interview questions helped us understand the interview data. From the interviews, we learned that fathers' power and

their desire to maintain the traditional Chinese dietary pattern at dinner and, for many, at lunch, was the major influence on how dairy products fit into these families' food systems. Traditional dietary habits (Chinese style dinner, warm breakfast), taste preferences (dislike of cheese, desire for Chinese style yogurt), lack of cooking skills, and ease of using supplements were bigger barriers than lactose intolerance for use of dairy products in the family food pattern. This type of information needs to be available prior to design of any intervention.

### ***Future Research and Study limitations***

Several research questions emerged from this qualitative study that could be tested in future research: Is the father's liking of dairy products a stronger predictor of family adoption of dairy-based dinner main dishes than the mother's or the child's liking of these? What is the relative contribution of liking of dairy products and lactose intolerance to adoption of dairy products by first generation Chinese American families? What is the influence of the cooking skill level of the mother and perhaps the father on family adoption of dairy-based main dishes?

This study was conducted using a small convenience sample of first generation Chinese American families in Pennsylvania. The results should be used with caution, because many of these families had relatively high education and income levels. Only a small number of parents reported they were lactose intolerant, perhaps because lactose intolerant parents may not want to participate in a study about dairy products. Quantitative and qualitative research among a more diverse population of Chinese American families is needed to examine how family functioning factors influence dairy product use. In addition, we did not study participants according to time of residence in the U.S. A larger quantitative study that examined this factor might show its influence on the adoption of dairy products. Despite these limitations, results of this study could

help plan an appropriate intervention to improve dairy product consumption of Chinese Americans, thus reducing their risk of osteoporosis.

### ***Implications for Practice***

This sample of Chinese American parents was not willing to consume more dairy products partially due to traditional dietary habits and preference for Chinese foods. However, they were not familiar with personal calcium requirements and the importance of calcium to their own bone health. Educational efforts to address this knowledge gap and show how dairy products can meet their personal preferences and calcium needs while fitting into their family dietary pattern may motivate behavioral change. When designing interventions to improve dairy intake among Chinese Americans, we recommend health educators consider the following suggestions.

1. *Address personal characteristics:* Introduce Chinese Americans to unfamiliar dairy products by offering opportunities to taste lactose free milk, organic milk, organic and new yogurt products, and various types of cheese (i.e., lowfat cheese). Offer strategies to help lactose intolerant individuals include dairy products in their diet. The lack of use of lactose free milk in this sample suggests a teaching opportunity. Chinese Americans prefer dairy products like yogurt that is not very sweet and has the sensory characteristics of traditional Chinese yogurts (i.e., thinner and sourer) and that contain natural additives/ingredients. If tasting can increase preference, they may accept information about the importance of dairy and calcium intake on good bone health.

2. *Consider how dairy products fit into traditional dietary behaviors:* Teach Chinese Americans how to fit dairy products in breakfast, lunch, desserts, and snacks. Yogurt that is similar to the Chinese yogurt in taste and texture may be a good choice for lunch and snacks. Some parents reported buying lunch and snacks at company cafeterias. Company lunch programs



could be encouraged to serve yogurt or simple recipes made with yogurt (i.e., parfaits made with yogurt and fruits). Most families ate fruits as desserts. Therefore, a fruit dip recipe using yogurt could be developed to complement this family dessert pattern.

3. *Include fathers in interventions:* Teach both mothers and fathers about how to use dairy products as ingredients when cooking familiar Chinese foods in their meal pattern. Fathers should be involved in these educational efforts. Once fathers approve the taste, the adoption of these recipes in family meals becomes easier. Dairy products that do not have a strong taste may be appropriate for developing such recipes. For example, adding grated parmesan cheese to common Chinese soups such as the tomato and egg drop soup makes the soup tastes richer, but the taste is still similar to the traditional one. Adding nonfat dry milk to fluid milk, milk tea, smoothies, or porridge does not change the taste much, but it boosts their calcium content. Using milk in steamed buns makes the steamed buns whiter, fluffier, and taste even better.

4. *Encourage formal communication among parents, reputable sources, and friends:* Provide clear nutrition information from reputable sources. Chinese Americans felt some information was confusing and they wanted more information from a trustworthy source. Clear information on the amount of calcium needed and effects of calcium on bone health may reduce misconceptions. Chinese schools and worksites where both parents and their friends could be reached might be a practical venue to reduce misconceptions and concerns, and encourage support.

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## References

- Baranowski T, Hearn MD. Health behavior interventions with families. In: Gochman DS, ed. *Handbook of Health Behavior Research IV. Relevance for Professionals and Issues for the Future*. New York, NY: Plenum Press; 1997:303-323.
- Babbar RK, Handa AB, Lo CM, Guttmacher SJ, Shindlecker R, Chung W, Fong C, Ho-Asjoe H, Chan-Ting R, Dixon LB. Bone health of immigrant Chinese women living in New York City. *J Community Health*. 2006; 31:7-23.
- Borugian MJ, Sheps SB, Whittemore AS, Wu AH, Potter JD, Gallagher RP. Carbohydrates and colorectal cancer risk among Chinese in North America. *Cancer Epidemiol Biomarkers Prev*. 2002; 11:187-193.
- Brown JL, Miller D. Couple's gender role preferences and management of family food preferences. *J Nutr Educ Behav*. 2002; 34: 215-223.
- Chau P, Lee H, Tseng R, Downes NJ. Dietary habits, health beliefs, and food practices of elderly Chinese women. *J Am Diet Assoc*. 1990; 90: 579-580.
- Chiu JF, Lan SJ, Yang CY, Wang PW, Yao WJ, Su IH, Hsieh CC. Long-term vegetarian diet and bone mineral density in postmenopausal Taiwanese women. *Calcif Tissue Int*. 1997; 60:245-249.
- De Bourdeaudhuij I. Perceived family members' influence on introducing healthy food into the family. *Health Educ Res*. 1997; 12:77-90.
- De Bourdeaudhuij I, Van Oost P. Family members' influence on decision making about food: Differences in perception and relationship with healthy eating. *Am J Health Promot*. 1998; 13:73-81.
- Glaser BG, Strauss AL. *The Discovery of Grounded Theory: strategies for qualitative research*. Chicago, IL: Aldine de Gruyter; 1967.
- Harnack L, Story M, Martinson B, Neumark-Sztainer D, Stang J. Guess who's cooking? The role of men in meal planning, shopping, and preparation in US families. *J Am Diet Assoc*. 1998; 98:995-1000.
- Holsti OR. *Content analysis for the social sciences and humanities*. Reading, MA: Addison-Wesley; 1969:140.

- Jackson KA, Savaiano DA. Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *J Am Coll Nutr.* 2001; 20:198S-207S.
- Johnson CS, McLeod W, Kennedy L, McLeod K. Osteoporosis health beliefs among younger and older men and women. *Health Educ Behav.* 2008;35:721-733.
- Kim KW, Reicks M, Sjoberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav.* 2003;35:294-301.
- Lv N, Brown JL, Liu BF. Factors influencing dairy product consumption of Chinese Americans in Pennsylvania. *Top Clin Nutr.* 2007; 22: 259-271.
- Lv N, Cason K. Dietary pattern change and Acculturation of First Generation Chinese Americans in Pennsylvania. *J Am Diet Assoc.* 2004; 104: 771-778.
- National Osteoporosis Foundation. America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation. Washington, DC; 2002.
- Nicklas TA. Calcium intake trends and health consequences from childhood through adulthood. *J Am Coll Nutr.* 2003; 22:340-356.
- Olson DH, Gorall DM. Circumplex Model of Marital and Family Systems. In: Walsh F, ed. *Normal Family Processes.* 3<sup>rd</sup> ed. New York, NY: Guilford Press; 2003: 514-548.
- Park K, Ureda JR. Specific motivations of milk consumption among pregnant women enrolled in or eligible for WIC. *J Nutr Educ Behav.* 1999;31:76-85.
- Satia JA, Patterson RE, Taylor VM, Cheney CL, Shiu-Thornton S, Chitnarong K, Kristal AR. Use of qualitative methods to study diet, acculturation, and health in Chinese-American women. *J Am Diet Assoc.* 2000; 100: 934-940.
- Savaiano D. Lactose intolerance: A self-fulfilling prophecy leading to osteoporosis? *Nutr Rev.* 2003; 61: 221-223.
- US Census Bureau. Census 2000 Summary File 1, Matrices P3, P4, PCT4, PCT5, PCT8, and PCT11. QT-P3. Race and Hispanic or Latino: 2000. Available at [http://factfinder.census.gov/bf/?\\_lang=en\\_vt\\_name=DEC\\_2000\\_SF1\\_U\\_QTP3\\_geo\\_id=01000US.html](http://factfinder.census.gov/bf/?_lang=en_vt_name=DEC_2000_SF1_U_QTP3_geo_id=01000US.html). Accessed November 6, 2008.
- US Census Bureau. 2006 American Community Survey: Selected Population Profile in the United States. Available at <http://factfinder.census.gov>. Accessed November 24, 2008.

## Chapter 5

### **Impact of a nutrition education program to increase intake of calcium-rich foods by Chinese American women<sup>7</sup>**

#### **Introduction**

Osteoporosis, a national as well as a global public health problem, results in 1.5 million Americans suffering fractures each year and an annual medical cost of at least \$18 billion (National Osteoporosis Foundation, 2002; Babbar et al., 2006). These numbers will rise noticeably with the growing elderly population (Melton, 2003).

Chinese Americans are the largest US Asian population. In 2006, there were 3.6 million Chinese living in the US, with 63% being foreign-born (US Census 2006). By 2050, about one-tenth of the US population will be of Asian descent, many of them Chinese Americans (US Census 2008). Among racial groups, Chinese women have a high risk of low bone mineral density and osteoporosis (Siris et al., 2001; Lauderdale et al., 2003). Many osteoporosis prevention efforts are aimed at Caucasians and African Americans. Chinese American women, however, have received little attention from nutrition educators.

Nutrition education efforts to reduce the risk of osteoporosis have been focused on increasing calcium and vitamin D intake. Food frequency questionnaire data indicate that daily dietary calcium intake of Chinese American women is 500-600 mg (Walker et al., 2007; Borugian et al., 2002), suggesting that their calcium intake is substantially below the Dietary Reference Intake, which increases their risk of osteoporosis (Jackson and Savaiano, 2001). A

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<sup>7</sup> Will be submitted to Journal of the American Dietetic Association.

search of the Science Citation Index revealed no data on vitamin D intake in the Chinese American population.

Many foods, including those that are calcium-fortified, are good sources of calcium and some are also enriched with vitamin D. Increasing consumption of these foods can boost total calcium and vitamin D intake, thus reducing the risk of osteoporosis. After immigration, Chinese Americans adopt some convenient Western foods into their breakfast, lunch or snacks while their dinner still follows the traditional Chinese vegetable, meat and starch pattern with no dairy products (Lv and Brown, 2009; Chau et al., 1990). Some food practices of adults appear resistant to change due to food habits established early in their life (Kelleher et al., 2006; Lee et al., 1994; Lawton et al., 2008). Nutrition education efforts should consider this adoption pattern.

Theoretical frameworks have been increasingly used as the basis to design nutrition education programs. The theory of planned behavior (TPB) or its precursor, the theory of reasoned action (TRA), has been used to design programs that successfully improved general healthy eating behaviors (Tsorbatzoudis 2005a; Tussing and Chapman-Novakofski, 2005) and physical activity (Tsorbatzoudis 2005b). According to TPB, one's consumption of a target food is determined by one's intention to consume this food, which would be influenced by three factors: attitude toward consumption, social influence, and perceived behavioral control over consumption (Park and Ureda, 1999; Montano et al., 1997). Attitude is further explained by two beliefs: the consequences of consumption and evaluation of these consequences. Social influence is influenced by two beliefs: what one's family, friends, or health professionals think one should or should not consume and one's motivation to comply with them. Perceived behavioral control is affected by perceived likelihood of facilitating or constraining conditions and the perceived effect of these conditions on consumption. TPB provided a framework for designing an intervention to increase calcium-rich food consumption. This intervention focused on influencing attitude and perceived behavioral control, as outlined in Figure 5-1. The objective of our study was to design

and pilot test this intervention to help Chinese American women incorporate calcium-rich foods into their dietary pattern to increase calcium and vitamin D intake.

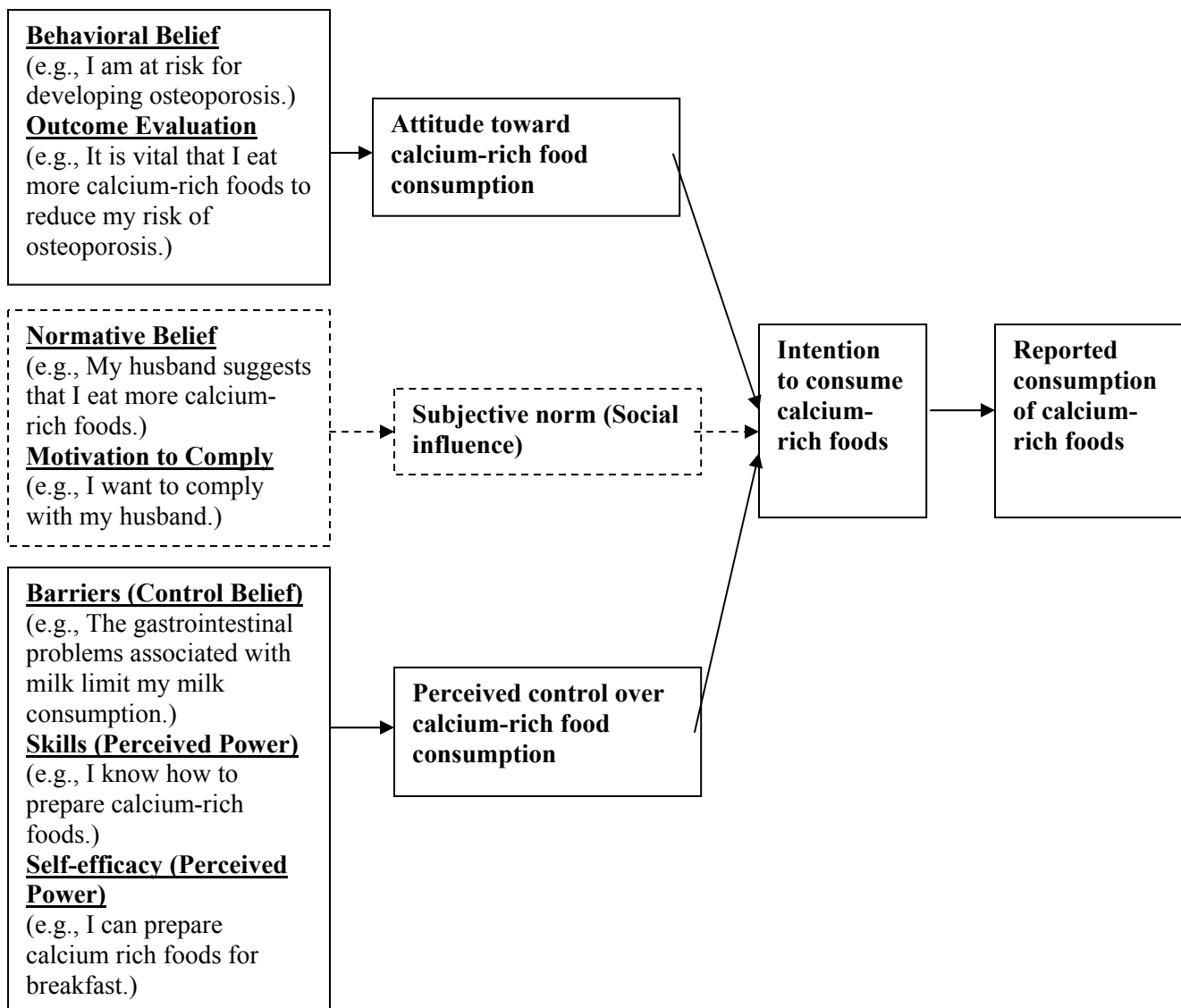


Figure 5-1: Theoretical framework of the Theory of Planned Behavior used to design our program to increase calcium-rich food consumption.

## **Methods**

### ***Study Participants***

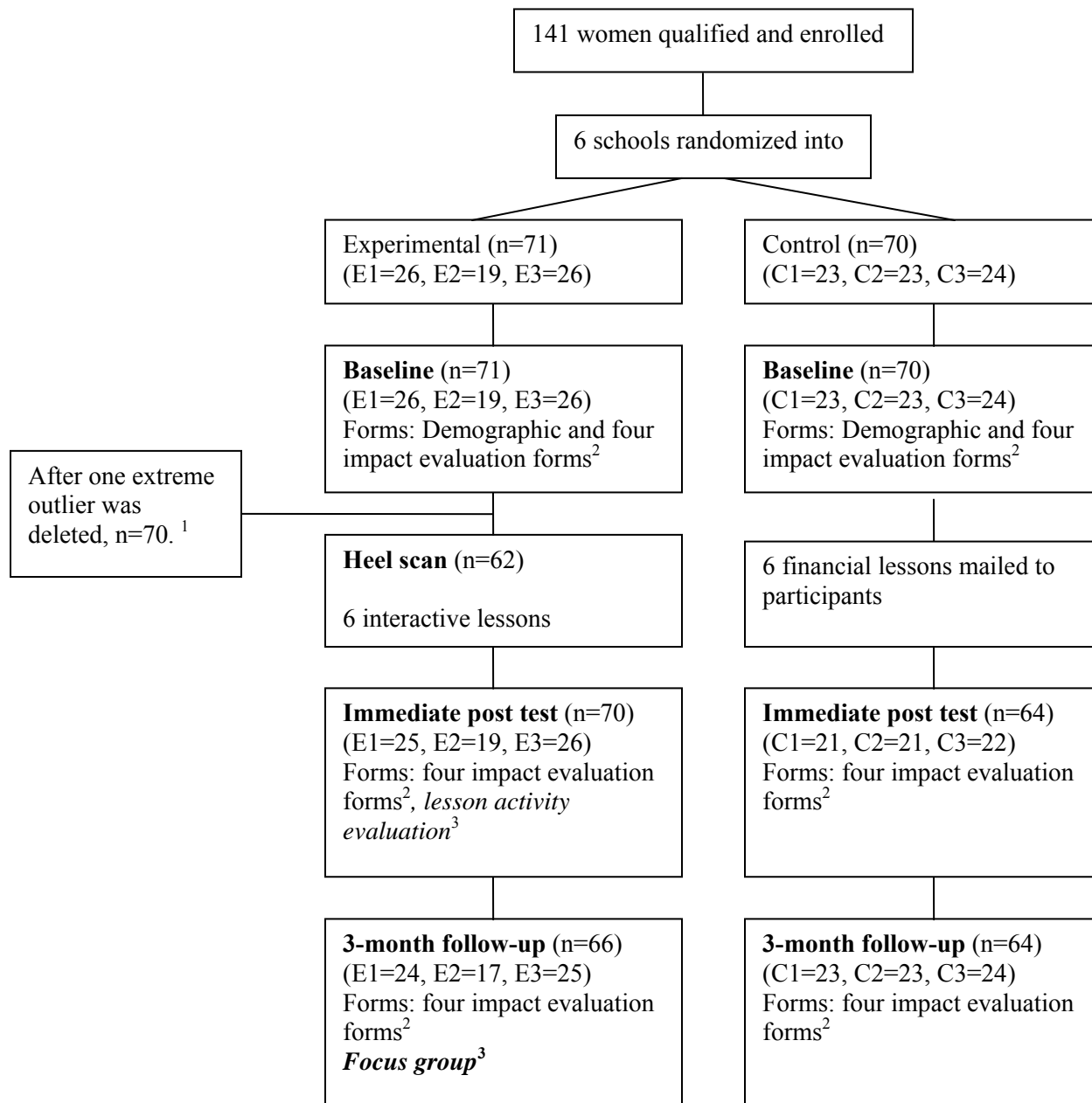
Chinese American women were recruited from six weekend Chinese schools in the Philadelphia area where their children were enrolled to maintain Chinese culture and language skills. A power analysis ( $\alpha=.05$ ; power=.80) indicated at least 44 women in each treatment group were needed to detect a statistically significant change of 150 mg of daily calcium intake. To account for attrition, 25 women per school (75 per treatment group) became our recruitment target. Participants had to meet the following criteria: a) first generation Chinese American women; b) have child(ren) enrolled in the weekly Chinese school; c) 35 to 55 years old (to tap into possible increased risk perception of osteoporosis among peri-menopausal and early menopausal women), and d) willing to accept random assignment. The recruiter visited the school and approached all mothers in the school waiting area starting from the entry and asked if they would participate in an education program to increase dietary calcium intake. Achieving the recruitment target required 2-3 visits to each school with about one third of those approached agreeing to participate. A total of 141 Chinese American women were recruited and their distribution across the six schools is shown in Table 5-2.

