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DIETARY AND ANTHROPOMETRIC STATUS OF
6-12 YEAR OLD JAPANESE CHILDREN
WHO LIVE IN THE UNITED STATES

presented by

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has been accepted towards fulfillment
of the requirements for

M.S. degree in Human Nutrition

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Date 7/9/96

# DIETARY AND ANTHROPOMETRIC STATUS OF 6-12 YEAR OLD JAPANESE CHILDREN WHO LIVE IN THE UNITED STATES.

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Food Science and Human Nutrition

1996

## ABSTRACT

## DIETARY AND ANTHROPOMETRIC STATUS OF 6-12 YEAR OLD JAPANESE CHILDREN WHO LIVE IN THE UNITED STATES.

By

Junko Ishihara

Westernization of lifestyle affects diet and anthropometric status in immigrants. This study was designed to investigate the dietary and anthropometric status of Japanese children who have lived in the US from 1 to 96 months. All values were adjusted for age and sex. Compared to children who lived in the U.S. for 1-2 months, body mass index increased by 15% and triceps skinfolds increased by 3.7% in those children who lived in the U.S. 48-96 months. Children who lived in the U.S. 1-12 months expended 62±2kcal/kg body weight per day whereas children who lived in the U.S. 48-96 months expended 59±2kcal/kg body weight per day. The average age for both groups of children were 8.3 years. Children consumed mean of 1779±50 kcal per day. Fat intake was 29.4±0.7% of the kilocalories with no change relative to length of stay. However, milk consumption increased from 0.6 to 1.7 servings per day.

# ACKNOWLEDGMENTS

My sincere appreciation is extended to the following people for their contributions to this study:

Dr. Rachel Schemmel, my advisor, who provided the opportunity for me to complete my degree and whose professionalism and optimism are much to be admired.

Dr. Norma Bobbitt, Dr. Sharon Hoerr and Dr. Won Song for their most helpful advice and insight regarding this study.

Dr. Norris Bryson from Department of Education, MSU, Ms. Sharalyn Brandell, Superintendent, Lakeview School District, Battle Creek, Mr. Katsumi Takasaki, Principal, Battle Creek Japanese School, and Mr. Ted Takagi, Chair and members of the Japanese Parent Committee for their understanding, cooperation and support for the project.

Undergraduate students, Yukari Aoshima and Stephanie VanDeventer for their valuable assistance in data collection, and Jennifer Torrenti for her assistance in data calculations related to snacking patterns of children.

Dr. Rob Tempelman for explaining and helping with the statistical procedure.

My family and my fiancé, David, for their support.

My appreciation is also extended to the Graduate School and Vice-Provost for University Outreach, Dr. Votruba, of Michigan State University for an All-University Outreach Grant to support the project.

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# CHAPTER I

# INTRODUCTION

It is important to identify the nutrient intake of individuals or groups of people when dealing with problems of chronic diseases. As difficult as it is to get accurate information about food intakes, and the translation of food intake into nutrient intake, it is even more difficult to alter food habits to promote overall health in the individual. The best place to begin to change food behavior is with the children (Van Horn et al., 1993).

In the U.S., there is a large discrepancy between dietary recommendations and food behavior (Patterson et al., 1990; Kant et al., 1991). Attention to food habits is important in order to assure a healthy society (Allison et al., 1993). The best time to develop good food habits is during childhood. Children are good imitators (Alford and Bogle, 1982) and children adapt their food habits to their culture.

The Western diet, with its high amount of protein, is one which has been documented to support good growth in children (Chusilp et al., 1992; Allen, 1994). Usually, the Western diet also has a high amount of fat. It is also a diet, which has routinely been criticized for its high quantity of fat, and low quantity of complex carbohydrates (Morbidity and Mortality Weekly Report, 1994). Recently, such diets have been associated with a high prevalence of obesity and all of the chronic diseases which accompany obesity and high dietary fat intakes (Kuczmarski et al, 1994; Miller et al, 1994).

Traditional Asian diet is unlike the Western diet. The diets of the elderly of Asian heritage are different from other elderly populations (Kim et al., 1993).

Likewise, among the Asian ethnic groups, underweight in the elderly is more common than obesity. The native Japanese diet is one which provides a high intake of complex carbohydrates in the form of grains (rice, noodles), fruits and vegetables and is low in fat (Kim et al., 1993).

Developed countries such as the U.S. have a high prevalence of obesity, cardiovascular disease, diabetes, and certain types of cancer such as breast and prostate (Abraham et al., 1983), which are associated with excessive intakes of energy or fat. Furthermore, migration of people to the U.S. (and their presumed adoption of the Western diet), is frequently associated with an increased incidence of chronic diseases. This has been demonstrated by comparisons of Irish who lived in Boston with those who live in Ireland. The incidence of cardiovascular disease is much higher for those Irish who migrated to the U.S. than for those who remained in Ireland (Brown et al., 1970). The same is true for Japanese who have migrated to Hawaii compared to those who remained in Japan (Stemmermann, 1985; Curb and Marcus, 1991). This is also true among native American populations as illustrated by the Pima Indians and their much higher prevalence of diabetes after adoption of the Western diet compared to their native diets (Bennett et al., 1982). With the ever-increasing global interactions, the adoption of the Western diet has become commonplace, not only upon migration to a Western country, but also within the country, as the economy improves.

One such country is Japan. It has an ever increasing number of American-type fast food restaurants, which would indicate that people are moving from the traditional Japanese diet to a Western diet. In contrast to 8.7% fat intake by Japanese in 1955, it jumped up to 25.4% in 1990 (Ministry of Health and Welfare, Japan, 1993). Little information is available on how rapidly diet changes take place, whether or not change can be forestalled, and whether or not there are certain factors such as the nutrition knowledge of the mother which will impact on dietary changes.

National Center of Health Statistics (NCHS) has done surveys which covers White, Blacks and Hispanics, but has not done surveys for the Asian population (National Health and Nutrition Examination Survey 1976-80; Hispanic Health and Nutrition Examination Survey, 1982-84). Since the Asians are the third fastest growing population in the U.S., predicted to be triple of 1992 by the year 2020 (Fusaro, 1994), those data would not be representative without the information of Asian population. Dietary and anthropometric data of Asian are needed. Prevention of chronic disease begins with a nation's children. Therefore, this study will investigate dietary behavior of Japanese children who now live in the U.S. with their parents. The parents are associated with various Japanese businesses within the state of Michigan. Many such companies are located in the Battle Creek area and the Japanese families have lived in the U.S. for varying lengths of time.

# CHAPTER II

# LITERATURE REVIEW

**<u>Culture and food behavior</u>**:

Cultural forces shape food intake and other behaviors (Terry, 1994). However, the incorporation of cultural factors into dietary assessments and interventions are all too often neglected or superficial. Culture influences food behavior and the food environment (Bass, et al. 1979; Terry, 1993). Observation of neighborhoods, homes in which people live, shopping practices, food availability, food storage, and food preparation all contribute to a better understanding of dietary behaviors.

The home environment greatly impacts culture. The home functions as a learning center, which was confirmed by research by Bobbitt and Paolucci (1975). Their classical study affirmed that the home is the primary environment for learning for children, especially prior to attending school. Additionally, the home serves as a learning center for all family members over the life cycle. For young, middle and older family categories, "feeding the family was ranked as the most frequent learning activity" (Bobbitt and Paolucci, 1975). The home is the environment that transmits culture and there are cultural influences on food choices and preferences which, in turn, impact nutritional status.

The acculturation, the adaptation in culture, happens sometime on this transmission process of culture in the home environment. The change does not likely appear suddenly. A study in Mexican-American family showed that the food-related roles in Mexicans who immigrated to the U.S. remained wife's job which is a tradition of Mexican culture (Yetley, 1981). A study in Chinese immigrants in

Australia showed the first generation Chinese-Australians kept more traditional, organized and structured family pattern than the second generation did (Rosenthal, 1990). Another study on Chinese students who studied in the U.S. reported that those students form an ethnic enclave of their own, and tended to remain in their original culture just like the first generation immigrant group (Kang, 1972).

The two most influential factors that relate to the acculturation are probably length of stay in the different culture and age of adaptation. Acculturation of Vietnamese immigrants and Haitian immigrants in the U.S. had been reported (Tran, 1992; Clement, 1991). Both studies showed that acculturation had significant relationship with age and length of the residence. Dietary habits is one of the largest portions that contribute to the acculturation. A study in Asian Indian immigrants to the U.S. reported that acculturation of their dietary habits of vegetarianism occurred in relationship to the factors such as marital status, age, sex, length of stay in the U.S. and caste (Gupta, 1975). Fruit and vegetable consumption was inversely related to the length of U.S. residence in Mexican women (Chavez et al, 1994). A study in Germany revealed that adaptation of immigrant children to the German way of life was easier and more complete for younger children, particularly those who arrived in Germany before beginning school (Schrader, 1978). The author of the article says that six year olds is the vulnerable age at which the enculturation, the transmission of the culture, begins.

**Measurement of food intake**:

Gibson (1990) has classified methods for the evaluation of food intake into two categories, one which gives quantitative information and the other qualitative. Quantitative methods are dietary recalls and records, designed to measure the quantity of foods consumed by individuals over a short period of time. Qualitative methods include a dietary history and a food frequency questionnaire, designed to obtain information about food consumed during a longer period of time. Food frequency questionnaire can also be a semiquantitative method.

***24-Hour Diet Recalls***. In the 24-hour recall method, the investigator, in an interview, helps the subject to recall the exact food intake for the previous day. Detailed descriptions of the foods, beverages, vitamin and mineral supplements consumed are recorded. Cooking methods, recipes, time of day food is consumed, brand names, especially for fast foods and cereals, are recorded by the interviewer. Quantities of the food consumed are estimated in household units by use of plates, glasses, cups, spoons of various sizes or with food models (Gibson, 1990).

For assessing the average food intake of large populations, the dietary recall is effective as well as economical. One of the limitations of such a retrospective method includes the inability of the subject to recall what was eaten yesterday (Young and Trulson, 1960). Many people eat without paying much attention to the type and amount of food eaten (Dwyer et al., 1987). This is associated with the fact that eating behavior is habitual and requires little attention (Anderson, 1980).