### ***Study Design***

The Institutional Review Board of the Pennsylvania State University approved all procedures. This was a Quasi-experimental study with a nested design and pre, immediate post, and 3-month follow-up assessments (see Figure 5-2). Three Chinese schools each were randomly

assigned to the experimental or control group. All participants completed baseline questionnaires and then the experimental group received a free heel scan provided by the AREUFIT Health Services, Inc. Two weeks later, they began six weekly interactive, 1.5-2 hour lessons provided at the schools during school hours. After the baseline measures, the control group received six weekly non-related financial lessons by mail. Immediately and three months after the intervention, post and follow-up questionnaires were completed by participants in both groups.





<sup>1</sup> An extreme outlier for baseline daily calcium intake was eliminated from the database. This person also had high education, annual household income, baseline scores for TPB scales, knowledge, and level of readiness to eat more dairy products.

<sup>2</sup> Four impact evaluation forms: FFQ, outcome, knowledge, readiness to eat more dairy products.

<sup>3</sup> Italics represent process evaluation.

Figure 5-2: Study design flow chart.

## ***Measures***

A demographic questionnaire assessing age, education, time in US, household characteristics and family history of fractures or osteoporosis plus current supplement use was administered at baseline.

***Impact evaluation*** was achieved by administering the following questionnaires to both the experimental and control group at all three time points.

**Food Frequency Questionnaire (FFQ)** format was modeled after that used by Kim et al. (2003) and included 26 calcium-rich foods from the 3-page calcium questionnaire of Sebring et al. (2007) that was validated against a 7-day food record (correlation for dietary calcium intake:  $r^2=0.33$ ,  $P<0.001$ ). These 26 items included breakfast milkshakes, calcium-fortified foods (orange juice, soy milk, tofu, bread, cereal), dairy products (regular milk, half & half, sliced, cubed, or shredded cheese, cottage cheese, ricotta cheese, yogurt, yogurt drink, ice cream and frozen yogurt, ice cream bars or cones), dishes made with milk or cheese (pudding, cream soup, macaroni & cheese, mashed potatoes), vegetables (broccoli, bok choy, kale, mustard greens, napa), beans and peas, fish with bones, and nuts. Three extra food items (lactose free or reduced milk, nonfat dry milk, and yogurt drink) covered in our intervention were added to the list for a total of 29 items. Participants indicated how frequently and how much of each item they had eaten in the past month and then indicated the fat level of milk, yogurt, and cheese usually consumed.

**Outcome questionnaire** was composed of 8 scales of TPB constructs [attitude (behavioral belief, outcome evaluation), subjective norm (normative belief, motivation to comply), perceived behavioral control (barriers, skills, self-efficacy), and intention]. The intervention focused on increasing self-efficacy by increasing skills and reducing barriers. Barriers and self-efficacy have been found to directly predict calcium intake of American women

most of whom were Caucasian (Schmiege et al., 2007). Therefore, barriers, skills, and self-efficacy were used to explain perceived behavioral control. The draft outcome questionnaire used a 5-point scale (ranging from “disagree a lot” to “agree a lot”) to evaluate each of 12-20 statements per construct for a total of 123 statements. After experts assessed face and content validity, the draft instrument was administered twice 4-5 weeks apart to 61 local married Chinese women to assess internal consistency and test-retest reliability. To increase the internal consistency and test-retest reliability of the scales, 20 statements were deleted, resulting in 103 statements in the final questionnaire. Please see Table 5-1 for Cronbach’s alpha at the first pilot test and Spearman’s rank correlation coefficients between two pilot tests.

Table 5-1: Cronbach’s alpha at the first pilot test and Spearman’s rank correlation coefficients between two pilot tests.

	<b>Cronbah <math>\alpha</math></b>	<b>Spearman r</b>
Behavioral belief (17 statements)	0.68	0.566**
Outcome evaluation (12 statements)	0.68	0.602**
Normative belief (9 statements)	0.41	0.452**
Motivation to comply (10 statements)	0.77	0.572**
Barriers (15 statements)	0.68	0.589**
Skills (18 statements)	0.94	0.773**
Self-efficacy (10 statements)	0.82	0.669**
Intention (12 statements)	0.60	0.502**

\*\* $P < .01$

Knowledge was positively related to food/nutrition attitudes and healthy dietary behaviors/nutrient intakes (i.e., calcium intake) (Chang, 2006; Lin and Lee, 2005; Baranowski et al., 1999; Chaubey and Gates, 1997) and was measured in many nutrition education programs. A draft ***knowledge questionnaire*** composed of 18 questions with four possible answers and one “Don’t know” option was tested along with the outcome questionnaire. Three questions answered correctly by more than 70% of participants were deleted, resulting in 15 questions. The final questionnaire covered 2-3 knowledge points in each lesson, including calcium intake

recommendation, osteoporosis risk factors, correct ways of taking calcium supplements, nutrients in nonfat dry milk, reading calcium and vitamin D content on Nutrition Facts labels, meaning of calcium bioavailability, identification of calcium-rich foods, strategies for handling lactose intolerance, dairy intake recommendation, benefits of live cultures, and calcium and lactose content of cheese.

**Readiness to eat more dairy products questionnaire** was based on that of Tucker et al. (2002) and assessed stage of readiness to eat dairy products, a group of natural calcium-rich foods. Stage of readiness to eat dairy products measured by this questionnaire was positively correlated with self efficacy, dairy calcium intake, and total dietary calcium intake (Snelling et al., 2006; Tucker et al., 2002). Since stage of change was measured as an outcome variables in other education interventions (De Vet et al., 2008, John et al., 2003), we included this measure in our experiment. The readiness to eat more dairy products questionnaire used is composed of four questions. It asks about the number of servings of dairy products one eats each day. If the answer is three servings or more, it asks how long one has been eating this amount. If the answer is less than three servings, it asks if one is seriously thinking about eating more dairy products in the next six months and/or if one is planning to eat more during the next month.

**Process evaluation** was achieved through the following at immediate post or 3-month follow-up with the experimental group.

**Lesson activity evaluation questionnaire** (immediate post) measured number of lessons attended, like/dislike of lesson components (food label reading activities, tasting manufactured foods, tasting recipes, recipe preparation, homework, and calcium/vitamin D assessment), and overall usefulness of the lessons. Preference and overall usefulness were measured by 5-point Likert scales.

**Focus groups** (n=5) were conducted as a separate session at 3-month follow-up by a trained moderator using Mandarin (participants' preference) in the three experimental schools.

Multiple sessions were needed to capture the maximum number of participants. First, participants were asked about barriers to increasing calcium-rich food intake and perceived impact of the intervention on calcium-rich food consumption, calcium intake, vitamin D intake, supplement intake, and family members. Participants were also asked about useful/not useful information in each lesson and how to improve the lesson content and activities. Each discussion lasted about 1 hour and was audio taped.

### ***Interactive Intervention Lessons***

The experimental group received a heel scan before six interactive lessons that were developed using TPB as a guide. Lesson topics were a) how to reduce the risk of osteoporosis; b) role of calcium supplements and nonfat dry milk; and use of c) non-dairy calcium-rich foods; d) cow's milk and soy milk; e) yogurt; and f) cheese. These lessons used visual demonstrations, food label reading activities, manufactured food tasting, recipe preparation and tasting, and take home activities. Heel scan results, information on reducing osteoporosis risk, amounts of calcium and vitamin D needed, calcium-rich foods versus calcium supplements, and benefits of calcium-rich foods, and food and recipe tasting were expected to affect attitude. Perceived control was addressed by learning how to read the Nutrition Facts panel, to deal with lactose intolerance, to fit specific calcium-rich foods in their diet, and to prepare calcium-rich recipes. Although not a focus, social influence was addressed through in-class discussion and homework encouraging family members to taste recipes presented in class. Recipes were chosen to fit Chinese American meal patterns as described in another study (Lv and Brown, 2009).

### ***Data Analysis***

Quantitative data was analyzed using the SPSS system (version 11.5 for windows, 2003, SPSS Inc, Chicago, IL). Demographic and lesson activity evaluation data was described using descriptive statistics.

### **Food Frequency Questionnaire**

Daily dietary calcium and vitamin D intake were calculated using the USDA nutrient database (USDA 2009) for 23 foods and Nutrition Facts labels on food packages for the 6 remaining food items not found in the USDA database. Food packages were used to calculate calcium and vitamin D content of breakfast milkshakes, yogurt drink, ice cream bars or cones, calcium-fortified tofu, and some specific calcium-fortified breads and cereals. When the brand and type of calcium-fortified bread or cereal were not specified, it was assumed that participants did not consume a calcium-fortified product. If only a brand was specified, a common regular (non-calcium-fortified) bread or cereal was used to calculate the calcium/vitamin D content. Peanuts, the most commonly consumed nuts in this sample, were used to calculate the calcium/vitamin D content for unspecified nuts. To normalize the distribution, daily calcium and vitamin D intake were transformed using square root (Wardle et al., 2005).

### **Outcome and Knowledge Questionnaire**

After recoding the reverse-worded statements in the outcome questionnaire, internal consistency reliability of each scale was determined using Cronbach's alpha. See Table 5-3. The mean score of all statements in each outcome construct was calculated. The knowledge score was the sum of the correct answers.

### **Readiness to Eat More Dairy Products Questionnaire**

Stages were coded as 1=Pre-contemplation; 2=Contemplation; 3=Preparation; 4=Action; and 5=Maintenance and treated as numerical data in linear mixed models (LMM) and regression analysis and as categorical data elsewhere.

To compare demographic characteristics among the six schools, one-way ANOVA with Tukey post hoc tests and Pearson chi-square were used for numerical and categorical variables, respectively. Because participants were nested within schools, LMM with repeated measures was used to test differences between the experimental and control group for daily calcium and vitamin D intake, theory constructs, knowledge, and readiness to eat more dairy products over time. Since annual household income, place of origin, length of stay in US, and relative's bone fractures were significantly different among the six Chinese schools at baseline (Table 5-2), they were considered for adjustment in the model. However, only when these covariates explained significant variance of the dependent variables, were they kept in the model for that particular dependent variable. This is noted in the footnote of Table 5-3. Paired t-tests were used to compare changes between any two assessment points within the experimental or control group. Independent t-tests were used to compare differences between the experimental and control group at an assessment point. Pearson r, Spearman rho, and one-way ANOVA with Tukey post hoc tests were used to measure the correlation between the change of calcium/vitamin D intake (3-month follow up - baseline) and numerical, ordinal, and categorical baseline variables of the experimental group, respectively. Step-wise multiple linear regression analysis was performed to determine the contribution of TPB constructs and baseline demographic variables to calcium/vitamin D intake at 3-month follow-up.

### **Focus Groups**

The audiotapes were simultaneously translated from Mandarin into English and transcribed by the Mandarin-speaking graduate researcher who conducted the focus groups. Thematic analysis with constant comparison was conducted using each group session as the unit

of analysis (Glaser and Strauss, 1967). A senior researcher generated a thematic coding list. Two graduate researchers then coded three focus group transcripts independently using the coding list. The agreements according to Holsti's (1969) formula were 0.89, 0.87, 0.82, showing that the coding list was reliable. Disagreements were discussed and resolved and one graduate researcher wrote thematic summaries.

## **Results**

### ***Participants' Characteristics***

As shown in Table 5-2, this was a sample of middle-aged mothers with high education and annual household income levels, who have lived in the U.S. for 19 years on average. A small portion (14%) was self-reported as lactose intolerant. One third of participants took calcium supplements. Annual household income, place of origin, length of stay in US, and relative's bone fractures differed significantly among the six schools. Only length of stay in US differed significantly between experimental and control group.



Table 5-2: Demographic characteristics [mean (standard deviation - SD) or mean (percentage)] at baseline in six experimental and control schools.

	Experimental			E total (n=70)	Control			C total (n=70)	P <sup>1</sup>	P <sup>2</sup>
	E1 (n=25)	E2 (n=19)	E3 (n=26)		C1(n=23)	C2 (n=23)	C3 (n=24)			
<b>Age (year)</b>	43.5 (4.9)	44.6 (4.6)	41.6 (3.6)	43.1(4.5)	43.7 (3.6)	40.9 (5.2)	42.5 (4.1)	42.3(4.4)	0.053*	0.343*
<b>Education</b>									0.139 <sup>+</sup>	0.686 <sup>+</sup>
11th grade or less	1 (4%)	1 (5.3%)	0 (0%)	2 (2.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
High school diploma or GED	1 (4%)	0 (0%)	0 (0%)	1 (1.4%)	1 (4.3%)	0 (0%)	1 (4.2%)	2 (2.9%)		
Some college or vocational training	1 (4%)	1 (5.3%)	0 (0%)	2 (2.9%)	0 (0%)	1 (4.3%)	0 (0%)	1 (1.4%)		
Graduate of vocational/tech school	5 (20%)	2 (10.5%)	0 (0%)	7 (10%)	1 (4.3%)	1 (4.3%)	2 (8.3%)	4 (5.7%)		
College graduate	10 (40%)	2 (10.5%)	2 (7.7%)	14 (20%)	5(21.7%)	4 (17.4%)	5 (20.8%)	14 (20%)		
Graduate or professional school	7 (28%)	12 (63.2%)	20 (76.9%)	39 (55.7%)	15(65.2%)	13 (56.5%)	14 (58.3%)	42 (60%)		
Postgraduate work	0 (0%)	1 (5.3%)	4 (15.4%)	5 (7.1%)	1 (4.3%)	4 (17.4%)	2 (8.3%)	7 (10%)		
<b>Annual household income</b>									0.028 <sup>+</sup>	0.684 <sup>+</sup>
\$24,999 or less	1 (4.5%)	3 (15.8%)	0 (0%)	4 (6%)	0 (0%)	0 (0%)	1 (5%)	1 (1.6%)		
\$25,000-\$49,999	5 (22.7%)	0 (0%)	0 (0%)	5 (7.5%)	2 (9.1%)	0 (0%)	3 (15%)	5 (7.8%)		
\$50,000-\$74,999	0 (0%)	2 (10.5%)	1 (3.8%)	3 (4.5%)	0 (0%)	3 (13.6%)	2 (10%)	5 (7.8%)		
\$75,000-\$100,000	6 (27.3%)	2 (10.5%)	6 (23.1%)	14 (20.9%)	4 (18.2%)	5 (22.7%)	5 (25%)	14 (21.9%)		
Above \$100,000	10 (45.5%)	12 (63.2%)	19 (73.1%)	41 (61.2%)	16(72.7%)	14 (63.6%)	9 (45%)	39 (60.9%)		
<b>Place of origin</b>									0.000 <sup>+</sup>	0.862 <sup>+</sup>
China	13 (52%)	2 (10.5%)	24 (92.3%)	39 (55.7%)	13(56.5%)	13 (56.5%)	18 (75%)	44 (62.9%)		
Taiwan	0 (0%)	13 (68.4%)	1 (3.8%)	14 (20%)	6 (26.1%)	3 (13.0%)	3 (12.5%)	12 (17.1%)		
Hong Kong/Macao	5 (20%)	1 (5.3%)	0 (0%)	6 (8.6%)	1 (4.3%)	2 (8.7%)	2 (8.3%)	5 (7.1%)		
Other	7 (28%)	3 (15.8%)	1 (3.8%)	11 (15.7%)	3 (13.0%)	5 (21.7%)	1 (4.2%)	9 (12.9%)		
<b>Length of stay in US (year)</b>	22.1 (7.0)	20.6 (7.1)	16.7 (4.1)	19.7 (6.5)	20.0 (4.7)	16.8 (6.6)	16 (5.8)	17.6 (5.9)	0.001*	0.042*

<b>Lactose intolerance status</b>									0.405 <sup>+</sup>	0.615 <sup>+</sup>
Yes	4 (16%)	4 (21.1%)	4 (15.4%)	12 (17.1%)	2 (8.7%)	3 (13.0%)	3 (12.5%)	8 (11.4%)		
No	19 (76%)	13 (68.4%)	21 (80.8%)	53 (75.7%)	20(87.0%)	20 (87.0%)	16 (66.7%)	56 (80.0%)		
Do not know/not sure	2 (8%)	2 (10.5%)	1 (3.8%)	5 (7.1%)	1 (4.3%)	0 (0%)	5 (20.8%)	6 (8.6%)		
<b>Ca supplements</b>									0.219 <sup>+</sup>	0.591 <sup>+</sup>
Yes	13 (52%)	5 (26.3%)	7 (26.9%)	25 (35.7%)	5 (21.7%)	7 (30.4%)	10 (41.7%)	22 (31.4%)		
No	12 (48%)	14 (73.7%)	19 (73.1%)	45 (64.3%)	18(78.3%)	16 (69.6%)	14 (58.3%)	48 (68.6%)		
<b>Bone fractures</b>									0.432 <sup>+</sup>	0.347 <sup>+</sup>
Yes	1 (4%)	1 (5.3%)	2 (7.7%)	4 (5.7%)	2 (8.7%)	1 (4.3%)	2 (8.3%)	5 (7.1%)		
No	22 (88%)	18 (94.7%)	24 (92.3%)	64 (91.4%)	21(91.3%)	22 (95.7%)	22 (91.7%)	65 (92.9%)		
Don't know	2 (8%)	0 (0%)	0 (0%)	2 (2.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0.0%)		
<b>Osteoporosis</b>									0.683 <sup>+</sup>	0.978 <sup>+</sup>
Yes	1 (4%)	1 (5.3%)	1 (3.8%)	3 (4.3%)	1 (4.3%)	0 (0%)	2 (8.3%)	3 (4.3%)		
No	17 (68%)	15 (78.9%)	21 (80.8%)	53 (75.7%)	14(60.9%)	19 (82.6%)	19 (79.2%)	52 (74.3%)		
Don't know	7 (28%)	3 (15.8%)	4 (15.4%)	14 (20%)	8 (34.8%)	4 (17.4%)	3 (12.5%)	15 (21.4%)		
<b>Osteopenia</b>									0.125 <sup>+</sup>	0.839 <sup>+</sup>
Yes	3 (12%)	0 (0%)	0 (0%)	3 (4.3%)	3 (13.0%)	1 (4.3%)	0 (0%)	4 (5.7%)		
No	17 (68%)	13 (68.4%)	21 (80.8%)	51 (72.9%)	11(47.8%)	17 (73.9%)	20 (83.3%)	48 (68.6%)		
Don't know	5 (20%)	6 (31.6%)	5 (19.2%)	16 (22.9%)	9 (39.1%)	5 (21.7%)	4 (16.7%)	18 (25.7%)		
<b>Relative's bone fractures</b>									0.002 <sup>+</sup>	0.209 <sup>+</sup>
Yes	2 (8%)	1 (5.3%)	10 (38.5%)	13 (18.6%)	7 (30.4%)	6 (26.1%)	7 (29.2%)	20 (28.6%)		
No	20 (80%)	11 (57.9%)	12 (46.2%)	43 (61.4%)	9 (39.1%)	16 (69.6%)	17 (70.8%)	42 (60.0%)		
Don't know	3 (12%)	7 (36.8%)	4 (15.4%)	14 (20%)	7 (30.4%)	1 (4.3%)	0 (0%)	8 (11.4%)		
<b>Relative's osteoporosis</b>									0.647 <sup>+</sup>	0.478 <sup>+</sup>
Yes	5 (20%)	4 (21.1%)	9 (34.6%)	18 (25.7%)	5 (21.7%)	5 (21.7%)	6 (25%)	16 (22.9%)		
No	10 (40%)	7 (36.8%)	10 (38.5%)	27 (38.6%)	8 (34.8%)	13 (56.5)	13 (54.2%)	34 (48.6%)		
Don't know	10 (40%)	8 (42.1%)	7 (26.9%)	25 (35.7%)	10(43.5%)	5 (21.7)	5 (20.8%)	20 (28.6%)		

<sup>1</sup> Comparison among six Chinese schools.

<sup>2</sup> Comparison between experimental and control group.

\* *P* value derived from one-way ANOVA with Tukey Post Hoc Test.

<sup>+</sup> *P* value derived from Pearson chi-square.

At baseline, there was no significant difference in calcium and vitamin D intake, all 8 theory constructs, knowledge, and readiness to eat more dairy products among the six schools. In both groups, most baseline calcium intake was contributed by three food items: regular cow's milk, calcium-fortified soy milk, and yogurt. Mean T-score of the 62 women who received the heel scan was  $-0.09 \pm 1.07$ . Among them, 51 (82.3%) had normal bone density (T-score  $> -1$ ) and 11 (17.7%) were osteopenic ( $-2.5 < \text{T-score} < -1$ ).