Omission of foods, which are not major parts of the meal, is apt to occur (Greger & Etnyre 1978, Krantzler et al. 1982). Memory may also be a problem, especially for the elderly (Bazarre et al. 1983) and young children (Emmons and Hayes, 1973). Another problem is that some individuals also want to be perceived as eating a good diet, so they may report eating food which they perceive as "healthy" even though they may not have consumed it (Madden et al. 1976). Some subjects may elaborate on what they have eaten, inventing details of foods consumed that are reasonable but not actually consumed (Dwyer 1987).

In addition, children have had little previous experience with food and food preparation which interferes with their ability to assess food intakes accurately (Lytle et al. 1993). The authors (Lytle et al. 1993) concluded that food diaries or food records for children 10 years and under greatly enhanced the accuracy of the food intake and concluded that this was a valid procedure for assessing food intake. Investigators such as Van Horn et al. (1993) and Lytle et al. (1993) suggest that 24-hour recalls without parental assistance are valid in children as young as 8 years of age. However, according to Hertzler et al. (1993) information reported by pre-schoolers is not sufficiently accurate to calculate nutrient intakes.

***Dietary record.*** Dietary record is a prospective method for obtaining information about food consumed. The number of days that food intake is recorded must be sufficient to obtain information about usual food intake (Sempos et al., 1984, St. Jeor et al., 1983, White et al., 1981, Guthrie and Crocetti, 1985). The food eaten and the amount is recorded at the time of consumption. In the seven-day dietary record, Gersovitz et al. (1978) reported that, in general, mean nutrient intakes were the same as those recorded by measurement of actual intake. There were two exceptions, means for kilocalories and thiamin were slightly lower when calculated from the seven-day record compared to actual intake. Gersovitz et al. (1978) also reported that adult age, gender, education, site or interviewer differences did not affect validity of the seven-day record.

When Gersovitz et al. (1978) used a seven-day record, they reported that the number of food records returned and the usability and the accuracy of the records tended to decline by the 5th, 6th and 7th days. At first, 85% of the records were able to be used, whereas by the 7th day, only 60% of the records were able to be used. Among adolescents, and when requesting seven-day records, Sprauve and Dodds (1965) received only 45% useable records. Subject dropout during the course of the study, may impact the final results. However, Dierks and Morse (1965) reported that they were able to use 95% of the three-day food intake records of preschool children. In general, one week-end day and two week days provide as useful information as seven or more days (Guthrie and Crocetti, 1985).

There are considerable differences between food intakes reported for week-days vs. week-end days (Thompson et al. 1986). Hackett et al. (1983) reported that the dietary diary or record and interview to estimate the food intake of children was a very effective method to obtain food intake data on children. This was also the procedure used in the Young Runners/Young Wrestlers study at MSU (Schemmel et al., 1988) and it was effective.

However, there are some problems associated with obtaining accurate food intake records. Subjects may have forgotten to record their intakes on the assigned day and decide to substitute a different day which impacts on the representativeness of the three-day records. Failure to record all foods, especially condiments or added fats and sweets, contributes to an underestimation of nutrient intakes (Sempos et al., 1984, St. Jeor et al., 1983; White et al., 1981). Another limitation is that food intake may be altered during the recording period. Subjects may also find it burdensome to do the detailed recording (Dwyer, 1988). Compared to the 24-hour recall, the problems related to memory are eliminated.

***Diet history***. A dietary history procedure was developed by Burke (1938), who was the research nutritionist for the Harvard (Boston) longitudinal studies of growth and development of children (Dwyer, 1988; Burke, 1947) in the 1930's. The dietary history method attempts to describe the subject's usual intake over several months or years, collects general information about the subject's overall health habits, forms a check on the data given and includes a three-day food diary or record (Lee and Nieman, 1993).

***Food frequency questionnaire (FFQ).*** The food frequency questionnaire is designed to assess the quality of food intake of individuals. It consists of lists of food items or food groups and inquires about frequency of food consumption of the listed foods (Dwyer, 1988; Lee and Nielsen 1993). In general, respondents identify whether the food is eaten daily, weekly, monthly or seldom. Some FFQ have portion size to allow the respondent to indicate the approximate amount of the food eaten. When that is not included, the investigator assumes a "standard" serving size portion was consumed. Standard portion sizes vary according to the age of the child (Alford and Bogle, 1982). An advantage of the FFQ is that it can be self-administered or administered by interviewers who are not well trained (Dwyer, 1988).

FFQ vary and may be designed to elicit specific responses about food intakes which may impact on Vitamin A or saturated fat or fat intake, for example. Commonly used food frequency questionnaires include those recently developed and recommended by Block (Brown and Griebler, 1993; Block et al., 1990; Block et al., 1989) or by Willett (Feskanich et al., 1993; Willett et al., 1985).

***Assessment of portion size.*** One of the major stumbling blocks in the assessment of food intakes is related to the ability of the responders to assess portion size. This may be a more serious drawback among some respondents such as children or the elderly (Gibson, 1990). For example, Dwyer et al., (1987) reported that children remember portions of the foods they like as being larger than portions of food they do not like. In 24-hour recalls, Gersovitz et al. (1978) have demonstrated that portion size of small servings is overestimated and that of large servings is underestimated (Flat slope syndrome).

Guthrie (1984) reported that subjects had difficulty assessing the amount of a food eaten without the assistance of measuring devices. Subjects were able to assess standard portion sizes of milk as a beverage, butter for toast, sugar on cereal and size of tossed salad better than standard portions for dry cereal, orange juice, tuna or fruit salads. Guthrie (1984) concluded that subjects needed to be provided some aid to estimate portion size. Bolland et al. (1988) reported that the group of subjects who had training with food models significantly improved in estimating portion size compared to subjects without training.

Various methods have been developed to assist subjects in estimating portion size. In the dietary intervention study on children (DISC), models were generic in nature, and did not depict any food. Models included rectangles, circles, wedges, thickness indicators, cups, mounds, bowls, spoons and other shapes. Van Horn et al. (1993) concluded that this was an effective procedure. In the Young Runners study at Michigan State University such a procedure was also found to be effective (Schemmel et al., 1986, Schemmel et al., 1988).

Hunter et al. (1988) suggest that specifying a standard serving size in FFQ does not introduce a large error. Kuehneman et al. (1994) compared the effectiveness of four different methods to evaluate the ability of care givers of young children to assess portion size in a FFQ. Compared to use of graduated food models, plastic food models and food pictures, these authors (Kuehneman et al., 1994), reported that use of standard serving sizes was most accurate for determining portion size. Gibson (1990) suggests that standard serving size is effective in FFQ, but that should not be used when gathering quantitative dietary data by food diaries or dietary recalls.

<u>**Nutrient composition of foods**</u>:

The collection of food intake data is usually done to obtain an assessment of nutrient intakes. As was true for food intake information, precautions must be taken to assure that the best possible food composition data are used. The United States Department of Agriculture (USDA) has the largest and most complete nutrient content of food data (Handbook No. 8, 1976-1986) in the world (Dwyer, 1988). The USDA attempts to develop mean values for nutrients in foods based on the U.S. available food supply. For example, if 80% of carrots eaten in the U.S. are grown in California and 20% in Michigan, then the mean values for nutrients in carrots grown in California would be weighted higher than the mean values for carrots grown in Michigan. Thus, nutrient values tend to be representative of the foods eaten. Many food composition tables rely on USDA data. However, USDA data are not identified as to source or brand name. The USDA Data Bank and Handbook contain 5300 food items for up to 70 different macro- or micro-nutrients (US General Accounting Office, 1993). Prepared foods are not included in the USDA Handbook. Others, such as Pennington (1993), have developed food composition tables for single food items as well as prepared foods but food composition data are based on USDA analytical data.

New food products are being developed at a rapid rate. Some of these food products may be added to the Handbook. For some nutrients, good analytical data are not yet developed (Rand, 1985). In view of some of the drawbacks of the food composition tables, and nutrient data bases, precautions need to be exercised when making precise conclusions about nutrient intake. This is even more true about the numerous computerized dietary assessment systems which have become widely available. These need to be updated on a routine basis to assure the most accurate information on the nutrient composition of foods is included.

**Significance of anthropometric measurements in children:**

Height and weight are widely used measurements which are sensitive indicators of growth and development of children. For children, weight for age, height for age and weight for height are frequently used to assess the growth of children. Weight for age in children from six months to seven years of age is an index of acute malnutrition, and is widely used to assess protein -energy malnutrition and over nutrition, especially in infancy when the measurement of length is difficult (Gibson, 1990). However, weight for age does not take into account height differences. Height for age can be used as an index of nutritional status of population group when the children are stunted because of the condition of periodic or chronic undernutrition. Weight for height reflects the current state of nutrition whereas height for age reflects past nutritional status (Waterlow et al., 1977). Weight for height is relatively independent of age between one and ten years (Gibson, 1990).

Percentile standards for weight for height, and height for age for each gender have been developed for American children of diverse backgrounds (Hamill et al., 1979). A weight to height index such as the Quetelet index may indicate a relative fatness (Garrow & Webster, 1985) but it is less closely related to body fat than the skinfold thickness (Womersley and Durnin, 1977).

Skinfold thicknesses provide an estimate of the size of the subcutaneous fat depots, which, in turn, provides an estimate of the total body fat (Durnin and Rahaman, 1967). Siri equation (Siri, 1961) or Brozek equation (Brozek, 1963) are frequently used to calculate body fat percentage for adults. However, these equations are not applicable to children (Lohman, 1981, Slaughter, 1984). Several researchers tried to investigate the equation to calculate the body fat percentage by skinfold thickness measurements in children. Weststrate and Deurenberg (1989) did a study to validate the body density calculated by use of theoretically defined prediction equations. These equations were constructed on the basis of Siri's and Brozek's equations, and they were sex- and age dependent. Moreover, Deurenberg et al. (1990) tested these equations in 378 boys and girls, aged 7-20 years. The result indicated that the assessment of percentage body fat from skinfold thicknesses had a prediction error of 3-5%, and which was highest in perepubertal children. However, Lohman (1986) suggested that the equations to calculate the body fat from skinfold thicknesses should be used with caution in children.

# CHAPTER III

## ANTHROPOMETRIC STATUS AND DIETARY FAT INTAKE OF 6-12-YEAR-OLD JAPANESE CHILDREN WHO LIVE IN THE UNITED STATES

## INTRODUCTION

In Western countries, obesity and excessive intakes of energy and fat are associated with a high prevalence of chronic diseases such as cardiovascular disease, diabetes, and some types of cancer (Abraham, 1983). In the United States, chronic diseases associated with the obesity have been a serious public health issue for years. Obesity in childhood is especially critical because it frequently leads to obesity in adulthood (Rimm & Rimm, 1976). Data from First and Second National Health Nutrition Surveys (NHANES I and NHANES II) indicated that prevalence of obesity in children, age 6-11, had increased from 22.5% to 27.1% between 1963 and 1980 in the US (Gortmaker et al., 1987).

When immigrants come to the US, acculturation occurs, and their life styles, including diet, shift to patterns which are similar to people who reside in the US (Yang & Fox, 1979). Intakes of energy and fat were significantly higher in US-born Chinese women than foreign-born Chinese (Schultz, et al., 1994). Anthropometric status and prevalence of certain diseases also change. Tanner indicated (1976) that a secular trend in stature of Japanese children who immigrated in the US occurred up to the late 1950s. After that, the trend shifted and their stature remained slightly shorter than Caucasians. Japanese adults who have migrated to Hawaii and California had a higher prevalence of obesity (12.9%, BMI $\geq$ 27.8) compared to those who remained in Japan (3.2%) (Curb & Marcus, 1991). Prevalence of diabetes increased in Pima Indians after adoption of the Western diet compared to their native diets (Bennet et al., 1982). It is evident that the Westernization of the people has a great impact on changing health status.

Furthermore, the Westernization of the diet, anthropometric changes and prevalence of certain diseases can also occur in the people's original countries today. The obesity is becoming more common among societies other than Western culture. According to the data from Japanese National Nutrition Survey (Ministry of Health and Welfare, Japan, 1993), obesity is defined by combination of triceps and subscapular skinfold thickness of 40 mm for adult males and 50 mm for adult females. Prevalence obesity in Japanese adults was 13.4% in men and 17.1% in women in 1991. Ohzeki et al. (1990) reported that in Japan the prevalence of juvenile obesity (125% or more of relative weight) was 1 in 100 adolescent boys and 2 in 100 adolescent girls, age 12-14, in Japan. It is presumed that obesity had not been a problem before the economic development of the country because the traditional Japanese diet was low in fat (Kim et al., 1993). Data collected in the Japanese National Nutrition Survey indicated that the average Japanese diet contained only 8.7% of energy from fat in 1955 (Ministry of Health and Welfare, Japan, 1993). However percent energy intake from fat jumped up to 25.4% in 1990.

Little information is available on how rapidly dietary and anthropometric changes occur in Japanese children living under the influential circumstance of Western culture. Therefore, this study will investigate the amount of dietary fat and anthropometric status in those children who have lived in the US from one month to 8 years. The study will also evaluate those parameters associated with month to 8 years. The study will also evaluate those parameters associated with fat intake and anthropometric status including such items as saturated and polyunsaturated fatty acid intakes, and percentage of kilocalories which come from fat, and physical activity.

The specific hypotheses tested are: (1) Japanese children who have lived in the US for 5 years or more have greater intakes of energy and fat, and have higher BMI and larger triceps skinfold measurements than those who have lived in the US for 1 year or less. Those who have lived in the US for 2-4 years have intermediate amount intakes of energy and fat, BMI and triceps skinfold. (2) Japanese children who consume more of their energy from fat consume more energy and fat, and have higher BMI and larger triceps skinfold. (3) There is a positive correlation between length of residence in the US and BMI, TSF, energy intake and fat intakes. (4) There is a negative correlation between length of residence and physical activity.

## METHOD

### Subjects:

Subjects are 59 healthy Japanese children (33 females, 26 males, ages 6 to 12 years) who attend Saturday school in Battle Creek, Michigan. They were born in Japan, but now they live in Michigan or Indiana with their families, as temporary residents. One or both of their parents work for companies that have branches in Battle Creek, Jackson, Coldwater or Kalamazoo, Michigan or Goshen, Indiana. The Japanese children attend US schools during the week, but attend Saturday school to study Japanese language and mathematics. It is assumed that the children are exposed to Western culture outside of the home at the public school, while the other hand, the children have a traditional family life at home.

This project was approved by the University Committee on Research Involving Human Subjects (UCRIHS) at Michigan State University fall, 1994 (IRB# 94-501, Appendix A). The project was conducted with the approval and cooperation of the Board of Battle Creek Japanese School (BCJS) and Mr. Takasaki, the principal. In order to get the approval of the project, investigators met with the board members and Mr. Takasaki at MSU to explain the duty and benefit of the subjects. Investigators also visited BCJS to meet with Japanese parents' school committee. The agreement between the BCJS and investigators required the investigators conpensate the each subject by providing feedback with nutritional and anthropometric information.

The consent form (Appendix B) and questionnaires were handed out to the students in the Japanese school class. The signing of the consent form by subjects' parents indicated a willingness to participate in the study. Fifty nine out of a potential of 83 students, or 71% participated in the study. All 55 households responded for at least one of the children in their house, and 4 households responded for 2 children.

**Data collection procedure**:

***Food records.*** Food intakes for three days (3-day food record form, Appendix C) were recorded by their parents in Japanese language. They were asked to include amounts of food eaten, brand names and recipes for mixed dishes.

Also requested were the time of day the food was eaten where the food was eaten. Written directions included two-dimensional food model pictures for filling out portion size (Appendix D) were given to the parents. Three-day food record include two weekdays and one weekend day. Subjects turned their food records into an investigator (J.I.) at school. After collecting the food records, the investigator interviewed some parents over the telephone when the information in food record needed further clarification.

***Food Questionnaire.*** A Block Screening Questionnaire for fat intake (Block et al., 1989) was modified and used (Appendix E). The questionnaire was designed to screen the subjects with high fat intake from meats and snacks. Questions were translated from English to Japanese, and asked orally to each student by a Japanese-speaking investigator (J.I.). Those questions sought information about how frequently those students eat certain type of foods.

***Demographic data.*** An instrument was developed to elicit demographic data (Appendix F). This questionnaire asked questions about child's age, sex, number of years of residence in the US and previous residence in the US, and physical activity.

***Measurement of height and weight.*** Height and weight were measured following standardized procedures (Lohman, 1988). Measurements were carried out by a trained investigator (J.I.).

Height was measured using a tape measure and a right-angle headboard. Nonstretchable tape measure was attached to a flat, vertical wall surface. The wall did not have a baseboard, and the subjects stood on bare floor. The subjects' feet were bare, and flat on floor. Heels were close together and against the wall. Shoulders were relaxed, and arms extended. Head, shoulder blades, and buttocks were against the wall. The subjects looked out straight. The investigator placed the right-angle headboard on the highest level of the head, and read the measurement on eye level. The measurement was read to the nearest 0.1 cm, and was done twice for each subject to insure accuracy. If there were differences in measurments, the average of the two heights was used to determine height.

Weight was measured using a balance-beam scale. The subjects wore light clothing and no shoes. The subjects stood still in the middle of the scale's platform without touching anything and with body weight equally distributed on both feet. The measurements were read to the nearest 1/4 lb., and were done twice for each subject to insure accuracy. If there were difference in measurements, average of the two weights was used to determine body weight.

***Measurement of triceps skinfold.*** The triceps skinfold is located at the back of left upper arm midway between the acromion and olecranon processes. The arm was folded to locate the midpoint. The arm was relaxed and hung freely during the skinfold measurement. The measurement was taken by separating the skin and subcutaneous tissue from the muscle. This was done by picking up the skin and subcutaneous tissue with the thumb and forefinger of the left hand at a distance 1 cm from the mark or site at which the Lange caliper is to be placed, and pulling the fold away from the underlying muscle. The fold was pinched and held while taking the measurement. However, the pressure on the fold was completely exerted by the caliper. The dial was read to the nearest 0.5 mm. The reading was done three times for each subject to insure accuracy. If there were difference in readings, the average of the three measurements was used to determine triceps skinfold of subjects.

**Data analyses**:

***Dietary intake measurements.*** Computer analyses of the food records for mean daily intakes and percent Recommended Dietary Allowance (RDA) of energy and fat including total fat, saturated fatty acid, polyunsaturated fatty acid, monounsaturated fatty acid and cholesterol were done by Nutritionist IV, Version 3.0 (N-squared computing, Salem, OR, 1993). Total fat, saturated fatty acid, polyunsaturated fatty acid and cholesterol intakes were divided by energy intake and converted to g/1000 kcal.

Percent energy intake from fat was calculated for each subject. Based on percent energy intake from fat subjects were divided into four groups; 24% or less, 25-29%, 30-34%, 35% or more. These cut off points were determined based on the average percent energy intake of 29.4% in our subjects.

Fat intake score was calculated individually from modified Block Food Questionnaire (Block et al., 1989). Points (less than once per month=0, 2-3 times per months=1, 1-2 times per week=2, 3-4 times per week=3, 5+ times per week=4) were added for 16 categories of foods high in fat.

***Anthropometric measurements.*** Body Mass Index (BMI) for each individual was calculated using Quetelet's index ($W/H^2$). BMI for each individual was adjusted for age and sex by using the mean value from Second National Health and Nutrition Examination Survey (NCHS, 1987). Triceps skinfold measurements were adjusted for age and sex by using the 50th percentile value from Second National Health and Nutrition Examination Survey (NCHS, 1987).

***Physical activity.*** Energy expenditure of each subject was estimated from resting energy expenditure (REE) and physical activity. REE for each subject were calculated using the equations by WHO (1985). Then REE was divided by 24 to obtain REE per hour. REE per hour for each subject was multiplied by sum of each activity hour, multiplied by activity factor (sleeping=1.0; sitting, eating etc.=1.5; walking=2.5; and vigorous sports=7.0) (Durnin & Passmore, 1967).

***Length of residence in the US.*** Based on the length of residence in the US, subjects were divided in to five groups; 1-12 months, 13-24 months, 25-36 months, 37-48 months and 49 months or more.

***Statistics .*** Means and standard errors of means were calculated by using the Statistical Package for the Social Science, Version 6.1 (SPSS Inc., Chicago, IL, 1994). Analysis of variance was done among the quintiles based on the length of residence in the US and among quartiles based on percent energy intake from fat in relationship to percent RDA of energy intake, fat intakes per 1000 kcal including saturated fatty acid, polyunsaturated fatty acid, cholesterol, adjusted BMI and adjusted TSF. Duncan's multiple range test was used to identify the significant difference among the means.