### ***Impact Evaluation***

Response rates to questionnaires collected at baseline, posttest, and 3-month follow-up were 100% (n=140), 96% (n=134), and 93% (n=130), respectively.

### **Daily Calcium and Vitamin D Intake**

An extreme outlier of calcium intake greater than three times the inter-quartile range between the first and third quartiles was deleted from the entire database. This participant also had high vitamin D intake, education, annual household income, baseline scores for TPB scales, knowledge, and level of readiness to eat more dairy products. Table 5-3 presents the changes in calcium intake, vitamin D intake, and theory constructs in experimental and control groups over time. From baseline to 3-month follow up, the experimental group achieved a significantly higher increase in daily calcium and vitamin D intake than the control group. The experimental group significantly increased its baseline calcium ( $t=7.898$ ,  $P=0.000$ ) and vitamin D intake ( $t=6.609$ ;  $P=0.000$ ) at posttest and this increase was retained at 3-month follow-up. The increase in calcium and vitamin D intake was mainly due to increased consumption of regular cow's milk, calcium-fortified orange juice, and yogurt. The control group's calcium and vitamin D intake did not change significantly over time. Calcium and vitamin D intake did not differ between lactose tolerant and intolerant participants at all three time points in both groups.

Table 5-3: Changes in calcium intake, vitamin D intake, and theory constructs in experimental and control group over time.

		Experiment <sup>a</sup>	Control <sup>a</sup>	Effect	P <sup>b</sup>
<b>End points</b>					
Ca intake (mg/d) <sup>1,2</sup>	Baseline	318.9 (246.5) <sup>A</sup>	394.0 (305.2) <sup>A</sup>	Group	0.093
	Posttest	534.3 (323.5) <sup>B</sup>	373.1 (266.4) <sup>A</sup>	Time	0.000
	Follow up	532.1 (325.8) <sup>B</sup>	367.7 (249.3) <sup>A</sup>	Group x Time <sup>c</sup>	0.000
Vit D intake (IU/d) <sup>2</sup>	Baseline	67.1 (69.4) <sup>A</sup>	87.6 (81.3) <sup>A</sup>	Group	0.397
	Posttest	116.3 (83.2) <sup>B</sup>	80.6 (70.8) <sup>A</sup>	Time	0.000
	Follow up	115.0 (89.6) <sup>B</sup>	81.6 (69.3) <sup>A</sup>	Group x Time <sup>c</sup>	0.000
<b>TPB constructs</b>					
Behavioral belief <sup>1,3</sup> (17 statements)	Baseline ( $\alpha=0.75$ )	3.6 (0.5) <sup>A</sup>	3.7 (0.5) <sup>A</sup>	Group	0.003
	Posttest ( $\alpha=0.76$ )	4.0 (0.5) <sup>B</sup>	3.7 (0.4) <sup>A</sup>	Time	0.000
	Follow up ( $\alpha=0.77$ )	4.0 (0.5) <sup>B</sup>	3.6 (0.4) <sup>A</sup>	Group x Time <sup>c</sup>	0.000
Outcome evaluation <sup>3</sup> (12 statements)	Baseline ( $\alpha=0.79$ )	4.1 (0.5) <sup>A</sup>	4.1 (0.5) <sup>A</sup>	Group	0.032
	Posttest ( $\alpha=0.82$ )	4.5 (0.4) <sup>B</sup>	4.2 (0.5) <sup>C</sup>	Time	0.000
	Follow up ( $\alpha=0.79$ )	4.4 (0.4) <sup>B</sup>	4.2 (0.4) <sup>D</sup>	Group x Time <sup>c</sup>	0.000
Normative belief <sup>3</sup> (9 statements)	Baseline ( $\alpha=0.27$ )	3.4 (0.4) <sup>A</sup>	3.4 (0.4) <sup>AB</sup>	Group	0.368
	Posttest ( $\alpha=0.33$ )	3.4 (0.5) <sup>AB</sup>	3.3 (0.4) <sup>B</sup>	Time	0.042
	Follow up ( $\alpha=0.36$ )	3.5 (0.5) <sup>A</sup>	3.4 (0.4) <sup>A</sup>	Group x Time	0.756
Motivation to comply <sup>3</sup> (10 statements)	Baseline ( $\alpha=0.74$ )	4.1 (0.6) <sup>A</sup>	4.1 (0.5) <sup>A</sup>	Group	0.906
	Posttest ( $\alpha=0.79$ )	4.3 (0.6) <sup>B</sup>	4.3 (0.5) <sup>B</sup>	Time	0.000
	Follow up ( $\alpha=0.82$ )	4.4 (0.5) <sup>BC</sup>	4.4 (0.4) <sup>C</sup>	Group x Time	0.452
Barriers <sup>1,3</sup> (15 statements)	Baseline ( $\alpha=0.72$ )	2.7 (0.5) <sup>A</sup>	2.5 (0.5) <sup>A</sup>	Group	0.046
	Posttest ( $\alpha=0.77$ )	2.3 (0.6) <sup>B</sup>	2.6 (0.4) <sup>C</sup>	Time	0.000
	Follow up ( $\alpha=0.79$ )	2.4 (0.6) <sup>B</sup>	2.6 (0.4) <sup>C</sup>	Group x Time <sup>c</sup>	0.000
Skills <sup>3</sup> (18 statements)	Baseline ( $\alpha=0.93$ )	2.6 (0.8) <sup>A</sup>	2.8 (0.7) <sup>A</sup>	Group	0.000
	Posttest ( $\alpha=0.95$ )	4.0 (0.7) <sup>B</sup>	2.7 (0.7) <sup>A</sup>	Time	0.000
	Follow up ( $\alpha=0.94$ )	3.9 (0.6) <sup>C</sup>	2.7 (0.6) <sup>A</sup>	Group x Time <sup>c</sup>	0.000
Self efficacy <sup>3</sup> (10 statements)	Baseline ( $\alpha=0.74$ )	3.3 (0.6) <sup>A</sup>	3.4 (0.5) <sup>A</sup>	Group	0.000
	Posttest ( $\alpha=0.85$ )	4.1 (0.6) <sup>B</sup>	3.4 (0.5) <sup>A</sup>	Time	0.000
	Follow up ( $\alpha=0.82$ )	4.1 (0.5) <sup>B</sup>	3.4 (0.4) <sup>A</sup>	Group x Time <sup>c</sup>	0.000
Intention <sup>3</sup> (12 statements)	Baseline ( $\alpha=0.84$ )	3.6 (0.6) <sup>A</sup>	3.5 (0.7) <sup>A</sup>	Group	0.000
	Posttest ( $\alpha=0.82$ )	4.1 (0.5) <sup>B</sup>	3.5 (0.5) <sup>C</sup>	Time	0.000
	Follow up ( $\alpha=0.78$ )	4.0 (0.5) <sup>B</sup>	3.6 (0.4) <sup>D</sup>	Group x Time <sup>c</sup>	0.000

<sup>a</sup> Mean and standard deviation were reported. Different and same capital letters indicate significant ( $p < 0.05$ ) and insignificant differences respectively, within the same treatment group for each dependent variable or across the treatment groups for each assessment point.

<sup>b</sup> Since random effect (nesting) does not explain significant variance of all dependent variables, random effect was removed from the models. *P* values were derived by linear mixed model with repeated measures and without random effect.

<sup>c</sup> A significant group x time interaction indicates that the response over time differed significantly between the two groups.

<sup>1</sup> Length of stay in US was controlled in the model.

<sup>2</sup> Data were square root transformed for analysis.

<sup>3</sup> Derived from a 5-point scale with 1=Disagree a lot; 2=Disagree a little; 3=Neither agree nor disagree; 4=Agree a little; 5=Agree a lot. After recoding the reverse-worded statements, higher number indicates more desirable results except for barriers.

### **Theory Constructs**

Based on LMM results, six theory construct scores improved significantly more in the experimental group than in the controls, with the largest improvement occurring in skills, followed by self-efficacy. There was no change in the two subjective norm constructs (normative belief and motivation to comply). (Table 5-3)

### **Intention, Calcium/Vitamin D Intake Explained by TPB Constructs in Experimental Group**

At 3-month follow up, TPB constructs explained 58.9% of intention to eat calcium-rich foods. Among TPB constructs, skills and outcome evaluation explained the most variance in intention. Intention explained 30.5% and 18.7% of calcium and vitamin D intake respectively at 3-month follow up (Table 5-4). When TPB constructs, readiness to eat more dairy products, knowledge, and baseline demographic variables were included in the multiple regression models as predictor *variables*, the amount of variance of calcium and vitamin D intake explained increased. Intention, readiness to eat more dairy products, and use of calcium supplements at baseline explained 45.9% of calcium intake. Intention, use of calcium supplements at baseline, and barriers explained 41.8% of vitamin D intake (Table 5-5).

Table 5-4: Multiple regressions of intention, calcium intake, and vitamin D intake on TPB constructs at 3-month follow up (experimental group).

Variable	$\beta$	Standard error	Standardized $\beta$	t	R2	Adjusted R2
<b>Contribution of skills and outcome evaluation to intention</b>						
<b>Model 1</b>					0.552	0.545
Skills	0.58	0.066	0.743	8.811***		
F(1,63)=77.640***						
<b>Model 2</b>						
Skills	0.499	0.072	0.639	6.911***	0.589	0.576
Outcome evaluation	0.269	0.113	0.219	2.373*		
F(2,62)=44.492***						
<b>Contribution of intention to calcium intake</b>						
<b>Model 1</b>					0.305	0.294
Intention	374.182	71.213	0.552	5.254***		
F(1,63)=27.609***						
<b>Contribution of intention to vitamin D intake</b>						
<b>Model 1</b>					0.187	0.174
Intention	80.963	21.256	0.433	3.809***		
F(1,63)=14.509***						

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

Table 5-5: Multiple regressions of intention, calcium intake, and vitamin D intake on TPB constructs, stages of change, knowledge, and baseline demographic variables at 3-month follow up (experimental group).

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Contribution of skills to intention</b>						
<b>Model 1</b>					0.579	0.571
Skills	0.614	0.073	0.761	8.452***		
F(1,52)=71.439***						
<b>Contribution of intention, stage of change, and use of calcium supplements to calcium intake</b>						
<b>Model 1</b>					0.319	0.306
Intention	381.000	77.188	0.565	4.936***		
F(1,52)=24.364***						
<b>Model 2</b>					0.404	0.380
Intention	304.894	78.220	0.452	3.898***		
Stage of change	111.040	41.248	0.312	2.692**		
F(2,51)=17.269***						
<b>Model 3</b>					0.459	0.427
Intention	317.116	75.446	0.470	4.203***		
Stage of change	111.628	39.684	0.314	2.813**		
Calcium supplements <sup>1</sup>	166.827	73.861	-0.236	-2.259*		
F(3,50)=14.139***						
<b>Contribution of intention, use of calcium supplements, and barriers to vitamin D intake</b>						
<b>Model 1</b>					0.204	0.189
Intention	83.848	22.961	0.452	3.652***		
F(1,52)=13.335***						
<b>Model 2</b>					0.325	0.299
Intention	88.995	21.415	0.480	4.156***		
Calcium supplements <sup>1</sup>	-68.009	22.471	-0.349	-3.026**		
F(2,51)=12.294***						
<b>Model 3</b>					0.418	0.383
Intention	70.837	21.082	0.382	3.360***		
Calcium supplements <sup>1</sup>	-81.012	21.567	-0.416	-3.756***		
Barriers	-51.377	18.161	-0.329	-2.829**		
F(3,50)=11.989***						

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

<sup>1</sup> In the last month, have you been regularly taking any calcium supplements? 1=Yes; 2=No.

### **Knowledge**

Compared to baseline, the experimental group significantly improved knowledge at posttest ( $t=15.475$ ,  $P=0.000$ ) and 3-month follow up ( $t=13.646$ ,  $P=0.000$ ). Although the control group showed a slight increase in knowledge at posttest ( $t=2.183$ ,  $P=0.033$ ) and retained this increase at 3-month follow up, the experimental group achieved a significantly larger improvement in knowledge than the control group over time (Table 5-6).

Table 5-6: Changes in knowledge and readiness to eat more dairy products in experimental and control group over time.

		Experimental <sup>a</sup>	Control <sup>a</sup>	Effect	P <sup>b</sup>
Knowledge <sup>1</sup> (15 questions)	Baseline	3.6 (2.4) <sup>A</sup>	3.5 (2.2) <sup>A</sup>	Group	0.000
	Posttest	10 (3.8) <sup>B</sup>	3.6 (2.0) <sup>D</sup>	Time	0.000
	Follow up	9.4 (3.7) <sup>C</sup>	3.7 (2.0) <sup>D</sup>	Group x Time <sup>c</sup>	0.000
Readiness to eat more dairy <sup>2</sup>	Baseline	2.2 (1.3)	2.1 (1.3)	Group	0.002
	Posttest	3.0 (1.0)	2.1 (1.2)	Time	0.000
	Follow up	2.8 (0.9)	2.2 (1.1)	Group x Time <sup>c</sup>	0.000

<sup>a</sup> Mean and standard deviation were reported. Different and same capital letters indicate significant ( $p<0.05$ ) and insignificant differences respectively, within the same treatment group for each dependent variable or across the treatment groups for each assessment point.

<sup>b</sup> Since random effect (nesting) does not explain significant variance of all dependent variables, random effect was removed from the models.  $P$  values were derived by linear mixed model with repeated measures and without random effect.

<sup>c</sup> A significant group x time interaction indicates that the response over time differed significantly between the two groups.

<sup>1</sup> The knowledge score was the sum of the correct answers. The possible range is from 0 to 15.

<sup>2</sup> 1=Precontemplation; 2=Contemplation; 3=Preparation; 4=Action; 5=Maintenance.

### **Readiness to Eat More Dairy Products**

LMM results showed a significant group by time effect in readiness to eat more dairy products (Table 5-6). In the experimental group, the number of women at the *pre-contemplation* and *contemplation* stage at posttest decreased by 22 and 3, respectively. The number of women at the *preparation* and *action* stage increased by 17 and 10, respectively. However, the number of



women at the *action* stage dropped from 10 at posttest to 4 at 3-month follow up. In the control group, the number of women at each stage did not change much over time (Table 5-7).

Table 5-7: Changes in readiness to eat more dairy products in experimental and control group.

	Precontemplation	Contemplation	Preparation	Action	Maintenance
	<b>Experimental</b>				
Baseline (n=70)	32	4	27	0	7
Posttest (n=70)	10	1	44	10	5
Follow up (n=66)	10	1	48	4	3
	<b>Control</b>				
Baseline (n=70)	35	4	25	0	6
Posttest (n=64)	30	4	26	1	3
Follow up (n=64)	28	3	30	0	3

#### **Correlation between Calcium/Vitamin D Increase (Follow Up-Baseline) and Class Attendance**

##### **/Demographic Variables in Experimental Group**

Number of classes attended (dose) was significantly and positively correlated with calcium increase ( $r=0.242$ ,  $P=0.05$ ), but not vitamin D increase. Among all demographic variables, only blood relative's osteoporosis history was significantly and positively correlated with the increase of calcium ( $F=3.642$ ,  $P=0.032$ ) and vitamin D ( $F=3.856$ ,  $P=0.026$ ). Participants whose blood relatives had osteoporosis increased 3-month follow up calcium and vitamin D more (178.6 mg and 55.0 IU respectively) than those whose blood relatives did not have osteoporosis. Baseline heel scan results and readiness to eat more dairy products were not correlated with calcium and vitamin D increase.

##### **Process Evaluation in Experimental Group**

##### **Lesson Activity Evaluation**

On average, the number of lessons attended was  $4.1 \pm 1.9$  of six. On a 5-point scale (1=disliked, 2=disliked moderately, 3=neither liked nor disliked, 4=liked moderately, 5=liked), food label reading activities, tasting recipes, and calcium/vitamin D assessment were rated  $4.6 \pm 0.7$ , tasting manufactured foods was rated  $4.5 \pm 0.7$ , recipe preparation was rated  $4.4 \pm 0.9$ , and homework was rated  $3.7 \pm 0.8$ . Overall usefulness of the lessons was rated  $4.8 \pm 0.4$  on a 5-point scale, ranging from 1=not useful at all, 2=somewhat useful, 3=moderately useful, 4=useful, to 5=very useful.

### **Focus Groups**

Half of the 70 experimental participants attended one of five focus groups whose sizes ranged from 5 to 9 participants. Participants reported that after the intervention, they were more aware of dietary methods to prevent osteoporosis, level of calcium and vitamin D intake recommended, role of sunlight exposure, and calcium bioavailability. They reported increasing consumption of broccoli, dark green vegetables, dairy products (i.e., milk, yogurt), and calcium-fortified foods (i.e., orange juice, soy milk, bread). However, barriers to increased calcium and vitamin D intake included ingrained dietary habits, busy lifestyle, family members' different food preferences (i.e., children's dislike of vegetables), concern about dairy products (i.e., growth hormones, interference with iron absorption, kidney stones), undesirable taste of low fat foods, lactose intolerance, and limited availability of calcium-fortified foods in Chinese stores. Although the effect of this intervention on calcium supplement usage varied, some participants reported using calcium supplements more wisely after the intervention. These mothers also reported that this intervention affected their husband, children, and even elderly in the family, because participants prepared calcium-rich meals and snacks and shared information with family members.

Participants reported that all information, visual demonstrations, activities, and handouts were useful. Activities especially useful included the heel scan, food label reading, recipe tasting, and calcium and vitamin D assessment. These mothers also suggested providing more recipes (i.e., soup made with cheese), offering a potluck of calcium rich foods at the end of the intervention and a follow-up heel scan, and providing handouts with reputable internet resources and in-depth information as ways to improve the intervention. At the end, focus group participants noted this intervention was worthwhile and they would recommend it to their friends.

## **Discussion**

At baseline, participants in our study had low dietary calcium and vitamin D intake and only one third of them reported taking calcium supplements. Their low calcium and vitamin D intake, together with limited knowledge about osteoporosis prevention and calcium-rich foods, underlined the importance of this educational intervention.

Our six-week intervention significantly increased this sample's dietary calcium and vitamin D intake. At 3-month follow up, women in the experimental group increased their calcium and vitamin D intake by about 213 mg and 48 IU, respectively. Other osteoporosis prevention interventions have targeted calcium intake as the main outcome variable and resulted in no significant increase in calcium intake (Sedlak et al., 2000; Blalock et al., 2000; Ribeiro and Blakeley, 2001) or increases comparable to (Tussing and Chapman-Novakofski, 2005; Hien et al., 2008), or higher (Manios et al., 2007) than ours. All or most participants in these interventions were Caucasians except one intervention conducted in Vietnam (Hien et al., 2008). Although one intervention was developed based on theoretical models (Sedlak et al., 2000), interventions that did not produce changes in calcium intake were of short duration (e.g., 3 weekly 1-hour sessions, one-time written packets, and a one-day workshop) and lacked interactive activities. Such

interventions are likely to alter knowledge, not behavior. In contrast, interventions that produced significant increases in calcium intake used repeated contact (e.g., 8 weekly lessons, 5-month bi-weekly lessons, 18-month intervention), used visual demonstrations and hands-on activities, and were based on theoretical models. Our intervention consisted of one heel scan and 6-interactive lessons. The heel scan before the lessons was provided to increase risk perception. However, we did not find any relationship between bone mineral density and calcium and vitamin D increase in the experimental group, probably because of the low prevalence of osteopenia. In addition, our participants' increased calcium and vitamin D intake was mainly due to eating more of the foods that were major contributors at baseline, suggesting that these adults' food habits are resistant to change.

Women in the experimental group reported more positive attitudes toward, and greater perceived behavioral control over, eating calcium-rich foods with no change in subjective norm. Multiple linear regression analysis revealed that our intervention mainly changed intention by influencing attitude and perceived behavior control and explained a degree of variance in intention similar to another osteoporosis prevention program using TPB (Tussing and Chapman-Novakofski, 2005). Others have found that subjective norm was a weaker predictor of intention than attitude and perceived behavior control and reported comparable average  $R^2$  values for intention (e.g., 41% and 39%) (Godin and Kok, 1996; Armitage and Conner, 2001).

TPB generally explains more variance in intention than behaviors. In this study, attitude and perceived behavior control variables explained 59% of intention. Intention explained 31% of calcium intake and 19% of vitamin D intake, similar to the influence on behavior reported in review studies (e.g., 34% and 27%) (Godin and Kok, 1996; Armitage and Conner, 2001). This may be due to specifying the end point of the intervention as nutrient intake. Intention as defined by TPB is thought to explain specific behaviors (e.g., milk intake) better than unspecific food choices needed to reach a calcium intake level (Baronowski et al., 1999; Backman et al., 2002;

Tussing and Chapman-Novakofski, 2005). In addition, social expectations greatly influence an individual's dietary behavior in this population (Lv and Brown, 2009), as also noted in our focus groups. Our social influence scales had low internal consistency making it less likely to detect an effect of social support on behaviors.

We found that, in addition to intention, 'readiness to eat more dairy products' and barriers scores at 3-month follow up and baseline use of calcium supplements increased the variance in 3-month follow up nutrient intake explained. Those using calcium supplements at baseline may be motivated to increase nutrient intake by their perceived risk. At 3-month follow up, higher stage of change for dairy products is associated with greater calcium intake (Gulliver and Horwath, 2001; Tucker et al., 2002; Snelling et al., 2006). In addition to influencing intention, barriers/perceived behavior control also has been shown to directly influence behaviors (Lien et al., 2002; Godin and Kok, 1996). However, it is unclear why 3-month follow up barriers scores added to the explained variance in vitamin D intake but not in calcium intake.

Women in the experimental group also shifted stage of change for dairy product consumption and improved their knowledge. Our intervention mainly moved women at the pre-contemplation and contemplation stage to the preparation stage. At 3-month follow up, some at the action and maintenance stage at post-test dropped back, suggesting barriers to increasing dairy product intake reemerge after the intervention. Our stage of change instrument focused only on dairy products, which prevented us seeing a change in stage to eat other calcium-rich foods. If we had used an instrument that focused on calcium-rich foods, we would probably have seen different results. Our intervention significantly improved knowledge as have other osteoporosis prevention programs (Sedlak et al., 2000; Blalock et al., 2000; Ribeiro and Blakeley, 2001).

Lesson attendance was correlated with increased calcium, but not vitamin D intake, probably because not all calcium-rich foods targeted in the lessons are also rich in vitamin D and vitamin D was not emphasized as much as calcium intake in the lessons. Others have reported

that session attendance is critical to alter nutrient intake (Havas et al., 1998; Havas et al., 2003). In addition, participants whose blood relatives had osteoporosis reported a greater increase in calcium and vitamin D intake (3-month follow up-baseline) than those whose relatives did not have osteoporosis, perhaps due to a difference in risk perception. Perceived risk is correlated with adoption of iron-fortified soy sauce and increased fruit and vegetable intake (Sun et al., 2006; Kim et al., 2007)

Major strengths of our study were a) focusing on increasing the intake of calcium-rich foods instead of calcium supplements, which is always the safest way to increase calcium intake, and use of b) theory-based intervention, c) a randomized control evaluation design, d) repeated assessments, and e) both impact and process evaluation. The focus groups supplemented the impact evaluation and provided information on the possible barriers experienced by participants after the intervention. Nutrition educators could use this information to design and improve osteoporosis prevention interventions.

Our study had a number of limitations. First, it was conducted using a self-selected sample of participants, typical of community-based studies, with high education and income level. Second, internal reliability of the two subjective norm constructs was low and may have contributed to their lack of effect on intention. Third, focus groups were conducted by the same researcher who delivered the lessons which makes it less likely that deficiencies in the lessons were exposed. Fourth, only a small portion of our sample was self-reported as lactose intolerant. Although self-report may not be accurate, the increase in calcium and vitamin D intake mainly contributed by regular cow's milk in this intervention might not be seen in samples with more lactose intolerant participants. Despite these limitations, the results support the use of this interactive intervention to increase calcium and vitamin D intake in Chinese American women.

### **Implication for Research and Practice**

Several important messages that emerged from our study included:

1. For dietetics practitioners, the TPB provided an effective framework for a theory-based nutrition education intervention using interactive activities and visual demonstrations that increased calcium and vitamin D intake of the target audience.

2. Further studies should examine the effect of this intervention in a more diverse sample of Chinese American women with a greater proportion of lactose intolerant individuals. This is a difficult audience to reach but Chinese social clubs and churches are possible venues to deliver education interventions.

3. An intervention's acceptability is increased if the educator is Chinese and speaks Mandarin.

4. Social acceptability of calcium rich foods could be promoted by encouraging women to invite a friend to the sessions and offering recipes for dishes that might be used at social events. Chinese Americans rely heavily on their social network for information and support.

5. Future research could utilize in-person or telephone motivational interviewing sessions to encourage progress after the intervention (Resnicow et al., 2002). This strategy may reduce the number of people who regress from the action and maintenance stage.

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## References

- Armitage CJ, Conner M. Efficacy of the Theory of Planned Behaviour: A meta-analytic review. *Br J Soc Psychol*. 2001; 40:471–499
- Babbar RK, Handa AB, Lo CM, Guttmacher SJ, Shindlecker R, Chung W, Fong C, Ho-Asjoe H, Chan-Ting R, Dixon LB. Bone health of immigrant Chinese women living in New York City. *J Community Health*. 2006; 31:7-23.
- Backman DR, Haddad EH, Lee JW, Johnston PK, Hodgkin GE. Psychosocial predictors of healthful dietary behavior in adolescents. *J Nutr Educ Behav*. 2002; 34:184-193.
- Baranowski T, Cullen KW, Baranowski J. Psychosocial correlates of dietary intake: Advancing dietary intervention. *Annu Rev Nutr*. 1999; 19:17-40.
- Blalock SJ, Currey SS, DeVellis RF, DeVellis BM, Giorgino KB, Anderson JJB, Dooley MA, Gold DT. Effects of educational materials concerning osteoporosis on women's knowledge, beliefs, and behavior. *Am J Health Promot*. 2000; 14:161-169.
- Borugian, M.J., Sheps, S.B., Whittemore, A.S., Wu AH, Potter JD, Gallagher RP. Carbohydrates and colorectal cancer risk among Chinese in North America. *Cancer Epidemiol Biomarkers Prev*. 2002; 11:187-193.
- Chang SF. A cross-sectional survey of calcium intake in relation to knowledge of osteoporosis and beliefs in young adult women. *Int J Nurs Pract*. 2006;12:21-27.
- Chau P, Lee H, Tseng R, Downes NJ. Dietary habits, health beliefs, and food practices of elderly Chinese women. *J Am Diet Assoc*. 1990; 90:579-580.
- Chaubey S, Gates G. Effect of the knowledge, attitude and demographic variables on iron and calcium intake among U.S. women. *J Am Diet Assoc*. 1997; 97:A115.
- De Vet E, De Nooijer J, De Vries NK, Brug J. Testing the transtheoretical model for fruit intake: comparing web-based tailored stage-matched and stage-mismatched feedback. *Health Educ Res*. 2008; 23:218-227.



- Glaser BG, Strauss AL. The discovery of grounded theory: Strategies for qualitative research. Chicago, IL: Aldine de Gruyter; 1967.
- Godin G, Kok G. The theory of planned behavior: A review of its application to health-related behaviors. *Am J Health Promot.* 1996; 11:87-98.
- Gulliver P, Horwath CC. Assessing women's perceived benefits, barriers, and stage of change for meeting milk product consumption recommendations. *J Am Diet Assoc.* 2001; 101(11):1354-1357.
- Havas S, Anliker J, Damron D, Langenberg P, Ballesteros M, Feldman R. Final results of the Maryland WIC 5-A-Day Promotion Program. *Am J Public Health.* 1998; 88(8):1161-1167.
- Havas S, Anliker J, Greenberg D, Block G, Block T, Blik C, Langenberg P, DiClemente C. Final results of the Maryland WIC food for life program. *Prev Med.* 2003; 37(5): 406-416.
- Hien VT, Khan NC, Mai LB, Lam NT, Phuong TM, Nhung BT, Nhien NV, Nakamori M, Yamamoto S. Effect of community-based nutrition education intervention on calcium intake and bone mass in postmenopausal Vietnamese women. *Public Health Nutr.* 2008; 31:1-6. [Epub ahead of print]
- Hoslti OR. Content analysis for the social sciences and humanities. Reading, MA: Addison-Wesley; 1969.
- Jackson KA, Savaiano DA. Lactose maldigestion, calcium intake and osteoporosis in African-, Asian-, and Hispanic-Americans. *J Am Coll Nutr.* 2001; 20:198S-207S.
- John JH, Yudkin PL, Neil HAW, Ziebland S. Does Stage of Change predict outcome in a primary-care intervention to encourage an increase in fruit and vegetable consumption? *Health Educ Res.* 2003; 18:429-438.
- Kelleher CC, Lynch JW, Daly L, et al. The "Americanisation" of migrants: Evidence for the contribution of ethnicity, social deprivation, lifestyle and life-course processes to the mid-20th century Coronary Heart Disease epidemic in the US. *Soc Sci Med.* 2006; 63:465-484.
- Kim C, McEwen LN, Piette JD, Goewey J, Ferrara A, Walker EA. Risk perception for diabetes among women with histories of gestational diabetes mellitus. *Diabetes Care.* 2007; 30(9):2281-6.
- Kim KW, Reicks M, Sjoberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav.* 2003; 35: 294-301.
- Lauderdale D, Kuohung V, Chang SL, Chin MH. Identifying older Chinese immigrants at high risk for osteoporosis. *J Gen Intern Med.* 2003; 18:508-515.
- Lawton J, Ahmad N, Hanna L, Douglas M, Bains H, Hallowell N. et al. 2008. We should change ourselves but we can't: Accounts of food and eating practices among British Pakistanis and Indians with type 2 diabetes. *Ethn Health.* 2008;13:305-319.

- Lee MM, Wu AW, Whittemore AS, et al. Comparison of dietary habits, physical activity and body size among Chinese in North America and China. *Int J Epidemiol*. 1994;23:984-990.
- Lien N, Lytle LA, Komro KA. Applying theory of planned behavior to fruit and vegetable consumption of young adolescents. *Am J health Promot*. 2002; 16(4):189-197.
- Lin W, Lee YW. Nutrition knowledge, attitudes, and dietary restriction behavior of the Taiwanese elderly. *Asia Pac J Clin Nutr*. 2005; 14:221-229.
- Lv N, Brown JL. Chinese American family food systems: Impact of Western influences. *J Nutr Educ Behav*. 2009; (Accepted).
- Manios Y, Moschonis G, Katsaroli I, Grammatikaki E, Tanagra S. Changes in diet quality score, macro- and micronutrients intake following a nutrition education intervention in postmenopausal women. *J Hum Nutr Diet*. 2007;20:126-131.
- Melton LJ III. Adverse outcomes of osteoporotic fractures in the general population. *J Bone Miner Res*. 2003; 18:1139-41.
- Montano DE, Kasprzyk D, Taplin SH. The Theory of Reasoned Action and The Theory of Planned Behavior. In: Glanz K, Lewis FM, Rimer BK, eds. *Health behavior and health education: Theory, research, and practice*. 2nd ed. San Francisco, CA: Jossey-Bass Inc; 1997:85-112.
- National Osteoporosis Foundation. *America's bone health: The state of osteoporosis and low bone mass in our nation*. Washington, DC; 2002.
- Park K, Ureda JR. Specific motivation of milk consumption among pregnant women enrolled in or eligible for WIC. *J Nutr Educ Behav*. 1999; 31:76-85.
- Ray NF, Chan JK, Thamer M, Melton LJ III. Medical expenditures for the treatment of osteoporotic fractures in the United States in 1995: Report from the National Osteoporosis Foundation. *J Bone Miner Res*. 1997; 12:24-35.
- Resnicow, K., DiIorio, C., Soet, J. E., Borrelli, B., Ernst, D., & Hecht, J. Motivational interviewing in health promotion: It sounds like something is changing. *Health Psychol*. 2002; 21:444-451.
- Ribeiro V, Blakeley JA. Evaluation of an osteoporosis workshop for women. *Public Health Nurs*. 2001; 18:186-193.
- Schmiege, SJ; Aiken, LS; Sander, JL, Gerend MA. Osteoporosis prevention among young women: Psychosocial models of calcium consumption and weight-bearing exercise. *Health Psychol*; 2007; 26(5):577-587.
- Sebring NG, Denkinger BI, Menzie CM, Yanoff LB, Parikh SJ, Yanovski JA. Validation of three food frequency questionnaires to assess dietary calcium intake in adults. *J Am Diet Assoc*. 2007; 107(5): 752-759.

Sedlak CA, Dohney MO, Jones SL. Osteoporosis education programs: Changing knowledge and behaviors. *Public Health Nurs.* 2000; 17:398-402.

Siris ES, Miller PD, Barrett-Connor E, Faulkner KG, Wehren LE, Abbott TA, Berger ML, Santora AC, Sherwood LM. Identification and fracture outcomes of undiagnosed low bone mineral density in postmenopausal women: results from the National Osteoporosis Risk Assessment. *JAMA.* 2001; 286:2815-2822.

Snelling AM, Adams TB, Korba C, Tucker L. Stage of change algorithm for calcium intake by male college students. *J Am Diet Assoc.* 2006; 106(6):904-907.

Sun XY, Guo Y, Wang SS, Sun J. Predicting iron-fortified soy sauce consumption intention: Application of the theory of planned behavior and health belief model. *J Nutr Educ Behav.* 2006; 38(5): 276-285.

Tsorbatzoudis H. Evaluation of a planned behavior theory-based intervention programme to promote healthy eating. *Percept Mot Skills.* 2005a; 101(2):587-604.

Tsorbatzoudis H. Evaluation of a school-based intervention programme to promote physical activity: An application of the theory of planned behavior. *Percept Mot Skills.* 2005b; 101(3):787-902.

Tucker LJ, Snelling AM, Adams TB. Development and validity of a stage of change algorithm for calcium intake for college female students. *J Am Coll Nutr.* 2002; 21:530-535.

Tussing L, Chapman-Novakofski K. Osteoporosis prevention education: Behavior theories and calcium intake. *J Am Diet Assoc.* 2005; 105 (1): 92-97.

US Census Bureau. National Population Projections. Released 2008. Available at <http://www.census.gov/population/www/projections/summarytables.html>. Accessed November 14, 2008.

U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 21. 2008. Available at <http://www.ars.usda.gov/ba/bhnrc/ndl>. Accessed February 16, 2009.

Walker MD, Babbar R, Opotowsky A, McMahon DJ, Liu G, Bilezikian JP. Determinants of bone mineral density in Chinese-American women. *Osteoporos Int.* 2007; 18:471-478.

Walker J, Ball M. Increasing calcium intake in women on a low-fat diet. *Eur J Clin Nutr.* 1993; 47:718-723.

Wardle J, Carnell S, Cooke L. Parental control over feeding and children's fruit and vegetable intake: How are they related? *J Am Diet Assoc.* 2005; 105:227-232.

## **Chapter 6**

### **Discussion and conclusions**

This project about increasing Chinese Americans' dietary calcium intake was composed of three studies: focus groups to identify factors influencing dairy product consumption, couple interviews to learn about the family food system, and a nutrition education intervention to increase dietary calcium and vitamin D intake. These three studies were connected and the later studies were based on the results of the former studies.

#### **Factors Influencing Dairy Product Consumption**

Due to language barriers and lack of access to their social network, Chinese Americans are a hard-to-reach population for Caucasian researchers. The Chinese American diet contains more vegetables and fewer high-fat foods compared to the typical American diet (Yu et al., 1991; Tam et al., 2005; Gao et al., 2009). However, it does not contain enough calcium-rich foods, especially dairy products. Therefore, Chinese Americans' calcium intake is much lower than recommended, thus increasing their risk of osteoporosis. Previous studies found that Chinese immigrants reported increased dairy product consumption after immigration (Lee et al., 1994; Lv and Cason, 2004). However, before we launched our first study, we knew little about the psychosocial factors influencing Chinese Americans' dairy product consumption.

To understand the psychosocial factors and how sex and marital status might influence these factors, we conducted 8 focus groups using the 2 by 2 design (sex x marital status). Employing the Theory of Planned Behavior, we found that Chinese Americans' dairy product consumption was influenced by attitudes towards dairy products (i.e., they consumed dairy

products for their good taste, texture, pleasure, nutrition, and convenience), social influences (i.e., family members and/or friends greatly influenced their food choice), and perceived behavioral control (i.e., dairy products only fit in breakfast, snacks, and fast foods; lack of ability to cook with dairy products; barriers to eating more dairy products included traditional dietary habits, unfamiliarity, etc.). These psychosocial factors differed slightly by sex and marital status. For example, we found females were more concerned about fat content and weight control when choosing milk, compared to males (Lv et al., 2007). Wardle and others (2004) also found that women were more likely than men to report avoiding high-fat foods in Caucasian, Asian, and African populations in 23 countries. Family interaction had more influence on the food choice of married adults, compared to single adults, while friends' influence was viewed as more important by single than by married adults. This suggested that the major source of social influence changes from friends to family members upon marriage (Lv et al., 2007).

The results of the focus group interviews showed that family interaction was important in food choice and dairy product consumption in Chinese American families, in agreement with studies of Caucasians (De Bourdeaudhuij, 1997; Park and Ureda, 1999; Brown and Miller, 2002). However, we knew little about how family members influence each other's selection of dairy products and other foods and how they perceive the possibility of fitting dairy products into the Chinese diet. Therefore, the second study was conducted to study the family food system and use of dairy products.

### **Family Food System**

In the second step we conducted 20 couple interviews, using the Reciprocal Determinism Model together with the Circumplex Model of Marital and Family Systems as a guide to design the interview script and analyze the data. We explored the influence of family interaction on

dairy product consumption and the whole family food purchase, preparation, and consumption system.

A major finding of the second study was that children's preferences and needs had more influence on the choice of dairy products and snacks than those of their parents, while parents', especially father's, preferences had a major influence on dinner food choices and preparation methods. This is consistent with findings in Caucasians (Pill and Parry, 1989; De Bourdeaudhuij, 1997; Crockett et al., 1989; De Bourdeaudhuij and Van Oost, 1998). Therefore, when suggesting new food choices for dinners, educators should consider the influence of adults, especially fathers. In contrast, family members did not have much influence on an individual's choices of snacks and foods for breakfast. Family members' food choices for lunch were different. To some parents and all children, lunch was an introduction to new foods that could replace more traditional ones. Most children ate lunch in institutional settings where they learned to prefer Western foods like macaroni & cheese to Chinese foods. Parents' behaviors diverged at lunch time. The majority of parents took dinner leftovers while others chose to eat out. Some parents ate out at Asian restaurants but some turned to Western fast foods. Thus lunch choices could either reinforce the Chinese meal pattern or serve as a way to learn to accept Western foods. Even though some parents ate Western foods at lunch, no parents wanted to change what they ate at dinner.

The second study also provided detailed information on how Chinese American families use milk, yogurt, and cheese, and how these might fit in their meal patterns. Based on this information, the dairy products or dishes attractive to Chinese Americans would have to complement their traditional dietary pattern, be desirable in taste and texture, and satisfy people's need for convenience. Breakfast, lunch, or snacks were the most likely channels to introduce dairy products as the dinner was generally off limits to Western foods. The results also suggested

that to achieve a maximum increase of dietary calcium intake, other calcium-rich foods, such as calcium-containing vegetables and calcium-fortified foods, should also be promoted.

### **A Pilot Nutrition Education Intervention**

The third study was a quasi-experimental study. Based on the results of our previous studies, we designed a nutrition education intervention to increase dietary calcium and vitamin D intake among married Chinese American women, because women are at a higher risk of osteoporosis than men and they typically have lower calcium intakes than men (Broussard and Magus, 2004). The 6-week intervention was designed using the Theory of Planned Behavior as a theoretical basis to address attitudes (expressed through behavioral belief and outcome evaluation), social influence (expressed through normative belief and motivation to comply), and perceived behavioral control (expressed through barriers, skills, and self-efficacy), and intention to consume calcium-rich foods. Figure 6-1 shows a proposed relationship between the three explanatory factors and calcium-rich food consumption.