Correlation coefficients were calculated in relationship to age, length of residence, adjusted BMI and TSF, fat intakes per 1000 kcal including total fat, saturated fatty acid, polyunsaturated fatty acid, and cholesterol, and fat intake scores based on Block food screening questionnaire (Block et al., 1989).

## RESULTS

Means and standard errors of means of height, weight and TSF, and BMI according to subjects' age and sex are presented in Table 1. The mean BMI and TSF for the all subjects was 17.1±0.4 (17.0±0.6 for boys; 17.2±0.5 for girls) and 12.2±0.5 (11.0±0.7 for boys; 13.2±0.8 for girls), respectively. Height, weigh, BMI and TSF for both boys and girls increased with age. The smallest TSF for both boys and girls were at the age of 6 (8.6±1.6 mm, 8.6±2.1 mm, respectively). Height, body weight, BMI and TSF of subjects increased with age, however there were not significant differences between boys and girls.

Means and standard errors of means of energy intake, fat intakes including total fat, saturated fat, polyunsaturated fat and cholesterol, and energy expenditure according subject's age and sex are presented in Table 2. Mean±SEM of energy intake for the entire population was 1779±50 kcal (1831±86 for boys; 1739±60 for girls). Mean intake of energy increased with age, however there were not significant differences between boys and girls. The mean fat intakes including total fat, saturated fat, polyunsaturated fatty acid and cholesterol were 59.5±2.7 g, 21.0±1.2 g, 10.9±0.5 g and 320±15 mg, respectively. The mean fat intakes including total fat, saturated fat, polyunsaturated fatty acid and cholesterol for boys were 59.3±2.7 g, 20.5±1.9 g, 11.2±0.9 g, and 309±21 mg, respectively. The mean fat intakes including total fat, saturated fat, polyunsaturated fatty acid and cholesterol for girls were 59.7±3.5 g, 21.4±1.7 g, 10.7±0.6 g, and 330±22 mg, respectively. There were no significant differences in fat intakes in different age and sex groups.

Energy expenditure and physical activities of Japanese school children living in the US are presented in Table 3. Energy expenditure increased in both boys and girls with age, although it did differ between boys and girls. Hours of resting tended to decrease with age, however hours of other activities did not change among different age groups. None of the hours of activities change with age.

Daily fat intake per 1000 kcal according subject's age and sex are presented in Table 4. About 30% of total fat was consumed as saturated fat by all ages and sexes, and about 15 % was consumed as polyunsaturated fatty acid. The ratio of saturated fatty acid and polyunsaturated fatty acid was about 2 to 1 for all age and sex. None of the fat intakes per 1000 kcal were significantly different among different age and sex groups.

The mean and standard error of mean for %kcal from fat for all subjects were 29.4 ± 0.7 %. In quartile groups divided by % energy intake from fat, saturated fatty acid intake and polyunsaturated fatty acid intake had significant increase as % energy intake from fat increase (P<0.01) (Table 5). There was a significant difference between first group and forth group in energy intake. However, there were no significant changes in energy intake, cholesterol, TSF, BMI and energy expenditure with the increase of % energy intake from fat.

In five groups divided by length of residence in the US (Table 6), TSF and BMI increased significantly in subjects who are living in the US longer. However, there was no significant increases in energy intake, saturated fat, polyunsaturated fatty acid, cholesterol, fat intake score and energy expenditure with length of residence in the US.

Table 7-1 summarizes the correlation between the potential variable in this study. Age- and sex-adjusted BMI and TSF for entire subjects correlated each other (P<0.01), indicating that both measurements are in the agreement in terms of the measurement of body mass of our subjects. The parallel between BMI and TSF is illustrated in Figure 1.

Although age- and sex-adjusted BMI and TSF did not correlate with intakes of energy or any of fats, they were negatively correlated with energy expenditure of the subjects (P<0.05). Age- and sex-adjusted BMI and TSF were positively linearly correlated with length of residence in the US (P<0.01), however intakes of energy and fat did not correlate with BMI and TSF. These results may suggest that in this group it is rather the change in subjects' physical activity that changes their anthropometric status rather than change in their diet, although the inverse correlation between length of residence in US and energy expenditure was not significant.

Energy intake significantly correlated with %kcal of fat, total fat intake, and saturated fat intake ($P<0.01$). %kcal of fat correlated with energy intake, total fat intake, saturated fat intake, and polyunsaturated fatty acid intake ($P<0.01$). Total fat intake correlated with energy intake, %kcal of fat, saturated fatty acid intake and polyunsaturated fatty acid intake ($P<0.01$). Saturated fatty acid intake correlated with energy intake, %kcal of fat, total fat intake and cholesterol intake ($P<0.01$). polyunsaturated fatty acid intake correlated with %kcal of fat, total fat intake ($P<0.01$) and energy expenditure ($P<0.05$), and inversely correlated with length of residence in US ($P<0.05$). Figure 2 illustrates the parallel of three fat intakes. Fat intake score inversely correlated with BMI ($P<0.05$).

## DISCUSSION

Based on data from the Third National Health and Nutrition Examination Survey (NHANES III), total energy intake and percent energy from fat in the US population were 2095±20 kcal and 34.0±0.2 %, respectively (MMWR, 1994). Compared to NHANES II, the percent of energy from fat decreased in NHANES III. However, it was still lower (25.4%) in Japanese population (Ministry of Health and Welfare, Japan, 1993). Data from NHANES III also indicated that average of total energy intake and percent of energy from fat for age 6-11 in the US were 1897±25.0kcal and 34.0±0.4%. Subjects of this study tended to have lower energy intake (1979±50kcal) and percent energy intake from fat (29.4±0.7%)

compared to NHANES III data. However, percent energy intake from fat in this subjects were about 4% higher than Japanese counterparts living in Japan (Ministry of Health and Welfare, Japan, 1993).

BMI of the subjects in this study were compared (Figure 5) to NHANES II (NCHS, 1987) and Japanese National Nutrition Survey (Ministry of Health and Welfare, Japan, 1993). Norms of BMI in US and Japanese children in Japan were very similar for both boys and girls. Tanner (1976) summarized growth of Japanese children in the US. He reported that a secular trend in stature of Japanese children in the US occurred up to the late 1950s, but after that the trend stopped and their adult stature remained slightly shorter than Caucasians. He also compared the statures for Japanese living in the US and for Japanese living in Japan. A similar secular trend occurred in Japan, so that the statures of Japanese living in the US and in Japanese living in Japan were very close. In 1957, the average growth spurt of Japanese boys was initiated at 13.8 years of age and this age dropped to 12.8 years by 1977 (Tanner et al., 1982). Nowadays, the mean height and weight of Japanese boys and girls from age 2 to 18 (Ministry of Health and Welfare, Japan, 1993) fall in between 50th and 90th percentile of National Center for Health Statistics growth chart (Hammil, et al., 1979).

In this study, BMI of Japanese children living in the US followed norms of US and Japanese counterparts living in Japan in both boys and girls even though there were slight variations because of the small sample size (Figure 5).

We assumed that the growth spurt and puberty were assumed not to affect the subjects in terms of BMI because they were younger than 12 years old.

Ohzeki et al. (1992) studied the skinfold thickness in Japanese children age 3-11 years old to define the standards for Japanese children and compare their racial characteristics in skinfold to British children. In their study, boys had their thinnest TSF at the age 5 (Mean = 8.3mm), and girls had the thinnest TSF at the age of 6 (Mean = 9.5mm). The study indicated that TSF in Japanese children were similar to results of British Caucasian children. The smallest TSF in our study occurred at age of 6, but we were unable to identify whether or not it occurred at a younger age, since our youngest subjects were 6 years of age.

Means and standard errors of means of TSF from subjects of our study were compared (Figure 6) to the data from NHANES II (NCHS, 1987). TSF from our subjects were slightly larger than the norms of similar aged US counterparts. However, the standard errors of means were quite large in our subjects because of small sample size.

The result that both BMI and TSF adjusted for age and sex significantly correlated with subjects' length of residence in the US indicates that the longer the children live in the US, the higher their BMI and larger their TSF are in the Japanese children who live in the US for 1 months to 5 years (Table 7-1, Figure 3 and 4). In this study neither energy intake nor energy expenditure significantly correlated with length of residence. BMI and TSF did not correlate with energy intake but negatively correlated with energy expenditure. This would suggest that the physical activity, rather than diet, had a greater affect on their anthropometric status. Further study of energy expenditure and energy intake with larger population in relationship to length of residence may be worthwhile since BMI and TSF did correlate with length of residence.

There was a significant correlation between energy intake and fat intakes (total fat and saturated fat). This result would indicate that children who consume more energy also consume more fat, especially saturated fat. According to the data from JNNS, Japanese, in 1955, consumed only 14% of fat from animal source, which is primary source of saturated fat. However they consumed 40% of fat from animal source in 1991 (Ministry of Health and Welfare, Japan, 1993). The source of dietary fat may be an important parameter to look at the dietary change.

Fat intake score by modified Block Screening Questionnaire did not correlate with any variables except for the negative correlation with BMI. It is assumed that the screening questionnaire did not adequately represent this particular subjects. From 3-day food records filled out by subjects, several foods were found to be high in fat and consumed often, but were not on the Screening Questionnaire. Such items that may be appropriate to be included in the Questionnaire when it is used for Japanese subjects are: fried foods such as stir fried foods, fried rice or fried tofu; vegetable oils such as sesame oil used in cooking etc..

In summary, BMI and TSF of Japanese children living in the US are affected strongly by their length of residence and physical activity, but not by food intakes. Food intakes were not affected by length of residence. It is assumed that diets of those children did not change because they lived at home where the diet did not differ much from diets they would have in Japan.