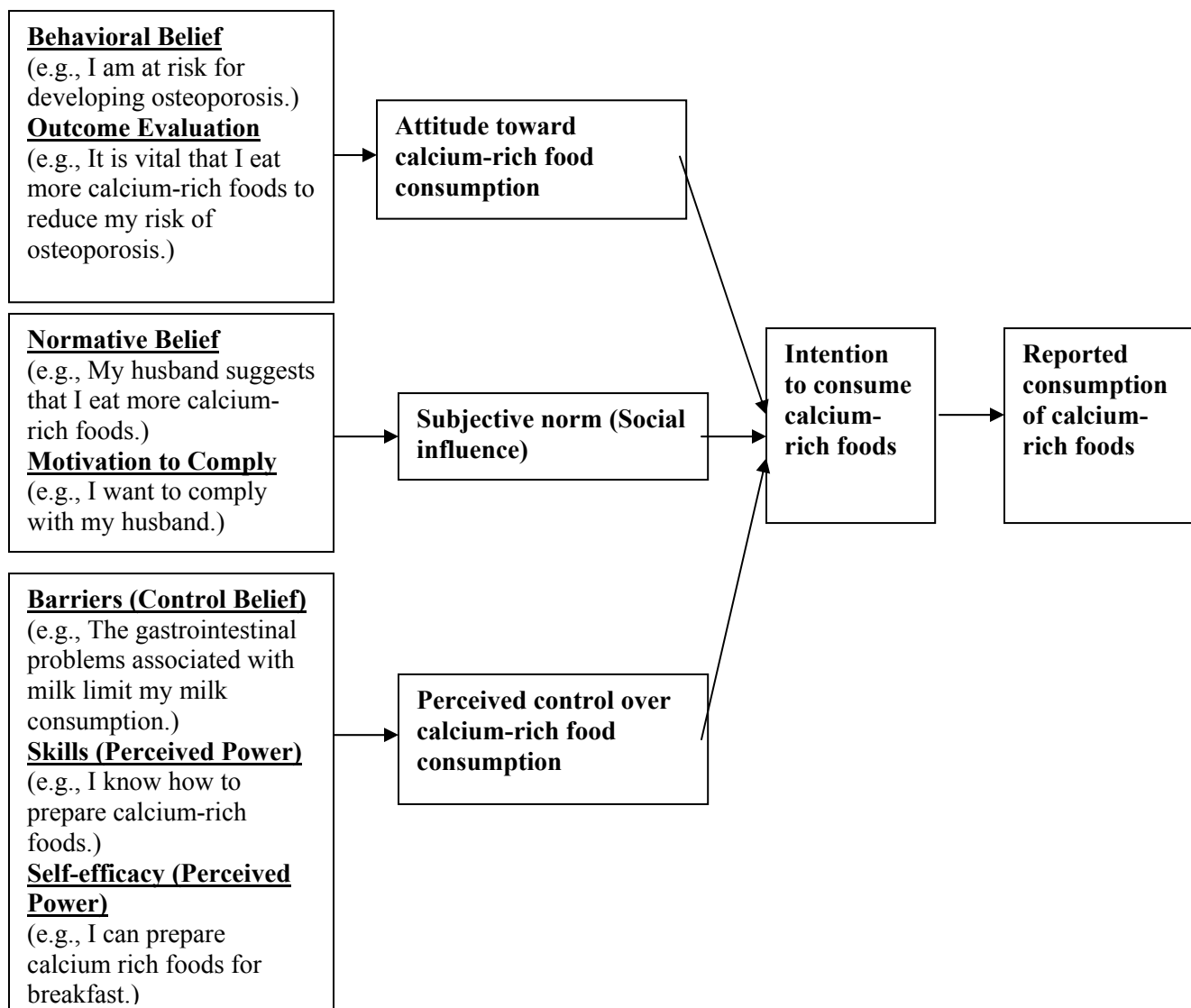


Figure 6-1: Theoretical framework of the Theory of Planned Behavior for explaining calcium-rich food consumption.

In the lessons, attitude was addressed by the heel scan results, information on osteoporosis prevention, amounts of calcium and vitamin D recommended, effects of calcium-rich foods versus calcium supplements on bone health, and food and recipe tasting. For example, experimental participants received a free heel scan before they began the six interactive lessons. They learned their risk of osteoporosis from the results of the heel scan, so they could start



thinking about this issue beforehand and might be more likely to accept the messages delivered in the lessons. Attitude was also addressed by delivering information (i.e., knowledge) on osteoporosis prevention, amount of calcium and vitamin D recommended, and effects of calcium-rich foods versus calcium supplements on bone health. Participants in the experimental group significantly improved their knowledge and attitude towards consuming calcium-rich foods, suggesting that knowledge improvement may precede positive attitude change. Social influence was not a focus. It was addressed through in-class discussion and homework encouraging the husband and children to taste recipes learned in class. Perceived control was addressed by learning how to read the Nutrition Facts panel, to deal with lactose intolerance, and to prepare calcium-rich foods and fit these foods into their diet. For example, interactive food label reading activities were conducted from lesson 3 to lesson 6. Additionally, in lesson 5, American plain yogurt was modified to mimic the taste and texture of traditional Chinese yogurt. This was designed based on the results of the couple interviews. Many participants in the couple interviews preferred the thinner, sourer, and less sweet Chinese yogurt than American yogurt which was too sweet to them. One woman reported that since plain yogurt was sour, she added sugar to American plain yogurt and stirred it to make it taste like traditional Chinese yogurt. Also, this way, she could adjust the amount of sugar added to obtain just the sweetness she liked. This idea was adopted in the nutrition education lesson. In this study, calcium and vitamin D increase (follow up-baseline) was not correlated with baseline readiness to eat more dairy products. One intervention study also found that people's baseline stage of change appeared to have little influence on their fruit and vegetable increase (John et al., 2003). Brug and others (1997) suggested that attitude-focused intervention might be more effective for people in the pre-contemplation stage and that intervention focusing on self-efficacy to overcome barriers might be more useful for those in the contemplation and preparation stages. No correlation with baseline stage of change was observed in this study, probably because a) both attitude and perceived

behavioral control were emphasized in this intervention so our participants in all three early stages of change could benefit; or b) baseline stage of change for dairy products alone might not be a good predictor for increasing calcium intake from calcium-rich foods in general.

To evaluate the effect of the intervention, four questionnaires were either developed (knowledge questionnaire and outcome questionnaires measuring theory constructs), adapted from other sources (food frequency questionnaire assessing calcium and vitamin D intake), or used in the format of other researchers (stage of change questionnaire). I expected that the intervention would improve all theory constructs, increase daily dietary calcium and vitamin D intake, improve knowledge, and increase stage of change for eating dairy products (i.e., move through five stages of behavioral change: pre-contemplation, contemplation, preparation, action, and maintenance) in the experimental group versus the control group. Therefore, we hypothesized that:

H1: Mean score on the behavioral belief scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H2: Mean score on the outcome evaluation scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H3: Mean score on the normative belief scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H4: Mean score on the motivation to comply scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H5: Mean score on the barrier scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H6: Mean score on the skill scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H7: Mean score on the self-efficacy scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H8: Mean score on the intention scale will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H9: Daily dietary calcium intake will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H10: Daily dietary vitamin D intake will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H11: Knowledge will be significantly increased in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

H12: Stage of eating more dairy products will be significantly improved in married Chinese American women in the experimental group compared to the control group at post intervention assessments.

All hypotheses except H3 and H4 were supported. This intervention did not focus on changing social influence. We only encouraged social support through in-class discussions and

take-home activities. In addition, the results for H3 and H4 may not be reliable, because the normative belief and motivation to comply scales, which were used to measure social influence in our study, had low internal consistency. More qualitative studies about social influence on calcium-rich food consumption are needed before these subjective norm scales can be improved.

Dairy products are a large group of calcium-rich foods. Lactose intolerance is proposed to be one of the factors affecting Chinese Americans' dairy intake. Although we presented specific strategies to deal with lactose intolerance in the nutrition education lessons, it may still be a barrier to increasing calcium intake. Therefore, we proposed that:

H13: Increase of daily dietary calcium intake will be significantly higher in lactose tolerant married Chinese American women in the experimental group than lactose intolerant married Chinese American women in the experimental group.

This hypothesis was rejected, probably due to the following reasons. First, the strategies to deal with lactose intolerance might have been already used by lactose intolerant participants and were effective. Second, lactose intolerant participants might choose other non-dairy calcium-rich foods to increase their calcium intake. Third, few of the women reported they were lactose intolerant. Due to the small number of lactose intolerant women in the sample, we were not able to detect a statistically significant difference.

H14: Increase of daily dietary calcium intake will be positively associated with age in married Chinese American women in the experimental group.

This hypothesis was rejected. When we proposed this hypothesis, we assumed that older women might perceive more risk of osteoporosis than younger women, which could result in greater increase in calcium intake in older women than younger women. However, neither age nor baseline bone mineral density was positively associated with the increase of daily dietary calcium intake in the experimental group. In the experimental group, 79% of women were

between 35 and 46 years old. Therefore, we may not have had a broad enough age range to detect the association between age and increase in calcium intake.

Only blood relative's osteoporosis history was associated with the increase of daily dietary calcium intake. Those who had osteoporotic blood relatives reported more increase in daily dietary calcium intake than those without osteoporotic blood relatives. This suggests that those who had osteoporotic blood relatives may perceive more risk for osteoporosis than those without osteoporotic blood relatives.

In summary, our intervention significantly improved calcium intake, vitamin D intake, most of the constructs of the Theory of Planned Behavior, knowledge, and readiness to eat more dairy products in the experimental group. The effectiveness of our intervention can be attributed to our previous studies and the use of the Theory of Planned Behavior. Results of both the focus groups and the couple interviews, together with the Theory of Planned Behavior helped us identify the areas that needed emphasis in our intervention. For example, at least three calcium-rich recipes were introduced in each of the last five lessons. We selected these recipes based on the Chinese Americans' food patterns described in the couple interviews. This insured that the selected recipes could fit into participants' meal patterns. Some strategies of fitting specific calcium-rich foods in the diet of Chinese American families emerged from the focus groups and couple interviews. For example, participants in the focus groups and/or couple interviews reported that they used milk to prepare milk tea and steamed buns and modified American plain yogurt to make it taste like Chinese yogurt. These were modified and incorporated in this intervention to improve participants' perceived behavioral control.

## **Limitations**

Results of our studies were drawn from Pennsylvania samples. All samples were self-selected. Most participants were recruited from Pennsylvania Chinese schools. Participants recruited from Chinese schools had higher education and income level than the census data for Chinese Americans in the US. For example, US Census data (2006) showed that 55.2% of Chinese American males and 48.5% of Chinese American females 25 years old or older have obtained bachelor's degree or higher in the U.S. In Pennsylvania, 54.0% of Chinese American males and 55.2% of Chinese American females 25 years old or older have obtained bachelor's degree or higher. In contrast, 86.4% of Chinese American women in our nutrition education intervention had bachelor's degree or higher. In the couple interview study, 95% of Chinese American men and 90% of Chinese American women had bachelor's degree or higher.

In addition, only 14% of Chinese American women in our sample were lactose intolerant. Lactose intolerance status may influence attitudes toward dairy product consumption, perceived behavioral control over dairy product consumption, and dairy product consumption. Our results need to be validated in more diverse national samples that include more lactose intolerant individuals.

## **Contributions and Implications**

To the best of the author's knowledge, our focus group study was the first to investigate the reasons associated with the consumption and non-consumption of dairy products among Chinese Americans. The same topic was explored in samples most of whom were Caucasians (Park and Ureda, 1999; Brewer et al., 1999; Gulliver and Horwath, 2001; Kim et al., 2003). The focus group study suggested that lactose intolerance was not as a big issue so much as traditional

dietary habits and provided useful information that was used to increase dairy product consumption in Chinese Americans.

The data from couple interviews was unique because no previous studies had looked in detail at the food systems in Chinese American families. This information should be useful for nutrition educators wishing to design interventions to influence dietary behaviors in this population. The results indicated that many Chinese adults consider dinner a very important cultural event that helped them retain their preferences for Chinese foods and teach their children cultural food patterns that would resist the influence of Western foods. Compared to dinners, parents were more willing to change breakfast and snacks. Lunch choices could enhance or retard adoption of American foods of questionable nutrition quality. Many Chinese American parents took dinner leftovers as lunch because they preferred Chinese foods and it probably saved them money in a high cost of living area. Other parents ate Western foods for lunch, suggesting that lunch is less resistant to change than dinner. Nutrition educators also should consider this dietary pattern when designing interventions. For example, lunch may be an opportune meal to introduce new foods, however what to offer needs to be considered. Chinese Americans might be encouraged to eat yogurt with their lunch. Recipes for creamed soups (i.e., creamy broccoli soup and creamy tomato soup) that both children and parents like might be developed. Chinese American parents are concerned about their children's vegetable consumption. They may want to serve these kinds of soups at dinner, so their children can eat some vegetables.

The couple interviews also investigated family interaction around food selection, preparation, and serving in Chinese American families. Family members' different roles and power to influence foods served at meals or as snacks were previously studied in Caucasian families. Our study was the first to collect such information in Chinese American families. Most children learned to prefer Western foods to Chinese foods through lunches served in institutional settings. Although some parents ate Western foods at lunch, all parents preferred Chinese foods

to Western foods. Parents' and children's differing preferences created conflicts at dinnertime. Our interviews demonstrated that parents, especially the father, used their influence over meal choices (which we called power) to retain the Chinese dinner content they preferred and gave children greater freedom around snacks and restaurant and take out choices to balance the restrictions imposed on dinner choices. This suggested that family members had different influences on food choices at meals and snacks, which should be considered when educators design future interventions.

Our nutrition education intervention was designed based on the Theory of Planned Behavior, using the results of focus group and couple interviews. It is the first intervention to demonstrate an increase in calcium and vitamin D intake among married Chinese American women. In spite of some limitations, results showed that this intervention was effective in increasing the calcium and vitamin D intakes of this audience. The extended effect of this intervention at 3-month follow up suggested the importance of a narrow focus on specific calcium-rich foods in the intervention, use of theoretical models, use of previous qualitative results, and use of visual demonstration and interactive activities. Nutrition educators who work with Chinese Americans could use this program to reduce the risk of osteoporosis in this population. Chinese Americans often cluster in big cities and have dense social networks with fellow Chinese. Chinese organizations such as Chinese churches and Chinese schools are possible venues to deliver the lessons.

### **Future Research**

1. Both focus group interviews and couple interviews suggested that social influence is an important factor influencing an individual's food choice in Chinese American families. However, the social influence scales in our outcome questionnaire had low internal consistency. It is



important to conduct qualitative studies and obtain more information on how social influence from different sources (i.e., family members, friends, dietitians, doctors, etc.) affects calcium-rich food consumption in Chinese Americans in order to design and validate scales to measure subjective norm more reliably. Such valid scales are needed to evaluate future nutrition education interventions to increase calcium intake in this population.

2. Effective communication is important when promoting healthful dietary behaviors in the family environment. Our couple interviews provided some information about the role of communication in Chinese American's family food system. More research is still needed to investigate the role of communication within families in relation to establishing couples' food choices and in altering food choices when children or disease processes become influential. In the couple interview study, we used the Reciprocal Determinism Model together with the Circumplex Model of Marital and Family Systems to study the family food system. In the Circumplex Model of Marital and Family Systems, communication is one dimension that describes family functioning together with two other dimensions, family flexibility and cohesion. Researchers might consider using Symbolic Interactionism, which focuses on the relation "between symbols (i.e., shared meanings) and interactions (i.e., verbal and nonverbal actions and communications)" (LaRossa and Reitzes, 1993) in conjunction with the Circumplex Model of Marital and Family Systems to learn how family members reach more or less shared goals (i.e., food choices) through verbal and nonverbal communications.

3. Additional research is needed with more diverse Chinese American groups to verify if the nutrition education intervention works in samples with lower education and income level and more lactose intolerant individuals. Our study used a self-selected sample. When we recruited participants for the intervention to increase calcium intake, we emphasized that the intervention covered not only dairy products but also other calcium-rich foods. Still, those who were lactose intolerant and believed calcium came mainly from dairy products might have self-selected out.

4. In the experimental group, at baseline, women were spread across stages of change of eating dairy products as follows: pre-contemplation 32; contemplation 4; preparation 27; and maintenance 7, respectively. No one was in the action stage. Results of the stage of change for dairy product questionnaire showed that our intervention mainly moved some pre-contemplation and contemplation experimental women to the preparation stage. This suggested that our intervention may be more effective for women at the pre-contemplation stage than those at the preparation stage. Not reaching the action stage may be the reason why our intervention did not achieve a higher calcium and vitamin D increase. We used a stage of change questionnaire specific for dairy products to evaluate the effect of the intervention. A questionnaire that measures stage of change for calcium-rich foods may produce different results. Such a stage of change instrument should be developed and validated for future studies and could be used to verify the effect of these lessons on stage of eating a variety of calcium-rich foods. If the results also show that these lessons are more effective for women at a certain stage than those at other stages, lessons addressing needs of women at other stages should be designed.

5. In future nutrition education interventions, social support should be more explicitly encouraged to achieve a better effect on calcium and vitamin D intake than was observed. Participants could be encouraged to bring their husband and/or a friend to the intervention. More calcium-rich recipes for dishes that might be used at social events or dinner could be offered in the intervention. A potluck attended by participants, their husband, and friends at the end of the intervention might increase social acceptability of these recipes. Parents are more likely to adopt a new recipe that was already used by other Chinese American families. For example, at the potluck, if both parents and children in a family like a calcium-rich vegetable recipe that was adopted by the other families, they might add it to their dinner menu as well.

6. Many participants in the focus groups and couple interviews indicated that they would like to increase yogurt consumption to increase calcium intake. However, American yogurt was

too sweet to them. They wanted a yogurt that is sourer, thinner, and less sweet than American yogurt. Therefore, people in the food industry could investigate the yogurt preferences of Chinese American consumers to design a yogurt or yogurt drink for this market segment. In addition, the focus group data showed that food packaging should be tailored to different segments of consumers. For example, young men in the focus group sample were sensitive to the feminine yogurt drink packaging (i.e., hour glass bottle shape, pink color). Therefore, the packaging of a yogurt drink designed for young men should emphasize masculine values.

## References

- Brewer JL, Blake AJ, Rankin SA, Douglass LW. Theory of Reasoned Action predicts milk consumption in women. *J Am Diet Assoc.* 1999; 99:39-44.
- Broussard DL, Magnus JH. Risk assessment and screening for low bone mineral density in a multi-ethnic population of women and men: does one approach fit all? *Osteoporos Int.* 2004; 15(5):349-60.
- Brown JL, Miller D. Couple's gender role preferences and management of family food preferences. *J Nutr Educ Behav.* 2002; 34:215-223.
- Brug J, Glanz K, Kok, G. The relationship between self-efficacy, attitudes, intake compared to others, consumption, and stages of change related to fruit and vegetables. *Am J Health Promot.* 1997; 12:25-30.
- Crockett S, Mullis R, Perry CL, Luepker RV. Parent education in youth-directed nutrition intervention. *Prev Med.* 1989; 18:475-491.
- De Bourdeaudhuij I. Perceived family members' influence on introducing healthy food into the family. *Health Educ Res.* 1997; 12:77-90.
- De Bourdeaudhuij I, Van Oost P. Family members' influence on decision making about food: differences in perception and relationship with healthy eating. *Am J Health Promot.* 1998; 13:73-81.
- Gao SK, Fitzpatrick AL, Psaty B, Jiang R, Post W, Cutler J, Maciejewski ML. Suboptimal nutritional intake for hypertension control in 4 ethnic groups. *Arch Intern Med.* 2009; 169(7):702-7.
- Gulliver P, Horwath CC. Assessing women's perceived benefits, barriers, and stage of change for meeting milk product consumption recommendations. *J Am Diet Assoc.* 2001; 101:1354-1357.
- John JH, Yudkin PL, Neil HAW, Ziebland S. Does Stage of Change predict outcome in a primary-care intervention to encourage an increase in fruit and vegetable consumption? *Health Educ Res.* 2003; 18:429-438.
- Kim KW, Reicks M, Sjoberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav.* 2003; 35:294-301.
- LaRossa R, Reitzes DC. Symbolic Interactionism and family studies. In: Boss PG, Doherty WJ, LaRossa R, Schumm WR, Steinmetz SK, eds. *Sourcebook of Family Theories and Methods: A Contextual Approach.* New York, NY: Plenum Press; 1993: 135-136.
- Lee MM, Wu AW, Whittemore AS, Zheng S, Gallagher R, Teh C, Zhou L, Wang X, Chen K, Ling C, Jiao D, Jung D, Paffenbarger RS. Comparison of dietary habits, physical activity and body size among Chinese in North America and China. *Int J Epidemiol.* 1994; 23:984-990.

Lv N, Cason K. Dietary pattern change and Acculturation of First Generation Chinese Americans in Pennsylvania. *J Am Diet Assoc.* 2004; 104:771-778.

Lv N, Brown JL, Liu BF. Factors influencing dairy product consumption of Chinese Americans in Pennsylvania. *Top Clin Nutr.* 2007; 22: 259-271.

Park K, Ureda JR. Specific motivations of milk consumption among pregnant women enrolled in or eligible for WIC. *J Nutr Educ Behav.* 1999; 31:76-85.

Pill R, Parry O. Making changes - women, food and families. *Health Educ J.* 1989; 48:51-54.

Tam CF, Nguyen L, Pe SS, Hajyan K, Kevork S, Davis R, Poon G, Lew PL. The effects of age, gender, obesity, health habits, and vegetable consumption frequency on hypertension in elderly Chinese Americans. *Nutr Res.* 2005; 25(1):31-43.

US Census Bureau. 2006 American Community Survey: Selected Population Profile in the United States. Available at <http://factfinder.census.gov>. Accessed May 21, 2009.

Wardle J, Haase AM, Steptoe A. Gender differences in food choice: the contribution of health beliefs and dieting. *Ann Behav Med.* 2004; 27:107-116.

Yu H, Harris RE, Gao YT, Gao R, Wynder EL. Comparative epidemiology of cancers of the colon, rectum, prostate, and breast in Shanghai, China versus the United States. *Int J Epidemiol.* 1991; 20:76-81.

## Appendix A

### Focus Group Scripts

#### 1. Introduction

Thank you for coming to our discussion. I am \_\_\_. My partner is \_\_\_. We are both from Penn State University. For the next 60-90 minutes, we will be talking about dairy products. We would like all of you to tell us your ideas (opinions) and feelings about buying and eating dairy products.

We will audiotape this discussion, so that the group responses can more easily be summarized. XX will take notes of what is said as a backup in case the tape recorder malfunctions. Is everyone comfortable with that?

We have a few simple rules to follow:

- We will not use last names. The moderator will indicate whom to speak by first names, if needed.
- Please speak one at a time. If everyone talks at once – we will be unable to understand what is said and lose your comments.
- Any opinion is welcome, so please feel free to express your opinions. There are no right or wrong answers and we value any of your opinions.

#### Ice-breaker

Now, let's go around the table and introduce ourselves. As we do this,

- Please tell the group about your favorite place (s) to shop for food and explain what you like about the food products offered there?

Probe:           Where do you prefer to shop?

American supermarket or Chinese grocery store?

#### Variety of dairy products

All US supermarkets and many small grocery store sell dairy products. We would like to know your opinions of dairy products currently sold.

*[Bring out empty dairy product cartons]*

Here are some examples of dairy products that are available in the US supermarkets (and Asian supermarkets, if there are any).

#### 1. Reasons for acceptance

First let's concentrate on the products you buy frequently.

[We need to get the opinion of everyone around the table. We may have to go around the table asking each to comment]

**- Which ones do you buy?**

[Sort the products into groups based on responses. Then focus the discussion the most popular ones]

**- What are your reasons for buying them?**

Probes: What do you like about the dairy products you eat? [*We will get to dislikes in a moment*]

- What about taste?
- What about aroma?
- What about texture?
- What about color?
- What about health?
- What role does convenience play in your choices?

**2. Reasons for rejection**

**- Which of these don't you buy?** Let's put these 'not liked' products into a group.

[*Put these products into a group so attention can focus on these*]

**-What are the reasons for not buying these?**

[*Dislike may be only one reason*]

What do you dislike about these dairy products (or others in your store)?

- Probes:
- What about taste?
  - What about aroma?
  - What about texture?
  - What about color?
  - What about health?
  - What about ability to digest (lactose intolerance)?
  - What role does familiarity play in your avoidance or choices?

[*May have to move to next dairy product and repeat*]

**3. Influence of family members**

Some of you mentioned that members of your family had likes and dislikes.

**- How do the likes and dislikes of family members affect your use of dairy products?**

- Probes:
- What is their opinion of these products?
  - What about your children's opinions?
  - How do their likes and dislikes affect what dairy products you might buy?

[*Refer to group of acceptable dairy products*]

**- What do your children seem to like about those dairy products that you buy?**

**- What do other adults in your household like about those dairy products you buy?**

[*Refer to group of unacceptable dairy products*]

**- What do your children seem to dislike among this group?**

**- What do other adults in your household dislike about any of these?**

**- Whose opinion carries the most weight in your decision to buy?**

Probes: What about other adults in your family?

**- How well do US dairy products fit into meals or dishes served in your home?**

Probes: What might help you or your family tries more of these dairy products?

What about cooking skills?

What about recipe availability?

Probes: What kinds of packaging would fit?  
What ingredients would fit?

**4. Desired dairy products**

We want to design a dairy product or products that appeals to people like you.

*[Point to all the products on the table in the undesirable group]*

**- What would make any of these products more appealing to you?**

Probes: You may consider taste, aroma, texture, color, nutrition, convenience, packaging, shelf life, low lactose, and so on.

What about the dairy products that you mentioned just now?

What might make them more appealing to your children?

Probes: You may consider taste, aroma, texture, color, nutrition, convenience, packaging, shelf life, low lactose, and so on.

If you could request a perfect dairy product for someone like yourself, what would you want?

Probes: Tell me more about that.  
What unique features would make a dairy product appealing to Chinese like you?

**5. Dairy product safety**

*[Again refer to the dairy products on display]*

We need to know how safe you think these products are to eat.

*[Ask participants to move items into a 'safe to eat group']*

*[If they want to put in several groups - let them and then ask about each group.]*

**- Please share your reasoning for putting items in the 'safe' group?**



Probes: How important is 'shelf life' to you?  
 What is role of spoilage - having the product go bad?  
 What about packaging?  
 How would 'safety' of these compare to 'safety' of meat?  
 - Bacteria  
 - Additives, preservatives  
 - Amount of fat  
 - Hormones  
 - Probiotics  
 - Organic (vs regular)  
 What about lactose intolerance?  
 How important is safety for long-term storage?

### 6. Reaction to specific dairy products

There are a lot of 'new' dairy products on the market. Let's look at these together.

*[Bring out a bag containing new or unusual dairy products and place these on the table: UTH milk, yogurt drinks, lactose free milk, Carnation Milkshakes, Slimfast Diet shakes]*

#### **-Have any of you purchased these or eaten them?**

*[If few have, give a thumbnail sketch of each product. For instance, UTH milk can be kept at room temperature for X time. But must be refrigerated once opened.]*

#### **- Which of these appeal to you? And why?**

*[Move those that seem to be appealing into a group]*

Probes: What makes it appealing?  
 What makes it unappealing?

#### **- What do you think of the packaging?**

Probes: You may consider attractiveness, claims, and so on.

#### **- How important is it to you to taste a new dairy product before you buy it?**

*[Offer participants the chance to taste small amounts of each of the products. For those that wish to, place small tablespoon amounts in small tasting cups and pass out.]*

#### **- What could be altered in these products to make them more appealing?**

Probes: What might one of these products replace in your diet?  
 How could it be changed so it substitutes for what you use now?

### 7. Information channel

**- When this new dairy product designed for Chinese tastes is produced, how would you like to learn about it?**

Probe: What is role of friends, relatives, co-workers?  
Remember when you came to the US, How do you learn about all these  
strange foods?

Do you have any final comments or points of view to add before we finish?

We have one last short questionnaire. It will only take you a few minutes. I will pass it out. After you finish the questionnaire, please come here to sign your name and we will give you a cash gift.

Thanks for attending!

Get signatures and give out incentives.

## Appendix B

### Couple Interview Scripts

#### Conducted with family members together and then separately

##### Introduction

We want to learn the opinions of Chinese families about American dairy products and how these might or might not fit into your meals. I will be asking you some questions to get our discussion started but please feel free to share whatever you think relevant to the subject with me.

I will audiotape this discussion, so that your responses can more easily be summarized. I will also take notes of what is said as a backup in case the tape recorder malfunctions. Are you comfortable with that? Most people forget about this tape recorder after a few minutes. Just face me as you speak so the microphone can pick you up.

#### Questions asked to family members together

##### 1. Typical meals (*Mechanics of Food Production in the Home* in Reciprocal Determinism Model)

**Before we discuss dairy products it would help me to understand how food is brought into your home and then served.**

##### a) How is food shopping handled in your family?

(Probe: Who does what?

What is each of your roles? Children's roles?

What about a shopping list? How is that put together?)

Where do you shop and how often? (times per week)

**b) Now walk me through how food is prepared in a typical weekday. Maybe we can go through meal by meal. So let's start with breakfast.**

##### a. Breakfast

*First tell me about a typical weekday breakfast for each member*

Tell me –

- Who prepares the breakfast?

- How the foods served are selected?

- Who eats breakfast in your family?

- Where does everybody eat breakfast? (Together at home? Bring breakfast with them? Buy on way to work?)

##### b. Lunch

*Next tell me about a typical weekday lunch for each of you*

Tell me –

- Who prepares the lunch?
- How the foods served are selected?
- Where does everybody eat lunch? (Together at home? Bring lunch with them? Buy around work?)
- Any desserts after lunch? If yes, what will be eaten by whom?

### **c. Dinner**

*Now tell me about a typical weekday dinner in your family*

Tell me –

- Who prepares the dinner?
- How the foods served are selected?
- Where does everybody eat dinner? (Together at home? Eat out? Take out?)
- Any desserts after dinner? If yes, what will be eaten by whom?

### **d. Snacks (assume that they eat snacks – this gets more honest answers)**

Tell me –

- Who eats them?
- When are these eaten?
- What kinds of snacks are eaten between meals?

### **e. Beverage**

*Tell me about typical beverages drunk in your family*

Tell me –

- What does everybody drink? (Water? Milk? Soda? Tea?)

### **c) How do meals on weekends differ from those during the weekday?**

(Probe: What special dishes might be prepared?

Who does the cooking for the weekend meals?)

## **2. Dairy products (Family functioning and dietary behavior of family members in Reciprocal Determinism Model)**

- a) What dairy products are usually eaten at meals or snacks in your home, if any?
- b) What about outside of home, if any?

**If yes, they eat these sometimes – would go to questions c and d below.**

**If no, they do not eat – would go to questions e and f.**

- c) What are the reasons they are eaten?
- d) When selecting these dairy products – how are family member likes and dislikes weighted?
- e) What are your reasons for avoiding dairy products for yourself?
- f) What are your reasons for avoiding dairy products for your children?

- How interested would you be in cooking a Western style main dish that contains dairy products, if you were given a recipe, for example, like Lasagna, custard made from milk?
- How interested would you be in eating dairy products as snacks?
- If you were concerned about bone health, what role would dairy products play in addressing this?

- How do American dairy products and Chinese dairy products compare?  
(Probe: Which ones do you like better and why?)

### Questions asked to family members separately

#### 1. Family functioning (Family functioning in Reciprocal Determinism Model)

##### a. Roles

I want to review the roles played in shopping and cooking to be sure I understand your point of view.

Think about a scale running from 1-10 for actual work performed, where 10 is all the work and 1 is minimal work tell me

- How much of the actual work of shopping and cooking do you do day-to-day?  
Tell me why you feel that way.

##### b. Power

**Using the same scale as a measure of influence where 10 is maximum influence and 1 is minimal influence**

- How much influence do you feel you have on the choice of foods served at family meals?

Tell me why you feel this way.

- Whose food likes and dislikes mainly determine the choice of snacks?
- If you liked something and your partner did not like it, how would it affect what is offered at dinner?
- How would it affect what is available for a snack?
- If you liked something and your children did not like it, would it affect what is offered at dinner? As a snack?

**This leads into the next topic ---**

##### c. Flexibility

- How easy is it to introduce new Chinese foods or dishes into family meals?
- What about a Western style main dish with cheese into family meals?
- How willing are you to change what is served at family meals?
- What about your partner? Your children? Your parents?

**Most families have rules about foods ---**

##### d. Rules

- What rules does your family have about foods?  
For instance, what sorts of snacks or desserts are allowed?  
(Probe: Anything that is banished from the house or pantry?  
What can be refused or how it can be refused at the table?)
- What rules does your family have about introducing new foods into family meals?

##### e. Communication

- How were these rules about foods (banned, etc.) established?

#### 2. Supportive behaviors (Supportive behaviors in Reciprocal Determinism Model)

- What dairy products do you like, if any?
- How does your partner feel about the dairy products you like or dairy products in general?

- If you wanted to buy a new dairy product, how would your partner react?

**3. Lactose intolerance (Personal characteristics in Reciprocal Determinism Model)**

- Do you or your family member have unpleasant symptoms after eating dairy products?

**If yes, continue; if no stop here**

- How does this affect your use (your family member's use) of dairy products?  
(if still eat some)

- What strategies have you or your family member used to reduce those symptoms?

This has been very informative. Do you have any last comments about dairy products and their role in your family meals?

Thanks for participating. Now I need to interview your partner.

### Appendix C

## Demographic Data Form Used in Nutrition Education Intervention

Code No: \_\_\_/\_\_\_/\_\_\_

**Q1.** What was your age on your last birthday? \_\_\_\_\_ years

**Q2.** Your marital status is (please check one option below):

\_\_\_\_\_ Single    \_\_\_\_\_ Married    \_\_\_\_\_ Divorced    \_\_\_\_\_ Widowed    \_\_\_\_\_ Other

**Q3.** What level of schooling have you completed? (please check one option below)

\_\_\_\_\_ 11<sup>th</sup> grade or less

\_\_\_\_\_ High school diploma (12<sup>th</sup> grade) or GED

\_\_\_\_\_ Some college or vocational training

\_\_\_\_\_ Graduate of vocational/technical school

\_\_\_\_\_ College graduate (4 year Bachelor's Degree)

\_\_\_\_\_ Graduate or professional school (Masters, Ph.D. MPA, JD)

\_\_\_\_\_ Postgraduate work

**Q4.** Please indicate the annual income of your household:

\_\_\_\_\_ \$24,999 or less

\_\_\_\_\_ \$25,000-\$49,999

\_\_\_\_\_ \$50,000-\$74,999

\_\_\_\_\_ \$75,000-\$100,000

\_\_\_\_\_ Above \$100,000

**Q5.** Please check the members of your household other than yourself in the list below.

\_\_\_\_\_ Husband

\_\_\_\_\_ Husband's mother and/or father

\_\_\_\_\_ My mother and/or father

Other adult household members (please specify): \_\_\_\_\_

**Children (list sex and age – i.e., girl, age 7)**

Child 1: \_\_\_\_\_

Child 5: \_\_\_\_\_

Child 2: \_\_\_\_\_

Child 6: \_\_\_\_\_

Child 3: \_\_\_\_\_

Child 4: \_\_\_\_\_

**Q6.** Please indicate from where you immigrated:

- China - Please specify the province \_\_\_\_\_  
 Taiwan  
 Hong Kong/Macao  
 Other - Please specify \_\_\_\_\_

**Q7.** In what year did you first come to the United States?: \_\_\_\_\_

**Q8.** Are you lactose intolerant (have symptoms such as abdominal pain, bloating, diarrhea, and excessive flatus after drinking milk or eating other dairy products)?

- Yes  
 No  
 Do not know/not sure

**Q9.** In the last month, have you been regularly taking any calcium supplements?

- Yes (Go to Q10)  
 No (Go to Q11)

**Q10.** Please list dosage (mg of calcium) and frequency of taking any calcium supplements:

Dosage: \_\_\_\_\_ mg

Frequency (fill in one option): \_\_\_\_\_ times per day; \_\_\_\_\_ times per week; \_\_\_\_\_ times per month

**Q11.** Have you had any bone fractures as an adult (after age 21)?

- Yes  
 No  
 Don't know

**Q12.** Have you ever been diagnosed with osteoporosis?

- Yes  
 No  
 Don't know

**Q13.** Have you ever been diagnosed with osteopenia (low bone mass)?

- Yes  
 No  
 Don't know

**Q14.** Do you have blood relatives (relatives on your side of the family) who have suffered bone fractures as an adult?

- Yes - Please specify who has/have suffered \_\_\_\_\_  
 No  
 Don't know

**Q15.** Do you have blood relatives (relatives on your side of the family) who have suffered osteoporosis as an adult?

- Yes - Please specify who has/have suffered \_\_\_\_\_  
 No  
 Don't know



## Appendix D

### Food Frequency Questionnaire Used in Nutrition Education Intervention

Code No:    \_\_\_ / \_\_\_ / \_\_\_

This survey is about your usual intake of calcium-rich foods, including dairy products, **over the last 1 month**.

- Calcium-rich foods include some vegetables, a number of foods fortified with calcium like soy milk or cereal, and dairy products. Dairy products are made from cow's milk like yogurt and ice cream. You will also be asked about some foods made with dairy products (for instance, macaroni and cheese, pudding, milk used in cooking or added to cereal).
- If you eat low fat dairy products, please respond to the food item listed as if it were the fat value you eat. You will have a chance to indicate the fat level of milk, cheese, and yogurt you eat at the end of the food frequency questionnaire.
- Please answer **ALL the questions** honestly based on your own consumption. Your responses are confidential. **There are no right or wrong answers**. Just indicate how often and how much you actually eat the following food products.

---

**Here is an example of how to answer the questions. Two kinds of questions are associated with each type of food.**

**HOW OFTEN**, on average, did you eat or drink the food **in the past 1 month?**

- Please DO NOT SKIP any foods. MARK "Never" if you do not eat it.

**HOW MUCH** of that food do you eat or drink each time?

- Please choose the serving size closest to the average of what you normally eat.

**EXAMPLE:** Betty drinks a half 8-oz glass of milk three times a week.

TYPE OF FOOD	HOW OFTEN											HOW MUCH EACH TIME		
	NEVER or LESS THAN ONCE Per MONTH	1 Per MONTH	2-3 TIMES Per MONTH	1 Per WEEK	2 TIMES Per WEEK	3-4 TIMES Per WEEK	5-6 TIMES Per WEEK	VERY DAY	2 Per DAY	3 Per DAY	4+ Per DAY	S	M	L
1. Cow' milk as a beverage (any fat level)						X						4 oz glass	8 oz glass	12 oz glass

**How often and how much have you usually drunk/eaten each of the following foods over the last 1 month?**

TYPE OF FOOD	HOW OFTEN											HOW MUCH EACH TIME		
	NEVER or LESS THAN ONCE Per MONTH	1 Per MONTH	2-3 TIMES Per MONTH	1 Per WEEK	2 TIMES Per WEEK	3-4 TIMES Per WEEK	5-6 TIMES Per WEEK	EVERY DAY	2 Per DAY	3 Per DAY	4+ Per DAY	S	M	L
1. Regular cow' milk (as a beverage, on cereal)												4 oz glass	8 oz glass	12 oz glass
2. Lactose free or reduced milk (as a beverage, on cereal)												4 oz glass	8 oz glass	12 oz glass
3. Instant breakfast milkshakes like Carnation, diet shakes like Slimfast, or liquid supplements like Ensure												½ packet /can	1 packet /can	1 ½ packet /can
4. Calcium fortified orange juice												4 oz glass	8 oz glass	12 oz glass
5. Calcium fortified soy milk												4 oz glass	8 oz glass	12 oz glass
6. Nonfat dry milk (used in cooking and baking)												1 table- spoon	2 table- spoon	3 table- spoon
7. Half & Half (e.g. added to coffee or tea)												½ table- spoon	1 table- spoon	1 ½ table-
8. Cheese, sliced, cubed, or shredded (e.g. cheese on pizza)												1 slice or 1 oz or ¼ cup	2 slices or 2 oz or ½ cup	3 slices or 3 oz or ¾ cup
9. Cottage cheese												½ cup	1 cup	1 ½ cup
11. Ricotta cheese												½ cup	1 cup	1 ½ cup
12. Yogurt												½ 6-oz cup	1 6-oz cup	1 ½ 6-oz cup

TYPE OF FOOD	HOW OFTEN											HOW MUCH EACH TIME		
	NEVER or LESS THAN ONCE Per MONTH	1 Per MONTH	2-3 TIMES Per MONTH	1 Per WEEK	2 TIMES Per WEEK	3-4 TIMES Per WEEK	5-6 TIMES Per WEEK	VERY DAY	2 Per DAY	3 Per DAY	4+ Per DAY	S	M	L
13. Yogurt drink												½ 10-oz bottle	1 10-oz bottle	1 ½ 10- oz bottle
14. Ice cream, frozen yogurt												1 scoop or ½ cup	2 scoop or 1 cup	3 scoop or 1 ½
15. Ice cream bars or cones												1 bar or cone	2 bar or cone	3 bar or cone
16. Pudding made with milk (If you never make pudding with milk, please check "never")												1 4-oz cup	2 4-oz cup	3 4-oz cup
17. Cream soup made with milk (If you never make cream soup with milk, please check "never")												½ cup	1 cup	1 ½ cup
18. Macaroni & cheese (If you never make Macaroni & cheese or buy it, please check "never")												½ cup	1 cup	1 ½ cup
19. Mashed potatoes made with milk (If you never make mashed potatoes with milk, please check "never")												½ cup	1 cup	1 ½ cup
20. Calcium fortified tofu												1/5 package	2/5 package	3/5 package
21. Broccoli, cooked												½ cup	1 cup	1 ½ cup
22. Bok Choy, cooked												¼ cup	½ cup	¾ cup

TYPE OF FOOD	HOW OFTEN											HOW MUCH EACH TIME		
	NEVER or LESS THAN ONCE Per MONTH	1 Per MONTH	2-3 TIMES Per MONTH	1 Per WEEK	2 TIMES Per WEEK	3-4 TIMES Per WEEK	5-6 TIMES Per WEEK	VERY DAY	2 Per DAY	3 Per DAY	4+ Per DAY	S	M	L
23. Kale, cooked												¼ cup	½ cup	¾ cup
24. Mustard greens, cooked												¼ cup	½ cup	¾ cup
25. Pe-tsai or napa, cooked												¼ cup	½ cup	¾ cup
26. Calcium fortified bread Specify name: _____ (If you don't know the name or if it is fortified, just say "never")												1 slice	2 slices	3 slices
27. Calcium fortified cereal Specify name: _____ (If you don't know the name or if it is fortified, just say "never")												½ cup	1 cup	1 ½ cup
28. Beans, peas (kidney, pinto, split, etc.), cooked												¼ cup	½ cup	¾ cup
29. Canned fish with bones (sardines, mackerel, salmon)												1 oz	2 oz	3 oz
30. Nuts Specify kind: _____												½ oz	1 oz	1 ½ oz

**Q1.** When you drink milk, what kind do you usually drink? **Circle ONLY ONE Below:**

- Whole fat milk                       2% milk                       1% milk                       Non-fat milk     I don't know/don't drink milk

**Q2.** When you eat cheese, is it mostly ... **Circle ONLY ONE Below:**

- Whole fat cheese                       Low-fat cheese                       Fat free cheese                       I don't know/don't eat cheese

**Q3.** When you eat yogurt, is it mostly ... **Circle ONLY ONE Below:**

- Whole fat yogurt                       Low-fat yogurt                       Fat free yogurt                       I don't know/don't eat yogurt

## Appendix E

### Outcome Questionnaire Used in Nutrition Education Intervention

Code No:    \_\_\_/\_\_\_/\_\_\_

**INSTRUCTIONS**

The following questions ask *your* opinions of eating calcium rich foods. There are no right or wrong answers. Please circle the number under the response that best describes your opinion. Here is an example of how to answer the questions.