Table 3-1. Height, weight, triceps skinfold and calculated body mass index (BMI) of Japanese school children age 6 to 12 living in the U.S.

| Age | n | Height (cm) | Body Weight (kg) | BMI ($kg/m^2$) | Triceps skinfold (mm) |
|---|---|---|---|---|---|
| | | | Boys | | |
| 6≤year<7 | 5 | 118.4±1.4 | 22.3±1.4 | 15.9±0.9 | 8.6±1.6 |
| 7≤year<8 | 8 | 123.1±1.2 | 24.4±1.0 | 16.0±0.5 | 11.3±0.8 |
| 8≤year<9 | 4 | 124.7±2.7 | 23.5±2.5 | 15.0±0.9 | 9.3±2.2 |
| 9≤year<10 | 4 | 133.4±2.9 | 32.2±3.5 | 17.9±1.3 | 12.8±1.8 |
| 10≤year<11 | 3 | 137.7±2.6 | 43.1±2.4 | 22.7±1.1 | 15.1±2.7 |
| 11≤year<12 | 1 | 149.0 | 35.8 | 16.1 | 8.0 |
| 12≤year<13 | 1 | 146.2 | 39.4 | 18.4 | 11.0 |
| | | | Girls | | |
| 6≤year<7 | 2 | 108.6±2.9 | 16.4±0.2 | 14.0±0.9 | 8.6±2.1 |
| 7≤year<8 | 7 | 121.7±1.7 | 23.6±2.4 | 15.8±1.1 | 12.0±2.2 |
| 8≤year<9 | 5 | 128.5±0.8 | 28.8±2.5 | 17.4±1.4 | 14.7±3.0 |
| 9≤year<10 | 8 | 133.5±1.9 | 31.1±2.4 | 17.3±1.0 | 12.5±1.2 |
| 10≤year<11 | 7 | 137.5±1.5 | 34.4±2.1 | 18.1±0.9 | 14.0±1.1 |
| 11≤year<12 | 3 | 148.7±4.6 | 41.7±5.2 | 18.7±1.2 | 15.8±0.9 |
| 12≤year<13 | 1 | 147.5 | 46.1 | 21.2 | 14.7 |
| ANOVA in age | | 0.000* | 0.000* | 0.000* | 0.031* |
| ANOVA in sex | | NS | NS | NS | NS |

Means ± SEM

* Significant ($p<0.05$)

NS: Not significant

Table 3-2. Daily energy intake and fat intakes of Japanese school children age 6-12 living in the U.S.

| Age | Energy intake (kcal) | Total fat (g) | Sat. Fat[a] (g) | PUFA[b] (g) | MUFA[c] (g) | Cholesterol (mg) |
|---|---|---|---|---|---|---|
| | | | Boys | | | |
| 6≤year<7 | 1751±169 | 60±7 | 21±3 | 12±1 | 19±3 | 355±44 |
| 7≤year<8 | 1636± 66 | 50±4 | 16±1 | 9±1 | 15±1 | 238±30 |
| 8≤year<9 | 1779±231 | 65±14 | 24±6 | 11±2 | 21±7 | 333±35 |
| 9≤year<10 | 2186±338 | 65±17 | 22±6 | 15±4 | 19±6 | 340±87 |
| 10≤year<11 | 1935±349 | 59±10 | 19±3 | 10±2 | 17±3 | 307±37 |
| 11≤year<12 | 2423 | 95 | 47 | 17 | 23 | 488 |
| 12≤year<13 | 1667 | 46 | 14 | 8 | 14 | 246 |
| | | | Girls | | | |
| 6≤year<7 | 1464± 28 | 54±8 | 18±4 | 10±5 | 14±3 | 227±26 |
| 7≤year<8 | 1698±158 | 59±10 | 23±5 | 11±1 | 17±3 | 397±50 |
| 8≤year<9 | 1589± 65 | 49±4 | 18±2 | 10±1 | 15±1 | 360±84 |
| 9≤year<10 | 1725±104 | 58±3 | 19±1 | 11±2 | 19±2 | 267±23 |
| 10≤year<11 | 1992±167 | 73±12 | 27±5 | 11±2 | 23±4 | 332±53 |
| 11≤year<12 | 1738±132 | 59±6 | 21±2 | 11±1 | 16±2 | 344±44 |
| 12≤year<13 | 1655 | 50 | 20 | 11 | 15 | 354 |
| ANOVA in age | 0.031* | NS | NS | NS | NS | NS |
| ANOVA in sex | NS | NS | NS | NS | NS | NS |

Means ± SEM
* Significant ($p<0.05$)
NS: Not significant
[a] Saturated fatty acid
[b] Polyunsaturated fatty acid
[c] Monounsaturated fatty acid

Table 3-3. Daily energy expenditure and hour of physical activity of Japanese school children age 6-12 living in the U.S.

| Age (year) | EE[a] (kcal) | Resting[b] (hour) | Very light[c] (hour) | Light[d] (hour) | Heavy[e] (hour) |
|---|---|---|---|---|---|
| | | Boys | | | |
| 6≤year<7 | 1507± 77 | 9.6±0.2 | 12.7±0.4 | 0.5±0.2 | 1.3±0.2 |
| 7≤year<8 | 1589± 39 | 9.3±0.1 | 12.9±0.4 | 0.6±0.3 | 1.3±0.3 |
| 8≤year<9 | 1488± 85 | 9.3±0.3 | 13.0±0.7 | 1.0±0.6 | 0.7±0.2 |
| 9≤year<10 | 2234±202 | 9.1±0.4 | 10.3±0.8 | 1.5±0.7 | 3.0±0.5 |
| 10≤year<11 | 2079± 38 | 9.2±0.2 | 12.8±0.9 | 1.3±0.9 | 0.8±0.3 |
| 11≤year<12 | 2010 | 7.0 | 15.5 | 0.0 | 1.5 |
| 12≤year<13 | 1974 | 9.0 | 13.7 | 0.3 | 1.0 |
| | | Girls | | | |
| 6≤year<7 | 1258± 14 | 10.0±0.0 | 11.9±0.6 | 1.4±0.6 | 0.7±0.0 |
| 7≤year<8 | 1526± 99 | 9.6±0.3 | 12.9±0.4 | 0.3±0.1 | 1.1±0.2 |
| 8≤year<9 | 1760±102 | 9.5±0.2 | 12.2±0.5 | 1.0±0.3 | 1.3±0.3 |
| 9≤year<10 | 1837± 93 | 8.7±0.2 | 13.4±0.4 | 0.6±0.2 | 1.3±0.2 |
| 10≤year<11 | 1742± 68 | 8.7±0.2 | 13.8±0.3 | 0.4±0.1 | 1.1±0.2 |
| 11≤year<12 | 2003±184 | 9.0±0.6 | 12.1±1.5 | 1.4±0.8 | 1.5±0.3 |
| 12≤year<13 | 2308 | 9.0 | 11.7 | 0.3 | 3.0 |
| ANOVA in age | 0.000* | 0.000* | NS | NS | NS |
| ANOVA in sex | NS | NS | NS | NS | NS |

Means ± SEM

* Significant (p<0.01)

NS: Not significant

[a] Energy expenditure calculated from resting energy expenditure and physical activity factors. (See method section.)

[b] Hours of sleeping.

[c] Hours of sitting and eating.

[d] Hours of walking.

[e] Hours of vigurous excersise.

Table 3-4. Daily fat intake per 1000 kcal of Japanese school children living in the U.S.

| Age (year) | Total fat (g/1000kcal) | Sat. Fat[a] (g/1000kcal) | PUFA[b] (g/1000kcal) | MUFA[c] (g/1000kcal) | Cholesterol (mg/1000kcal) |
|---|---|---|---|---|---|
| | | | Boys | | |
| 6≤year<7 | 34±2 | 12±1 | 7±1 | 19±5 | 210±29 |
| 7≤year<8 | 31±2 | 10±1 | 6±1 | 15±3 | 143±14 |
| 8≤year<9 | 36±4 | 13±2 | 6±1 | 21±6 | 197±33 |
| 9≤year<10 | 28±4 | 9±2 | 7±1 | 19±4 | 149±16 |
| 10≤year<11 | 31±1 | 10±0 | 5±0 | 17±5 | 164±24 |
| 11≤year<12 | 39 | 19 | 7 | 23 | 201 |
| 12≤year<13 | 28 | 8 | 5 | 14 | 147 |
| | | | Girls | | |
| 6≤year<7 | 37±4 | 12±3 | 7±3 | 9±2 | 155±21 |
| 7≤year<8 | 34±2 | 13±1 | 6±0 | 10±1 | 236±25 |
| 8≤year<9 | 31±2 | 11±1 | 6±1 | 10±1 | 224±45 |
| 9≤year<10 | 34±2 | 11±1 | 6±1 | 11±1 | 161±21 |
| 10≤year<11 | 35±3 | 13±2 | 5±1 | 11±1 | 165±16 |
| 11≤year<12 | 34±1 | 12±0 | 6±0 | 9±1 | 197±15 |
| 12≤year<13 | 30 | 12 | 7 | 9 | 214 |
| ANOVA in age | NS | NS | NS | NS | NS |
| ANOVA in sex | NS | NS | NS | NS | NS |

Means ± SEM
NS: Not significant
[a] Saturated fatty acid
[b] Polyunsaturated fatty acid
[c] Monounsaturated fatty acid

Table 3-5. Anthropometry and fat intake in relationship to % energy intake from fat of Japanese children who live in the U.S.

| %kcal from fat in diet | n | Age | Energy intake %RDA | Sat. Fat[a] g/1000kcal | PU FA[b] g/1000kcal | MUFA[c] g/1000kcal | Cholesterol[d] mg/1000kcal | TSF[e] mm | BMI[f] kg/m$^2$ | EE[g] kcal/kg BW |
|---|---|---|---|---|---|---|---|---|---|---|
| ≤24% | 10 | 8.3±0.5 | 79.1±3.2$^0$ | 7±0.5$^{1,2,3}$ | 4±0.3$^{1,2,3}$ | 7±0.4$^{1,2,3,4}$ | 161±14 | 13.5±1.2 | 17.7±0.8 | 62±3 |
| 25-29% | 19 | 8.8±0.4 | 85.6±3.9 | 11±0.3$^{1,4,5}$ | 6±0.4$^{1,4}$ | 6±0.2$^{2,5,6}$ | 173±15 | 12.0±0.9 | 18.0±0.6 | 60±2 |
| 30-34% | 20 | 8.0±0.3 | 89.6±4.6 | 12±0.3$^{2,4,6}$ | 7±0.3$^{2,4}$ | 11±0.2$^{3,5,7}$ | 190±15 | 13.1±0.9 | 17.7±0.6 | 62±2 |
| ≥35 | 10 | 8.4±0.5 | 99.3±7.9$^0$ | 16±0.8$^{3,5,6}$ | 6±0.5$^3$ | 13±0.7$^{4,6,7}$ | 203±19 | 9.0±1.2 | 15.5±0.8 | 62±3 |
| ANOVA (p) | | | 0.1151 | 0.0000* | 0.0004* | 0.0000* | 0.3929 | 0.0805 | 0.3321 | 0.8405 |

Means ± SEM

* Significant ($p<0.01$)

The same superscript numbers indicate a significant difference between values in the same column. (Duncan's multiple range test, $p<0.05$)

[a] Saturated fatty acid (g/1000kcal)

[b] Polyunsaturated fatty acid (g/1000kcal)

[c] Monounsaturated fatty acid (g/1000kcal)

[d] Cholesterol (mg/1000kcal)

[e] Triceps skinfold adjusted for age and sex by least squares mean adjustment

[f] Body mass index adjusted for age and sex by least squares mean adjustment

[g] Energy expenditure calculated from resting energy expenditure and physical activity factors. (Kcal/kg body weight)

Table 3-6. Anthropometry and fat intake in relationship to length of residence in the U.S. of Japanese children who live in the U.S.

| Length of residence in US (months) | n | Age | Energy intake (%RDA) | Sat. Fat[a] (g/ 1000kcal) | PUFA[b] (g/ 1000kcal) | Cholesterol (mg/ 1000kcal) | TSF[c] (mm) | BMI[d] | EE[e] (kcal/ kg) |
|---|---|---|---|---|---|---|---|---|---|
| 1-12 | 14 | 8.3±0.3 | 86.7±6.0 | 12±0.9 | 7±0.5 | 212±18 | 11.4±1.2$^{1}$ | 17.0±0.7$^{1}$ | 62±2 |
| 13-24 | 12 | 9.0±0.5 | 82.2±3.8 | 10±0.9 | 6±0.7 | 169±21 | 11.4±1.2$^{2}$ | 17.6±0.8$^{2}$ | 59±3 |
| 25-36 | 12 | 7.7±0.4 | 90.8±4.4 | 12±0.8 | 6±0.4 | 157±15 | 10.9±1.2$^{3}$ | 16.6±0.8$^{3}$ | 64±2 |
| 37-48 | 9 | 8.9±0.7 | 84.9±5.9 | 11±0.9 | 6±0.3 | 167±13 | 11.2±1.3$^{4}$ | 16.5±0.8$^{4}$ | 61±3 |
| >49 | 12 | 8.3±0.5 | 95.7±7.4 | 12±1.2 | 6±0.4 | 196±15 | 15.7±1.2$^{1,2,3,4}$ | 19.5±0.7$^{1,2,3,4}$ | 59±2 |
| ANOVA(p) | | | 0.4935 | 0.4783 | 0.4297 | 0.1282 | 0.0459* | 0.0406* | 0.3704 |

Means ± SEM
The same superscript numbers indicate a significant difference between values in the same column. (p<0.05)
* Significant (p<0.05)
[a] Saturated fatty acid
[b] Polyunsaturated fatty acid
[c] Body mass index adjusted for age and sex by least squares mean adjustment
[d] Triceps skinfold adjusted for age and sex by least squares mean adjustment
[e] Energy expenditure calculated from resting energy expenditure and physical activity factors. (See method section.)

Table 3-7-1. Correlation coefficient matrices for anthropometric and dietary intake variables of Japanese children living in the U.S.

| | BMI[a] | TSF[b] | Energy %RDA | Fat % of kcal | Total fat g/1000kcal | Sat. fat[c] g/1000kcal | PUFA[d] g/1000kcal | Cholesterol mg/1000kcal | Fat intake score[e] | EE[f] kcal/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Length of residence | 0.3761 p=0.003* | 0.3694 p=0.004* | 0.2025 p=0.124 | 0.1085 p=0.413 | 0.0883 p=0.506 | 0.0203 p=0.879 | -0.2667 p=0.041* | -0.0465 p=0.727 | -0.0230 p=0.863 | -0.1453 p=0.272 |
| BMI[a] | | 0.7690 p=0.000* | 0.1099 p=0.407 | -0.2109 p=0.109 | -0.2172 p=0.098 | -0.2250 p=0.087 | -0.2190 p=0.096 | -0.0562 p=0.624 | -0.2897 p=0.026* | -0.4916 p=0.000* |
| TSF[b] | | | 0.1625 p=0.219 | -0.1828 p=0.166 | -0.1938 p=0.141 | -0.2049 p=0.119 | -0.1502 p=0.256 | 0.0176 p=0.895 | -0.2228 p=0.090 | -0.2548 p=0.049* |
| Energy, %RDA | | | | 0.3855 p=0.003* | 0.3652 p=0.004* | 0.3603 p=0.005* | 0.0479 p=0.719 | -0.1397 p=0.291 | 0.2315 p=0.078 | 0.0365 p=0.784 |
| Fat, % of kcal | | | | | 0.9941 p=0.000* | 0.8558 p=0.000* | 0.4326 p=0.001* | 0.2143 p=0.103 | 0.1307 p=0.324 | 0.0640 p=0.630 |
| Total fat, g/1000kcal | | | | | | 0.8526 p=0.000* | 0.4381 p=0.001* | 0.2077 p=0.114 | 0.1348 p=0.309 | 0.0325 p=0.807 |
| Sat. fat[c], g/1000kcal | | | | | | | 0.2409 p=0.066 | 0.3143 p=0.015* | 0.1620 p=0.220 | -0.0104 p=0.938 |
| PUFA[d], g/1000kcal | | | | | | | | 0.0486 p=0.715 | -0.0997 p=0.453 | 0.2594 p=0.047* |
| Cholesterol, mg/1000kcal | | | | | | | | | -0.0560 p=0.673 | -0.0132 p=0.921 |
| Fat intake score[e] | | | | | | | | | | 0.1010 p=0.446 |

* Significant (p<0.05)
[a] Body mass index adjusted for age and sex
[b] Triceps skinfold adjusted for age and sex
[c] Saturated fatty acid
[d] Polyunsaturated fatty acid
[e] From modified Block Screening Questionnaire
[f] Energy expenditure per body weight calculated from resting energy expenditure and physical activity factors. (See method section.)

Table 3-7-2. Correlation coefficient matrices for boys

| | BMI[a] | TSF[b] | Energy %RDA | Fat % of kcal | Total fat g/1000kcal | Sat. fat[c] g/1000kcal | PUFA[d] g/1000kcal | Cholesterol mg/1000kcal | Fat intake score[e] | EE[f] kcal/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Length of residence | 0.2993 p=0.137 | 0.2305 p=0.257 | 0.3045 p=0.130 | -0.1868 p=0.361 | -0.2083 p=0.307 | -0.3503 p=0.079 | -0.2852 p=0.158 | -0.3402 p=0.089 | 0.1975 p=0.334 | -0.1803 p=0.378 |
| BMI[a] | | 0.6759 p=0.000* | 0.3255 p=0.105 | -0.1143 p=0.482 | -0.1564 p=0.446 | -0.1837 p=0.369 | -0.1135 p=0.581 | -0.0586 p=0.776 | -0.2973 p=0.140 | -0.5553 p=0.003* |
| TSF[b] | | | 0.3053 p=0.129 | -0.1180 p=0.566 | -0.1244 p=0.545 | -0.1965 p=0.336 | -0.0013 p=0.995 | 0.0136 p=0.947 | -0.2198 p=0.281 | -0.2644 p=0.192 |
| Energy, %RDA | | | | 0.3507 p=0.079 | 0.3170 p=0.115 | 0.2627 p=0.195 | 0.1423 p=0.488 | -0.0528 p=0.798 | 0.2447 p=0.228 | -0.0121 p=0.953 |
| Fat, % of kcal | | | | | 0.9964 p=0.000* | 0.8078 p=0.000* | 0.6348 p=0.000* | 0.3659 p=0.066 | 0.2626 p=0.195 | 0.0428 p=0.836 |
| Total fat, g/1000kcal | | | | | | 0.8091 p=0.000* | 0.6249 p=0.001* | 0.3617 p=0.069 | 0.2576 p=0.204 | 0.0206 p=0.920 |
| Sat. fat[c], g/1000kcal | | | | | | | 0.3217 p=0.109 | 0.5345 p=0.005* | 0.1361 p=0.507 | -0.1043 p=0.612 |
| PUFA[d], g/1000kcal | | | | | | | | 0.0869 p=0.673 | 0.0052 p=0.980 | 0.2511 p=0.216 |
| Cholesterol, mg/1000kcal | | | | | | | | | -0.1491 p=0.467 | -0.1218 p=0.553 |
| Fat intake score[e] | | | | | | | | | | 0.1570 p=0.444 |

* Significant ($p<0.05$)

[a] Body mass index adjusted for age and sex

[b] Triceps skinfold adjusted for age and sex

[c] Saturated fatty acid

[d] Polyunsaturated fatty acid

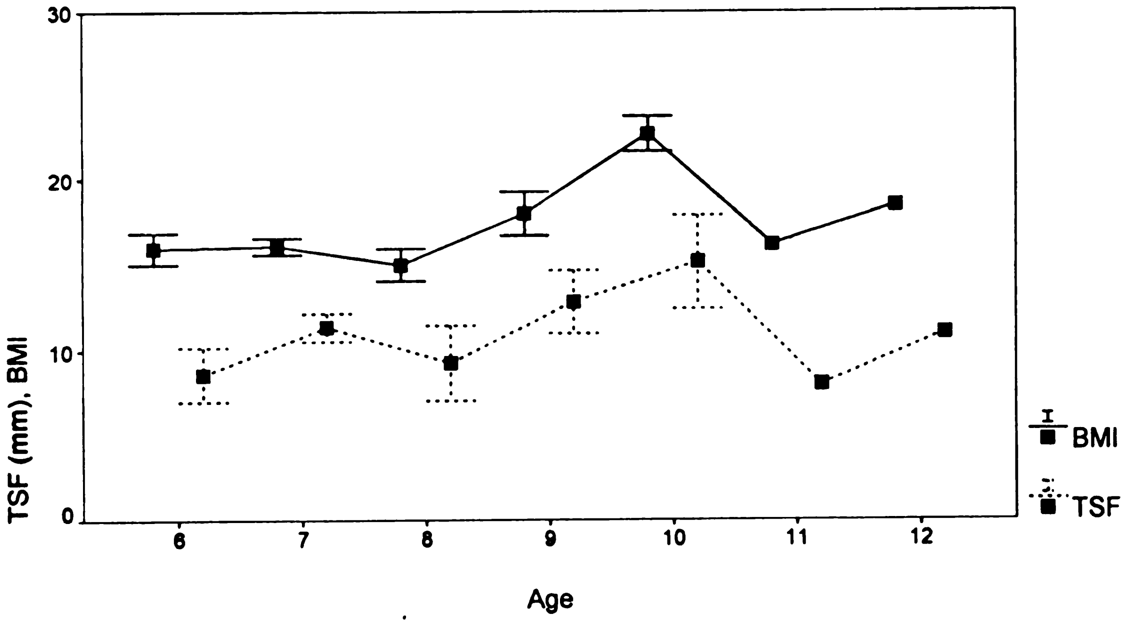
[e] From modified Block Screening Questionnaire

[f] Energy expenditure per body weight calculated from resting energy expenditure and physical activity factors. (See method section.)