**Example:** If you were asked to rate “Eating green vegetables will reduce my risk of cancer”, the five spaces should be interpreted as follows.

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
1. If you <i>agree a little</i> that eating green vegetables will reduce your risk of cancer, then you would circle:	1	2	3	4	5
2. If you <i>disagree a lot</i> that eating green vegetables will reduce your risk of cancer, you would circle:	1	2	3	4	5

**I. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I believe ...</b>					
1. Dairy products don't fit into my usual food choices.	1	2	3	4	5
2. My vegetable intake does not contribute to my bone health.	1	2	3	4	5
3. The only negative effect of osteoporosis is higher risk of bone fracture.	1	2	3	4	5
4. Other nutrients beside calcium are important for bone health.	1	2	3	4	5
5. My peak bone mass at age 35 affects my risk for osteoporosis.	1	2	3	4	5

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
6. The amount of calcium listed on the Nutrition Facts panel on the food label is the amount of calcium I will absorb from that food.	1	2	3	4	5
7. My mother's bone health is no indication of my bone health.	1	2	3	4	5
8. Dairy products are the only calcium rich foods in the supermarket.	1	2	3	4	5
9. Taking calcium supplements is an ideal way to meet my calcium need.	1	2	3	4	5
10. Once you lose your childhood tolerance for lactose in dairy products, you cannot get it back.	1	2	3	4	5
11. No negative side effects are associated with taking calcium supplements.	1	2	3	4	5
12. For the lactose intolerant, taking calcium supplements is best.	1	2	3	4	5
13. Taking calcium supplements is as effective in building my bone mass as eating calcium rich foods.	1	2	3	4	5
14. Dairy products should be avoided by those with lactose intolerance.	1	2	3	4	5
15. Evaluating the calcium content is the only important criteria for choosing a calcium supplement.	1	2	3	4	5
16. Uncomfortable symptoms associated with eating dairy products are very difficult to manage.	1	2	3	4	5
17. All calcium supplements deliver their calcium effectively in my body once they are swallowed.	1	2	3	4	5



**II. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I expect ...</b>					
1. It is important to me to reduce my risk of osteoporosis by altering my food choices.	1	2	3	4	5
2. It is not important to me to eat calcium rich foods since calcium supplements eliminate my need for these.	1	2	3	4	5
3. It is not important to me to increase my tolerance for dairy products.	1	2	3	4	5
4. It is important to me to reduce my risk of osteoporosis by getting adequate sun exposure.	1	2	3	4	5
5. It is vital that I plan my intake of dairy products during the day so I can increase my tolerance of them.	1	2	3	4	5
6. Careful planning so small amounts of milk will fit into my daily meal pattern is vital to meeting my daily calcium requirement.	1	2	3	4	5
7. It is vital to increase my calcium intake now in order to preserve my bone health.	1	2	3	4	5
8. It is important to me to consider other factors besides calcium content and price in making my choice of calcium supplements.	1	2	3	4	5
9. It is important to me that some dairy products are easier to digest than others.	1	2	3	4	5
10. Eating certain types of calcium rich foods is vital to boosting my calcium intake.	1	2	3	4	5
11. It is not important to me to monitor my vegetable intake as a part of maintaining my bone health.	1	2	3	4	5
12. It is vital that I eat more calcium rich foods in order to reduce my risk of fracture.	1	2	3	4	5

**III. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I feel ...</b>					
1. My husband would not support my efforts to increase my calcium-rich food intake.	1	2	3	4	5
2. I need the support of my friends to increase my calcium rich food intake.	1	2	3	4	5
3. My children play no role in efforts I make to increase my calcium-rich food intake.	1	2	3	4	5
4. My husband considers calcium rich foods suitable for snacks.	1	2	3	4	5
5. My friends have little influence over my food choices.	1	2	3	4	5
6. My children think some calcium rich foods are tasty.	1	2	3	4	5
7. My husband considers dairy foods to be unsuitable for our evening meals.	1	2	3	4	5
8. My friends would use calcium supplements rather than foods to reduce their risk of osteoporosis.	1	2	3	4	5
9. My children's food preferences would make it difficult for me to eat more calcium rich foods.	1	2	3	4	5

**IV. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I think ...</b>					
1. I want to increase my calcium rich food intake regardless of my husband's opinion.	1	2	3	4	5
2. I want to increase my calcium rich food intake regardless of my friend's opinions.	1	2	3	4	5
3. I want to increase my calcium rich food intake regardless of my children's feelings about this.	1	2	3	4	5
4. I am more likely to use calcium supplements instead of calcium rich foods if my friends rely on calcium supplements.	1	2	3	4	5
5. I am unlikely to increase my intake of calcium rich foods if my children are not interested in trying them.	1	2	3	4	5
6. I want to increase my intake of calcium rich foods regardless of my husband's interest in trying them.	1	2	3	4	5
7. I want to increase my calcium rich food intake regardless of my friends' interest in trying these foods.	1	2	3	4	5
8. I am more likely to prepare the calcium rich foods that my children like.	1	2	3	4	5
9. I am more likely to prepare the calcium rich foods that my husband likes.	1	2	3	4	5
10. I want to eat the calcium rich foods that my friends like.	1	2	3	4	5

**V. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I anticipate ...</b>					
1. It is too difficult to alter my food pattern to include calcium rich foods.	1	2	3	4	5
2. Calcium supplements are easier to use than calcium rich foods to insure that I have an adequate calcium intake.	1	2	3	4	5
3. It is too difficult to try recipes that use dairy products.	1	2	3	4	5
4. I have little personal risk of developing osteoporosis.	1	2	3	4	5
5. Drinking small amounts of milk with meals is too much trouble.	1	2	3	4	5
6. It is too difficult to fit dairy products into my meal pattern.	1	2	3	4	5
7. Calcium supplements are cheaper in the long run than calcium rich foods.	1	2	3	4	5
8. Drinking milk with Chinese dishes will not taste right.	1	2	3	4	5
9. It is too difficult to find calcium rich foods other than dairy products.	1	2	3	4	5
10. It is too late in my life to reduce my risk of osteoporosis.	1	2	3	4	5
11. Calcium supplements can provide more calcium than I can manage to get from my diet.	1	2	3	4	5
12. Lactose reduced milk does not taste good.	1	2	3	4	5
13. Calcium fortified foods are not easy to identify.	1	2	3	4	5
14. Yogurt in convenient 6-8 ounce containers is too expensive.	1	2	3	4	5
15. Cheese has too many calories for the amount of calcium it can provide.	1	2	3	4	5

**VI. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I can or I know ...</b>					
1. I know how to minimize the gastrointestinal symptoms associated with eating some dairy products.	1	2	3	4	5
2. I can identify foods that are major sources of vitamin K.	1	2	3	4	5
3. I know how to use the % DV (% Daily Value) on the Nutrition Facts panel to determine the milligrams of calcium in one serving of that food.	1	2	3	4	5
4. I know how to prepare some recipes using calcium-rich foods.	1	2	3	4	5
5. I can identify some cheeses that have low lactose content.	1	2	3	4	5
6. I can identify non-dairy calcium-fortified foods.	1	2	3	4	5
7. I know how to use the % DV (% Daily Value) on the Nutrition Facts panel to determine the International Units of Vitamin D in one serving of that food.	1	2	3	4	5
8. I know how to use nonfat dry milk to boost my calcium intake.	1	2	3	4	5
9. I can identify yogurt that contains live bacterial cultures.	1	2	3	4	5
10. I can identify foods with very low calcium bioavailability (i.e. where calcium is present but in a form humans absorb poorly).	1	2	3	4	5
11. I know how to identify soy milk that is a good source of calcium.	1	2	3	4	5
12. I know how much hard cheese provides the calcium found in one cup of milk.	1	2	3	4	5
13. I know how to increase my tolerance for dairy products.	1	2	3	4	5

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
14. I know how to identify non-dairy foods that are good sources of calcium.	1	2	3	4	5
15. I know how to identify tofu that is a good source of calcium.	1	2	3	4	5
16. I can identify calcium rich foods that fit into breakfast.	1	2	3	4	5
17. I can state the amount of calcium I need to get daily.	1	2	3	4	5
18. I can identify calcium rich foods that make good snacks.	1	2	3	4	5

**Please go to the next page!**

**VII. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I am confident that or I know that...</b>					
1. I can compare foods and identify the better source of calcium.	1	2	3	4	5
2. If I choose my foods carefully, I can increase my daily calcium intake.	1	2	3	4	5
3. I can prepare calcium rich snacks.	1	2	3	4	5
4. It is difficult for me to identify good food sources of <u>both</u> calcium and vitamin D.	1	2	3	4	5
5. I can adjust my food choices to include more calcium rich foods in my daily food pattern.	1	2	3	4	5
6. I can prepare calcium rich foods for breakfast.	1	2	3	4	5
7. It is difficult for me to identify calcium-rich foods in the supermarket.	1	2	3	4	5
8. It is difficult for me to eat some dairy products and control gastrointestinal symptoms.	1	2	3	4	5
9. I can identify calcium fortified foods that will help me meet my daily calcium need.	1	2	3	4	5
10. It is difficult for me to prepare recipes using calcium-rich foods.	1	2	3	4	5

**VIII. For each item below, please circle the number under the response that best describes your opinion.**

	Disagree a lot	Disagree a little	Neither disagree nor agree	Agree a little	Agree a lot
<b>I plan to ...</b>					
1. Drink fluid milk to increase my calcium intake.	1	2	3	4	5
2. Add several calcium-fortified foods to my weekly food intake.	1	2	3	4	5
3. Eat calcium-rich vegetables to increase my calcium intake.	1	2	3	4	5
4. Use nonfat dry milk to boost my calcium intake.	1	2	3	4	5
5. Purchase calcium-fortified tofu rather than regular tofu.	1	2	3	4	5
6. Prepare recipes made with calcium rich foods to increase my calcium intake.	1	2	3	4	5
7. Eat yogurt to increase my calcium intake.	1	2	3	4	5
8. Purchase calcium-fortified soy milk rather than unfortified soy milk.	1	2	3	4	5
9. Eat calcium rich foods as snacks to increase my calcium intake.	1	2	3	4	5
10. Eat cheese to increase my calcium intake.	1	2	3	4	5
11. Purchase calcium-fortified orange juice rather than unfortified orange juice.	1	2	3	4	5
12. Eat calcium-rich foods at breakfast to increase my calcium intake.	1	2	3	4	5

**Thank you! You have completed this questionnaire!**



## Appendix F

## Knowledge Questionnaire Used in Nutrition Education Intervention

Code No: \_\_\_/\_\_\_/\_\_\_

Please circle the **ONE** answer you think is correct. If you don't know, please circle "Don't know".

- Q1.** How many mg of calcium should you eat every day? (Please specify your age: \_\_\_\_\_)
- A. 800 mg
  - B. 1000 mg
  - C. 1200 mg
  - D. 1400 mg
  - E. Don't know
- Q2.** Which of the following is **NOT** a risk factor of osteoporosis?
- A. Being a woman
  - B. Small body size
  - C. Low calcium intake
  - D. Low vitamin A intake
  - E. Don't know
- Q3.** A physician recommends that Mrs. Smith get 600 mg more calcium per day. Which of the following is **NOT** a good way for her to get the extra calcium? (Assume Mrs. Smith has no problem digesting dairy products.)
- A. 1 calcium pill containing 600mg calcium taken before bedtime
  - B. 1 calcium pill containing 300 mg calcium taken with breakfast and 1 calcium pill containing 300 mg calcium taken before bedtime
  - C. Lunch: 1 cup of yogurt (300mg Ca); dinner: 1 calcium pill containing 300 mg calcium
  - D. Breakfast: 1 cup of milk (300mg Ca) and 1 calcium pill containing 300 mg calcium
  - E. Don't know.
- Q4.** Which of the following statements about nonfat dry milk is **FALSE**?
- A. Contains vitamin A
  - B. Contains no vitamin D
  - C. Contains few calories
  - D. Contains very little fat and cholesterol
  - E. Don't know

Q5. How much calcium does one serving of the following food contain?

- A. 15 mg
- B. 150 mg
- C. 180 mg
- D. 1500 mg
- E. Don't know

<b>Nutrition Facts</b>	
Serving Size 1 cup (228g)	
Servings Per Container 2	
<b>Amount Per Serving</b>	
<b>Calories 260</b>	<b>Calories from fat 120</b>
% Daily Value*	
<b>Total Fat 13g</b>	<b>20%</b>
Saturated Fat 5g	25%
<b>Cholesterol 30mg</b>	<b>10%</b>
<b>Sodium 660mg</b>	<b>28%</b>
<b>Total Carbohydrate 31g</b>	<b>10%</b>
Dietary Fiber 0g	0%
Sugars 5g	
<b>Protein 5g</b>	
Vitamin A 4%	• Vitamin C 2%
Calcium 15%	• Iron 4%
* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs:	
Calories:	2,000 2,500
Total Fat	Less than 65g 80g
Sat Fat	Less than 20g 25g
Cholesterol	Less than 300mg 300mg
Sodium	Less than 2,400mg 2,400mg
Total Carbohydrate	300g 375g
Dietary Fiber	25g 30g
Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4	

Q6. How much vitamin D does one serving of the following food contain?

- A. 25 IU
- B. 100 IU
- C. 250 IU
- D. 2500 IU
- E. Don't know

<b>Nutrition Facts</b>	
Serving Size 1 cup (236ml)	
Servings Per Container 1	
<b>Amount Per Serving</b>	
<b>Calories 120</b>	<b>Calories from Fat 45</b>
%Daily Value*	
<b>Total Fat 5g</b>	<b>8%</b>
Saturated Fat 3g	15%
<b>Cholesterol 20mg</b>	<b>7%</b>
<b>Sodium 120mg</b>	<b>5%</b>
<b>Total Carbohydrate 11mg</b>	<b>4%</b>
Dietary Fiber 0g	0%
Sugars 11g	
<b>Protein 9g</b>	<b>17%</b>
Vitamin A 10%	• Vitamin C 4%
Calcium 30%	• Iron 0% • Vitamin D 25%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:	

- Q7. What is the meaning of calcium bioavailability of a food?
- A. Total amount of calcium in the food
  - B. The amount of calcium released from the food during digestion
  - C.  $\frac{\text{Total amount of calcium in the}}{\text{Amount of calcium recommended for an age group}}$
  - D.  $\frac{\text{Amount of calcium absorbed into your blood}}{\text{Total amount of calcium in the}}$
  - E. Don't know
- Q8. Which of the following foods has the **lowest** calcium bioavailability?
- A. Cow's milk
  - B. Soy milk
  - C. Broccoli
  - D. Spinach
  - E. Don't know
- Q9. Which of the following statements about lactose intolerance is **FALSE**?
- A. Lactose intolerant people may have diarrhea when they eat dairy products
  - B. Lactose intolerance can be reduced by eating dairy products regularly
  - C. Lactose intolerant people should avoid all dairy products
  - D. Lactose intolerance is an inherited condition
  - E. Don't know
- Q10. For lactose intolerant people, which of the following is **most likely** to cause unpleasant symptoms when drinking regular cow's milk?
- A. Drinking 1 cup lactose free milk
  - B. Drinking 1/2 cup regular milk at breakfast and 1/2 cup regular milk at dinner
  - C. Drinking 1 cup cold regular milk between meals
  - D. Drinking 1 cup regular milk with dinner
  - E. Don't know
- Q11. The US government recommends people consume how many servings of dairy products per day?
- A. 2
  - B. 3
  - C. 4
  - D. 5
  - E. Don't know
- Q12. Which of the following statements about live cultures in yogurt products is **FALSE**?
- A. All yogurt products contain live cultures
  - B. Live cultures help you digest yogurt
  - C. Live cultures may enhance immunity and reduce the risk of certain cancers
  - D. Bacteria in the live cultures can die when passing through your digestive tract
  - E. Don't know

- Q13.** Which of the following cheeses contains the highest amount of lactose?
- A. Cheddar cheese
  - B. Swiss cheese
  - C. Parmesan cheese
  - D. Cottage cheese
  - E. Don't know
- Q14.** Which of the following cheeses contains the lowest amount of calcium?
- A. Cream cheese
  - B. Cheddar cheese
  - C. Swiss cheese
  - D. Provolone cheese
  - E. Don't know
- Q15.** Which of the following statements about cheese manufacture is **FALSE**?
- A. During cheese manufacture, lactose goes into the whey
  - B. Most cheese products are made from whey
  - C. The ripening process can lower the lactose content of cheese
  - D. Cheese is a fermented dairy product
  - E. Don't know

## Appendix G

**Readiness to Eat More Dairy Products Questionnaire Used in Nutrition  
Education Intervention**

Code No: \_\_\_\_\_

Please start with question 1. Put "X" on the line in front of the answer you choose.  
And then follow the arrows according to your answers.