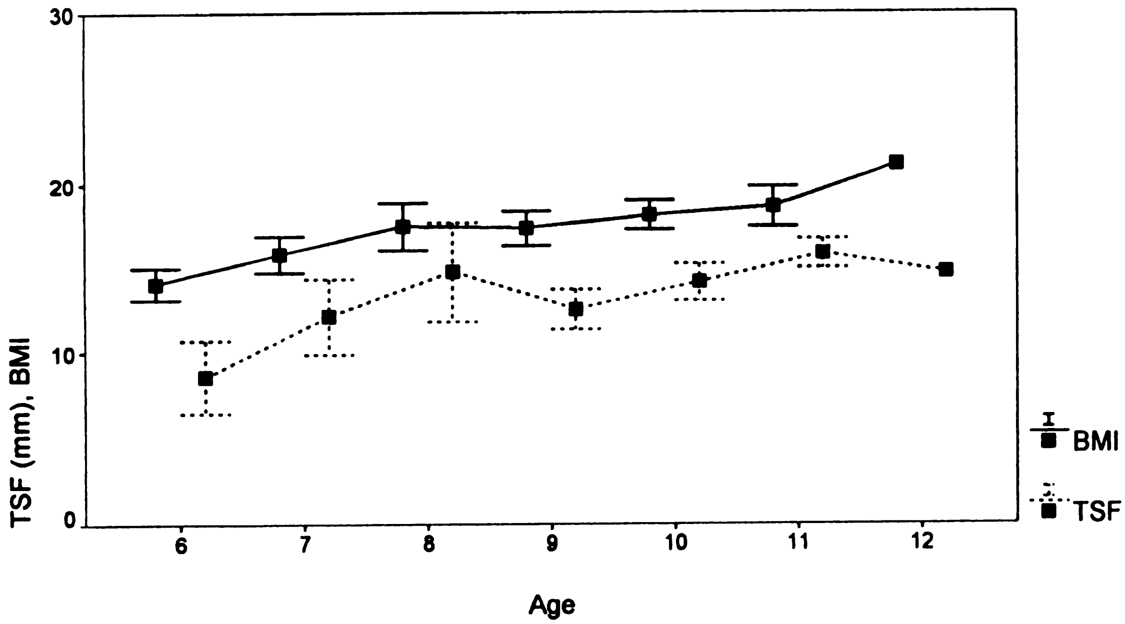
Table 3-7-3. Correlation coefficient matrices for girls

| | BMI[a] | TSF[b] | Energy %RDA | Fat % of kcal | Total fat g/1000kcal | Sat. fat[c] g/1000kcal | PUFA[d] g/1000kcal | Cholesterol mg/1000kcal | Fat intake score[e] | EE[f] kcal/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| Length of residence | 0.4320 p=0.012* | 0.4893 p=0.004* | 0.1366 p=0.448 | 0.3190 p=0.070 | 0.2995 p=0.090 | 0.2944 p=0.096 | -0.2588 p=0.146 | 0.0923 p=0.609 | -0.1783 p=0.321 | -0.1111 p=0.358 |
| BMI[a] | | 0.8428 p=0.000* | -0.1080 p=0.549 | -0.2541 p=0.154 | -0.2557 p=0.151 | -0.2493 p=0.162 | -0.2923 p=0.099 | -0.0541 p=0.765 | -0.2849 p=0.108 | -0.4992 p=0.003* |
| TSF[b] | | | -0.0210 p=0.908 | -0.1982 p=0.269 | -0.2117 p=0.237 | -0.1677 p=0.351 | -0.2577 p=0.148 | 0.0721 p=0.690 | -0.2299 p=0.198 | -0.3449 p=0.049* |
| Energy, %RDA | | | | 0.4882 p=0.004* | 0.4852 p=0.004* | 0.5449 p=0.001* | -0.0346 p=0.848 | -0.1784 p=0.321 | 0.2265 p=0.205 | 0.0211 p=0.907 |
| Fat, % of kcal | | | | | 0.9916 p=0.000* | 0.8962 p=0.000* | 0.2640 p=0.138 | 0.0837 p=0.643 | 0.0149 p=0.935 | 0.1559 p=0.386 |
| Total fat, g/1000kcal | | | | | | 0.8879 p=0.000* | 0.2824 p=0.111* | 0.0727 p=0.688 | 0.0269 p=0.882 | 0.1182 p=0.512 |
| Sat. fat[c], g/1000kcal | | | | | | | 0.1669 p=0.353 | 0.1365 p=.449 | 0.1894 p=0.291 | 0.1500 p=0.405 |
| PUFA[d], g/1000kcal | | | | | | | | 0.0178 p=0.922 | -0.1833 p=0.307 | 0.2948 p=0.096 |
| Cholesterol, mg/1000kcal | | | | | | | | | -0.0019 p=0.992 | 0.1195 p=0.508 |
| Fat intake score[e] | | | | | | | | | | 0.0648 p=0.720 |

* Significant ($p<0.05$)
[a] Body mass index adjusted for age and sex
[b] Triceps skinfold adjusted for age and sex
[c] Saturated fatty acid
[d] Polyunsaturated fatty acid
[e] From modified Block Screening Questionnaire
[f] Energy expenditure per body weight calculated from resting energy expenditure and physical activity factors. (See method section.)



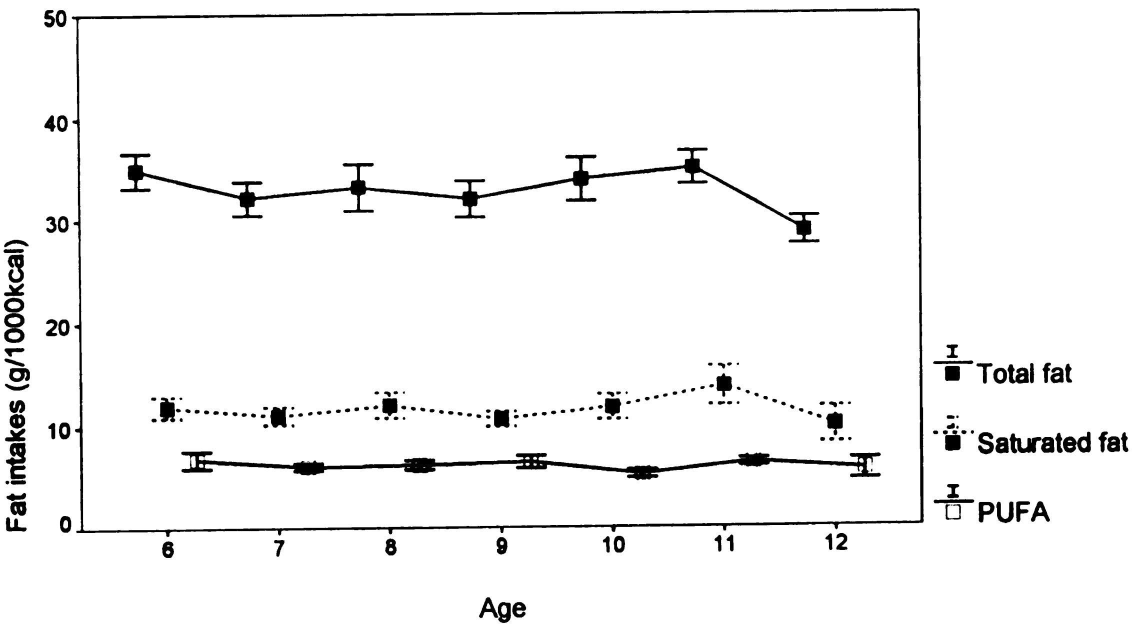

a) Boys




b) Girls

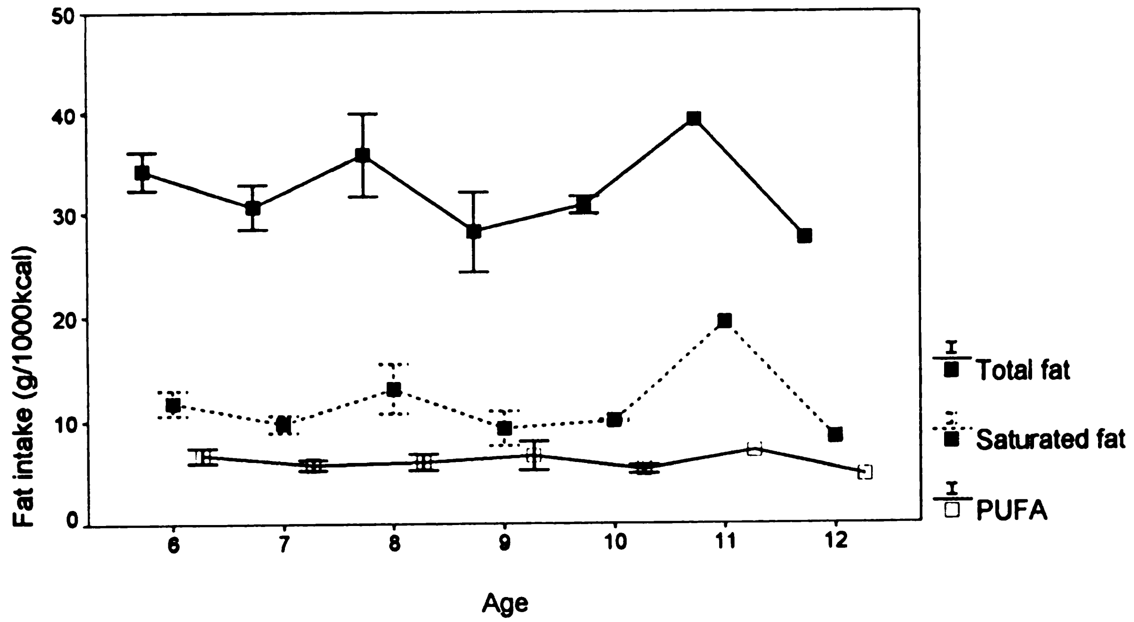
Fig. 3-1 Body mass index (BMI) and Triceps skinfold (TSF) for Japanese children living in the US.