**Q1. On average, how many servings of dairy products do you eat each day?**

Less than 3 servings

3 or more servings



**Q2. About how long have you been eating this number  
of daily servings of dairy products?**

1-6 months - END

Longer than 6 months - END

**Q3. Are you seriously thinking about eating more servings of dairy products per day  
starting in the next six months?**

Yes

No - END



**Q4. If yes, are you planning to eat more servings of dairy products per day during the  
next month?**

Yes - END

No - END

## Appendix H

### Nutrition Education Intervention Lesson Content and Demonstrations/Activities

Lesson	Content	Demonstrations/Activities
1	<ul style="list-style-type: none"> <li>- What is osteoporosis?</li> <li>- Bone development over time</li> <li>- Who have more risk to develop osteoporosis</li> <li>- Role of calcium and vitamin D and their daily need</li> </ul>	<ul style="list-style-type: none"> <li>- Calculate calcium and vitamin D intake.</li> <li>- Demonstrate the amount of calcium in bones for different age groups.</li> </ul>
2	<ul style="list-style-type: none"> <li>- Problems with calcium supplements</li> <li>- Nonfat dry milk and its nutrition</li> <li>- Tips for using nonfat dry milk</li> </ul>	<ul style="list-style-type: none"> <li>- Compare calcium and multi-vitamin supplements.</li> <li>- Demonstrate availability of calcium in two supplements.</li> <li>- Find a substitute or two to bring the total calcium content of breakfast to 300-500 mg.</li> <li>- Demonstrate a study showing food is the preferred calcium source than calcium supplements.</li> <li>- Compare the price of 100 mg of calcium from nonfat dry milk vs. from calcium supplements.</li> <li>- Taste and evaluate three recipes made with nonfat dry milk.</li> </ul>
3	<ul style="list-style-type: none"> <li>- Nutrition Facts Panel reading</li> <li>- Calcium in common foods and calcium bioavailability</li> <li>- Vitamin K enhances collagen formation</li> </ul>	<ul style="list-style-type: none"> <li>- Read nutrition facts panel.</li> <li>- Compare calcium content in regular foods and calcium-fortified foods.</li> <li>- Choose a food to increase the calcium content of a meal to at least 300 mg.</li> <li>- Demonstrate bioavailability of calcium in different foods.</li> <li>- Calculate how much of some foods we need to get 100 mg of calcium absorbed.</li> <li>- Taste and evaluate three recipes made with calcium-rich/fortified foods.</li> </ul>
4	<ul style="list-style-type: none"> <li>- Three servings of dairy products a day in the food guide pyramid</li> <li>- Strategies to help lactose intolerant people increase milk intake</li> <li>- Cow's Milk and its nutrition</li> <li>- Calcium fortified soy milk and its nutrition</li> </ul>	<ul style="list-style-type: none"> <li>- Demonstrate two studies proving that lactose intolerance symptoms could be reduced.</li> <li>- Taste and evaluate commercial milk products.</li> <li>- Taste and evaluate commercial calcium-fortified soy milk products.</li> <li>- Prepare, taste, and evaluate three recipes made with milk/calcium-fortified soy milk.</li> </ul>
5	<ul style="list-style-type: none"> <li>- Yogurt and its nutrition</li> <li>- Benefits of live cultures in yogurt</li> </ul>	<ul style="list-style-type: none"> <li>- Taste and evaluate commercial yogurt products.</li> <li>- Find live cultures on yogurt packages.</li> <li>- Compare calcium content in different yogurt products.</li> <li>- Prepare, taste, and evaluate three recipes made with yogurt.</li> <li>- Modify plain yogurt to make it taste like Chinese yogurt.</li> </ul>

6	<ul style="list-style-type: none"><li>- Cheese and its nutrition</li><li>- Calcium content of cheese</li></ul>	<ul style="list-style-type: none"><li>- Demonstrate different types of cheese.</li><li>- Demonstrate cheese coagulation.</li><li>- Taste and evaluate commercial cheese products.</li><li>- Compare calcium content in different cheese products.</li><li>- Demonstrate the size of 1 oz of cheese.</li><li>- Prepare, taste, and evaluate three recipes made with cheese.</li><li>- Calculate calcium and vitamin D intake.</li></ul>
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## Appendix I

**Multiple Regressions of Intention, Calcium Intake, and Vitamin D Intake on  
TPB Constructs, Stage of Change, Knowledge, and Baseline Demographic  
Variables at Baseline (Experimental Group)**

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Contribution of TPB constructs and baseline demographics to Intention</b>						
<b>Model</b>					0.259	0.240
Self efficacy	0.494	0.134	0.509	3.697***		
F(1,39)=13.666***						
<hr/>						
<b>Model</b>					0.406	0.375
Self efficacy	0.402	0.125	0.414	3.213**		
Outcome evaluation	0.551	0.180	0.394	3.061**		
F(2,38)=12.986***						
<hr/>						
<b>Model</b>					0.504	0.464
Self efficacy	0.455	0.117	0.470	3.879***		
Outcome evaluation	0.586	0.167	0.420	3.508***		
Years in US	0.031	0.012	0.320	2.709**		
F(3,37)=12.547***						
<hr/>						
<b>Model</b>					0.612	0.569
Self efficacy	0.542	0.109	0.559	4.983***		
Outcome evaluation	0.620	0.150	0.444	4.129***		
Years in US	0.039	0.011	0.395	3.630***		
Calcium supplements <sup>1</sup>	0.448	0.142	0.346	3.160**		
F(4,36)=14.193***						
<hr/>						
<b>Model</b>					0.657	0.607
Self efficacy	0.488	0.107	0.503	4.557***		
Outcome evaluation	0.587	0.144	0.420	4.071***		
Years in US	0.040	0.010	0.409	3.936***		
Calcium supplements <sup>1</sup>	0.503	0.138	0.389	3.653***		
Motivation to comply	0.253	0.119	0.229	2.131*		
F(5,35)=13.379***						
<hr/>						
<b>Contribution of baseline demographics to Calcium intake</b>						
<b>Model</b>					0.177	0.156
Relative's fractures <sup>2</sup>	-319.802	110.560	-0.420	-2.893**		
F(1,39)=8.367**						
<hr/>						
<b>Model</b>					0.267	0.228
Relative's fractures <sup>2</sup>	-276.803	107.567	-0.364	-2.573*		
Years in US	-12.845	5.948	-0.305	-2.159*		



F(2,38)=6.908\*\*

<b>Model</b>					0.345	0.292
Relative's fractures <sup>2</sup>	-244.299	104.189	-0.321	-2.345*		
Years in US	-15.051	5.794	-0.358	-2.598*		
Calcium supplements <sup>1</sup>	-159.839	76.058	-0.286	-2.102*		
F(3,37)=6.491***						

Contribution of baseline demographics to **Vitamin D intake**

<b>Model</b>					0.172	0.150
Years in US	-4.838	1.702	-0.414	-2.842**		
F(1,39)=8.080**						

<b>Model</b>					0.283	0.245
Years in US	-5.451	1.624	-0.467	-3.357**		
Calcium supplements <sup>1</sup>	-52.356	21.548	-0.338	-2.430*		
F(2,38)=7.500**						

<b>Model</b>					0.358	0.306
Years in US	-4.766	1.591	-0.408	-2.995**		
Calcium supplements <sup>1</sup>	-45.898	20.892	-0.296	-2.197*		
Relative's fractures <sup>2</sup>	-59.597	28.618	-0.282	-2.082*		
F(3,37)=6.884***						

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$ <sup>1</sup> In the last month, have you been regularly taking any calcium supplements? 1=Yes; 2=No.<sup>2</sup> Do you have blood relatives (relatives on your side of the family) who have suffered bone fractures as an adult? 1=Yes; 2=No and Don't know combined.

## Appendix J

**Multiple Regressions of Intention, Calcium Intake, and Vitamin D Intake on  
TPB Constructs, Stage of Change, Knowledge, and Baseline Demographic  
Variables at Posttest (Experimental Group)**

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Contribution of self efficacy and skills to Intention</b>						
<b>Model</b>					0.518	0.509
Self efficacy	0.631	0.081	0.720	7.756***		
F(1,56)=60.163***						
<hr/>						
<b>Model</b>					0.552	0.536
Self efficacy	0.474	0.110	0.541	4.308***		
Skills	0.194	0.095	0.257	2.042*		
F(2,55)=33.871***						
<hr/>						
<b>Contribution of knowledge and relative's fractures to Calcium intake</b>						
<b>Model</b>					0.169	0.155
Knowledge	34.590	10.234	0.412	3.380***		
F(1,56)=11.423***						
<hr/>						
<b>Model</b>					0.254	0.227
Knowledge	30.001	9.955	0.357	3.014**		
Relative's fractures <sup>1</sup>	-268.927	107.403	-0.297	-2.504*		
F(2,55)=9.384***						
<hr/>						
<b>Contribution of relative's fractures to stage of change to Vitamin D intake</b>						
<b>Model</b>					0.175	0.160
Relative's fractures <sup>1</sup>	-99.230	28.841	-0.418	-3.441***		
F(1,56)=11.838***						
<hr/>						
<b>Model</b>					0.260	0.233
Relative's fractures <sup>1</sup>	-78.550	28.757	-0.331	-2.732**		
Stage of change	26.206	10.412	0.305	2.517*		
F(2,55)=9.650***						

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

<sup>1</sup> Do you have blood relatives (relatives on your side of the family) who have suffered bone fractures as an adult? 1=Yes; 2=No and Don't know combined.

## Appendix K

**Multiple Regressions of Intention, Calcium Intake, and Vitamin D Intake on  
TPB Constructs, Stage of Change, Knowledge, and Baseline Demographic  
Variables at Baseline (Control Group)**

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Contribution of self efficacy, normative belief, and education to Intention</b>						
<b>Model</b>					0.098	0.084
Self efficacy	0.384	0.149	0.314	2.580*		
F(1,61)=6.654*						
<hr/>						
<b>Model</b>					0.215	0.189
Self efficacy	0.455	0.142	0.371	3.202**		
Normative belief	-0.512	0.172	-0.346	-2.987**		
F(2,60)=8.220***						
<hr/>						
<b>Model</b>					0.299	0.263
Self efficacy	0.439	0.136	0.358	3.237**		
Normative belief	-0.505	0.164	-0.341	-3.085**		
Education	-0.178	0.067	-0.289	-2.650**		
F(3,59)=8.372***						
<hr/>						
<b>Contribution of intention to Calcium intake</b>						
<b>Model</b>					0.123	0.109
Intention	164.808	56.230	0.351	2.931**		
F(1,61)=8.590**						
<hr/>						
<b>Contribution of intention to Vitamin D intake</b>						
<b>Model</b>					0.112	0.097
Intention	42.846	15.462	0.334	2.771**		
F(1,61)=7.679**						

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

## Appendix L

**Multiple Regressions of Intention, Calcium Intake, and Vitamin D Intake on  
TPB Constructs, Stage of Change, Knowledge, and Baseline Demographic  
Variables at Posttest (Control Group)**

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Model</b>						
Contribution of TPB constructs, stage of change, and education to <b>Intention</b>					0.101	0.085
Normative belief F(1,56)=6.280*	-0.417	0.167	-0.318	-2.506*		
<hr/>						
<b>Model</b>					0.205	0.176
Normative belief	-0.438	0.158	-0.333	-2.770**		
Self efficacy	0.350	0.130	0.324	2.690**		
F(2,55)=7.106**						
<hr/>						
<b>Model</b>					0.264	0.223
Normative belief	-0.439	0.154	-0.334	-2.860**		
Self efficacy	0.357	0.126	0.330	2.822**		
Stage of change	0.109	0.053	0.242	2.076*		
F(3,54)=6.459***						
<hr/>						
<b>Model</b>					0.323	0.272
Normative belief	-0.396	0.150	-0.301	-2.637*		
Self efficacy	0.342	0.123	0.316	2.787**		
Stage of change	0.115	0.051	0.255	2.256*		
Education	-0.119	0.056	-0.245	-2.145*		
F(4,53)=6.317***						
<hr/>						
<b>Model</b>					0.407	0.350
Normative belief	-0.347	0.143	-0.264	-2.423*		
Self efficacy	0.296	0.117	0.274	2.527*		
Stage of change	0.109	0.048	0.241	2.255*		
Education	-0.153	0.054	-0.315	-2.834**		
Evaluation of outcomes	0.320	0.118	0.302	2.719**		
F(5,52)=7.141***						
<hr/>						
<b>Model</b>					0.451	0.386
Normative belief	-0.320	0.140	-0.244	-2.296*		
Self efficacy	0.363	0.118	0.336	3.063**		
Stage of change	0.103	0.047	0.228	2.184*		
Education	-0.161	0.053	-0.331	-3.062**		
Evaluation of outcomes	0.464	0.135	0.438	3.443***		
Motivation to comply	-0.298	0.147	-0.260	-2.020*		
F(6,51)=6.984***						

---

	Contribution of intention to <b>Calcium intake</b>					
<b>Model</b>					0.167	0.152
Intention	207.371	61.986	0.408	3.345***		
F(1,56)=11.192***						

---

	Contribution of intention to <b>Vitamin D intake</b>					
<b>Model</b>					0.143	0.128
Intention	52.239	17.087	0.378	3.057**		
F(1,56)=9.347**						

---

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

## Appendix M

**Multiple Regressions of Intention, Calcium Intake, and Vitamin D Intake on  
TPB Constructs, Stage of Change, Knowledge, and Baseline Demographic  
Variables at 3-month Follow Up (Control Group)**

Variable	$\beta$	Standard error	Standardized $\beta$	t	R <sup>2</sup>	Adjusted R <sup>2</sup>
<b>Contribution of self efficacy, stage of change, and barriers to Intention</b>						
<b>Model</b>					0.122	0.107
Self efficacy F(1,56)=7.817**	0.333	0.119	0.350	2.796**		
<hr/>						
<b>Model</b>					0.214	0.185
Self efficacy	0.324	0.114	0.341	2.849**		
Stage of change F(2,55)=7.474***	0.116	0.046	0.302	2.526*		
<hr/>						
<b>Model</b>					0.291	0.251
Self efficacy	0.254	0.113	0.267	2.252*		
Stage of change	0.126	0.044	0.328	2.851**		
Barriers F(3,54)=7.374***	-0.308	0.127	-0.288	-2.420*		
<hr/>						
<b>Contribution of intention to Calcium intake</b>						
<b>Model</b>					0.223	0.209
Intention F(1,56)=16.056***	266.931	66.617	0.472	4.007***		
<hr/>						
<b>Contribution of intention to Vitamin D intake</b>						
<b>Model</b>					0.177	0.163
Intention F(1,56)=12.060***	68.086	19.606	0.421	3.473***		

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$

**Appendix N****Proportion of Participants Who Attended the Focus Groups after the Nutrition Education Intervention**

<b>Focus group</b>	<b>School</b>	<b>Number in lessons</b>	<b>Number in focus group</b>
1	E1	25	7
2	E1	25	5
3	E2	19	7
4	E3	26	9
5	E3	26	7

## Appendix O

### Focus Group Scripts Used to Evaluate Nutrition Education Intervention

#### Introduction

Welcome back.

I hope you had a good time trying out the recipes we shared in the lessons. Thank you for coming to our feedback discussion.

Again, I am Nan. This is XX. We are both from Penn State University. For the next hour or so, we will be discussing the nutrition education program you attended about three months ago. The length of the discussion depends on how much you want to talk. I would like all of you to tell us your ideas (opinions) and feelings about the program. Your inputs are very important for us to improve the quality of the program in the future.

We will audiotape this discussion, so that the group responses can more easily be summarized. XX will help me manage the tape recorder. She will also take notes of what is said as a backup in case the tape recorder malfunctions. Is everyone comfortable with that?

We have a few simple rules to follow:

- a. We will not use names. I will indicate whom to speak by talking and looking at you directly, if needed.
- b. Please speak one at a time. If everyone talks at once, I will be unable to understand what is said and lose your comments.
- c. Any opinion is welcome, so please feel free to express your opinions. There are no right or wrong answers and I value any of your opinions.

Let's start with your experience since the program –

1. What calcium rich foods are you eating more of, if any?  
[Probe: You can use your monthly calendar to answer this question.]
2. What barriers emerged that prevented you changing your calcium rich food intake?
3. What influence do you think the program had on your calcium intake?
4. What influence do you think the program had on your vitamin D intake?
5. What influence did the program have on your supplement intake?
6. What impact did the program have on your family members?
7. Overall, how worthwhile was the six-week program?

Now let's look at what was specifically useful or not useful about the program.



You have mentioned a few specifics about the program. Let's see what else you remember. Now, let's go around the room and say one thing you remember about the program.

To refresh our memory, let me briefly identify the lessons [*passing out the handouts. Put six table tents representing the six lessons on the table. Each table tent has the title of each lesson. Refer to the appropriate table tent when identifying each lesson.*]

[*Go over the content on the handout*]

In lesson 1, we talked about osteoporosis, bone development over your life time, who has more risk to develop osteoporosis, role of calcium and vitamin D and your daily need. We had a heel scan to learn our risk of osteoporosis and completed a questionnaire to estimate our calcium and vitamin D intake. Remember the take home activity was to check your refrigerator and pantry to find calcium and vitamin D-containing foods you have at home.

In lesson 2, we talked about the drawbacks of calcium supplements and introduced nonfat dry milk and how to add it to your meals to increase calcium intake. We compared two calcium supplements and two multi-vitamin supplements for nutrient content. We did another activity to find calcium rich substitutes for breakfast using food packages. At the end, we tasted and evaluated some recipes made with nonfat dry milk. The take home activities were to check calcium and vitamin D content in the calcium pill you take and to prepare the recipes we learned, including making hot cocoa with the hot cocoa mix given in class.

In lesson 3, we learned how to read Nutrition Facts Panel and did an activity to compare calcium and vitamin D content using food packages. We talked about different calcium rich foods and compared their calcium bioavailability. We also learned vitamin K helps collagen formation. At last, we tasted and evaluated some recipes made with calcium rich foods. The take home activity was to locate products that contain at least 20% DV calcium and 10% DV vitamin D per serving in grocery stores.

In lesson 4, we learned the new food guide pyramid. We talked about regular milk and how to deal with lactose intolerance symptoms. We introduced lactose free or reduced milk and soy milk. We tasted and evaluated some cow's milk and soy milk products. We also made milk pudding, tasted and evaluated milk pudding and sesame milk. The take home activities were to use the strategies when drinking milk and to prepare the recipes we learned, including making milk tea with the tea bag given in class.

In lesson 5, we talked about yogurt and benefits of live cultures in yogurt. We did several activities, including tasting yogurt products available in grocery stores, checking packages to find if yogurt contains live cultures, reading the Nutrition Facts Panel to find calcium content, modifying plain yogurt to match personal taste, and making, tasting, and evaluating some yogurt recipes. The take home activity was to prepare the recipes we learned, including modifying plain yogurt.

In lesson 6, we talked about different types of cheese products and their lactose and calcium levels. We did several activities, including tasting cheeses with different textures, comparing calcium content using the Nutrition Facts Panel, completing the calcium and vitamin D intake questionnaire again, and making, tasting, and evaluating some cheese recipes. The take home activity was to prepare the recipes we learned.

*[Leave table tents on the table.]*

As you can tell, these lessons have some common features –

- Background on nutrients and foods that influence bone health
- Using Nutrition Facts Panel to compare calcium sources
- Tasting and evaluating milk, yogurt, and cheese available in grocery stores
- Making recipes
- Tasting and evaluating recipes
- Homework activities
- Paper and pencil assessment activities (for calcium and vitamin D intake)

Hope this refreshed your memory of the lessons. Now let's look at what was specifically useful or not useful about the program.

8. What information did you find especially useful in any lesson? Please refer to the handout for content, activities, recipes, and homework activities of each lesson.

[Probe: What about lesson X (the lesson that is not mentioned by participants)?]

9. What information was not useful in any lesson?

[Probe: What about lesson X (the lesson that is not mentioned by participants)?]

10. What would you change in the program, if anything?

[Probe: What about content?

What about food tasting?

What about evaluation of the foods?

What about recipes?

What about making the recipes?

What about take home or homework activities?

What about assessment activities (i.e., paper and pencil forms, heel

scan)]

11. What would you tell your friends about this program?

Do you have any final comments or points of view to add before we finish?

Thanks for attending!

VITA  
Nan Lv

***The Pennsylvania State University***

Ph.D. in Food Science (GPA: 3.95 / 4.0)

***The Pennsylvania State University***

Master of Science in Food Science (GPA: 3.95 / 4.0)

***People's University of China***

Bachelor of Art in Commodity Science (GPA: 3.44 / 4.0)

***University Park, PA***

Anticipated December 2009

***University Park, PA***

August 2003

***Beijing, China***

July 1999

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## Selected Publications

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- Lv N, Brown JL. A nutrition education program to increase consumption of calcium-rich foods in Chinese American women. (In process).
- Lv N, Brown JL. Place of dairy products in the Chinese American family food system. (In process).
- Lv N, Brown JL. Chinese American family food systems: Impact of Western influences. *Journal of Nutrition Education and Behavior*. (Accepted).
- Lv N, Brown JL, Liu BF. Factors influencing dairy product consumption of Chinese Americans in Pennsylvania. *Topics In Clinical Nutrition*. 2007; 22:259-271.
- Lv N, Cason K. Dietary pattern change and acculturation of first generation Chinese Americans in Pennsylvania. *Journal of the American Dietetic Association*. 2004 May; 104:771-778.
- Lv N, Cason K. Current dietary pattern and acculturation of Chinese Americans in Pennsylvania. *Topics In Clinical Nutrition*. 2003; 18:291-300.
- Lv N, Cason K. Food safety related practices and acculturation of first generation Chinese Americans in Pennsylvania. *The Forum for Family and Consumer Issues*. 2004; 9(1). On-line: [http://www.ces.ncsu.edu/depts/fcs/pub/9\\_1/lv.html](http://www.ces.ncsu.edu/depts/fcs/pub/9_1/lv.html).

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## Honors and Awards

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- The Star Kay White Scholarship in Food Science (2008)
- Robert D. and Jeanne L. McCarthy Memorial Graduate Scholarship (2007)
- William Rosskam Memorial Scholarship (2006)
- William Rosskam Memorial Scholarship (2005)
- William Rosskam Memorial Scholarship (2004)
- Janet G. and Frank J. Dudek Graduate Scholarship in Food Science (2003)
- Best product in the Almond Innovation Contest held by Almond Board of California (2003)
- Nutrition, Health and Food Management (NHFM) Division Student Grant (2002-2003)
- Janet G. and Frank J. Dudek Graduate Scholarship in Food Science (2002)
- Penn State Internal Scholarship (2000-2002)
- Graduate Assistantship in the Department of Food Science, PSU (2000-2003)
- Renmin University of China Excellent Academic Achievement Scholarship (1996)