Fat intakes (g/1000kcal)

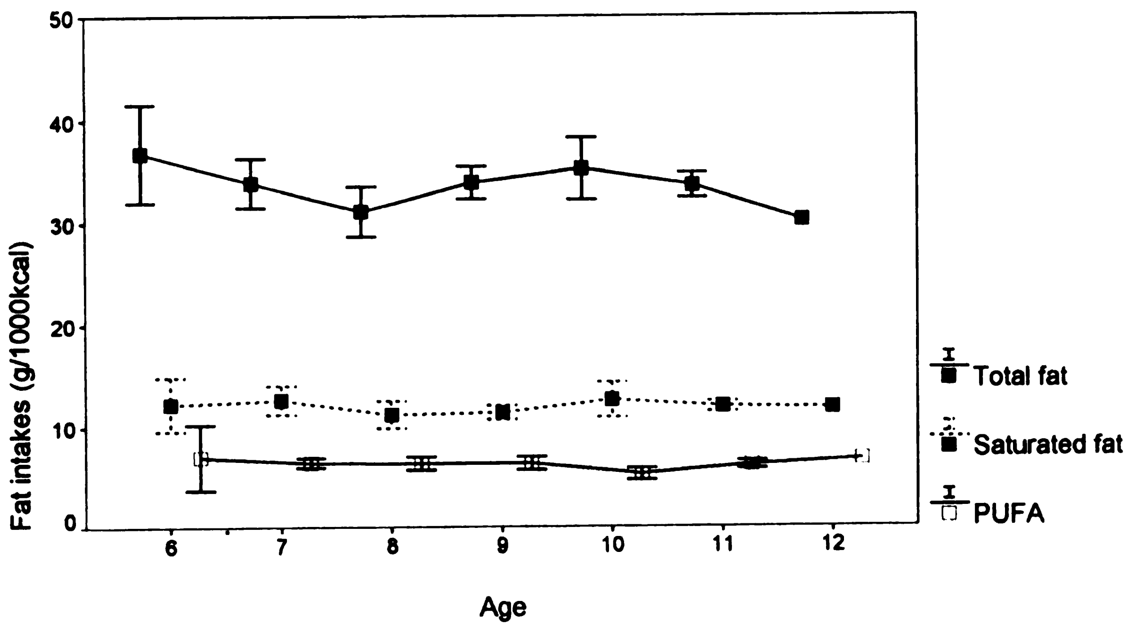



(a). All subjects

Fig. 3-2 Fat intakes in relationship to age




b) Boys




c) Girls

## Fig. 3-2 Fat intakes in relationship to age

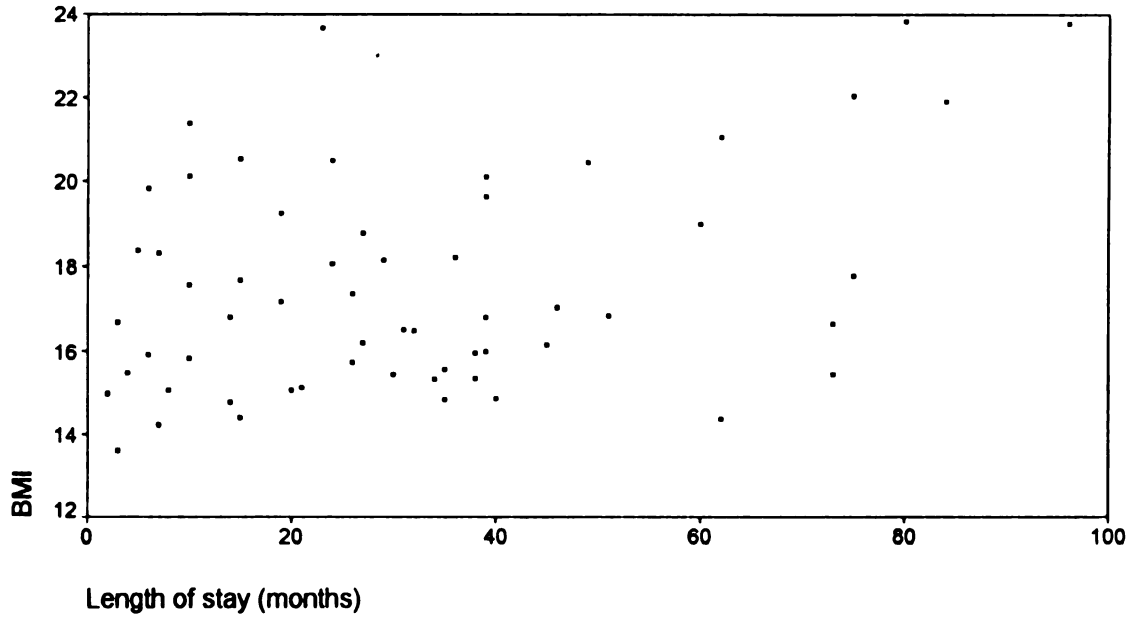



Fig 3-3. Correlation between length of stay and BMI

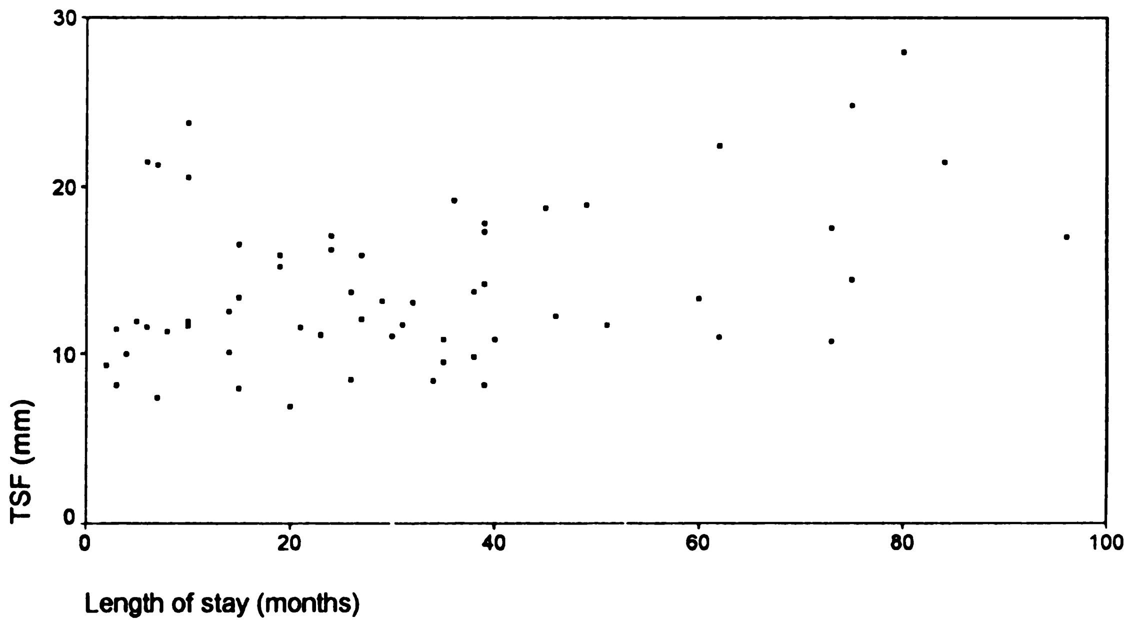
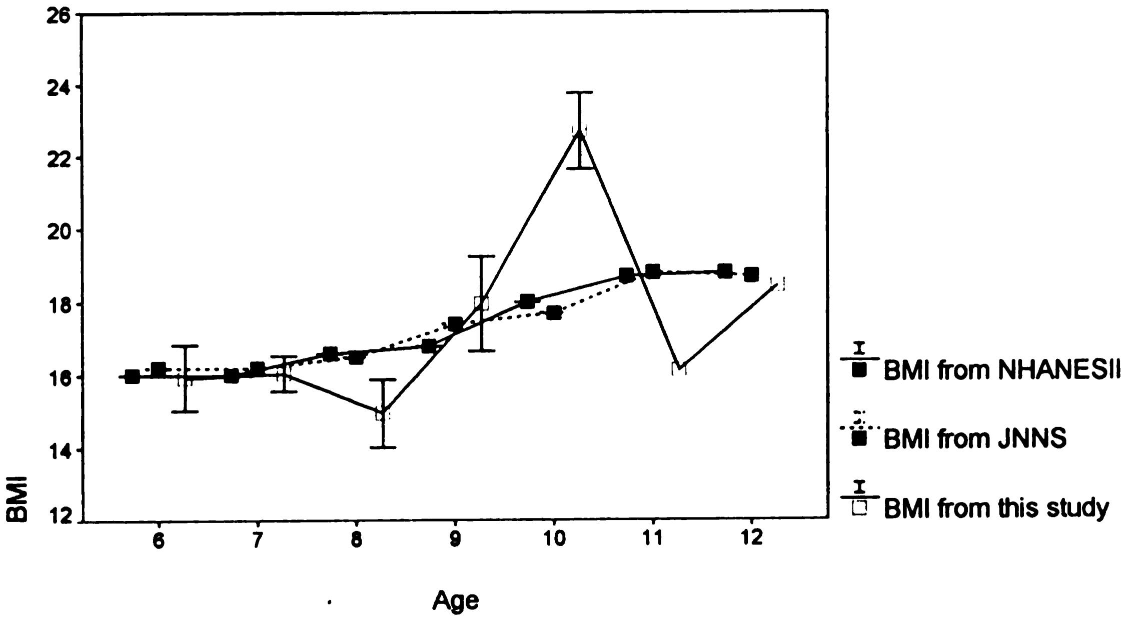


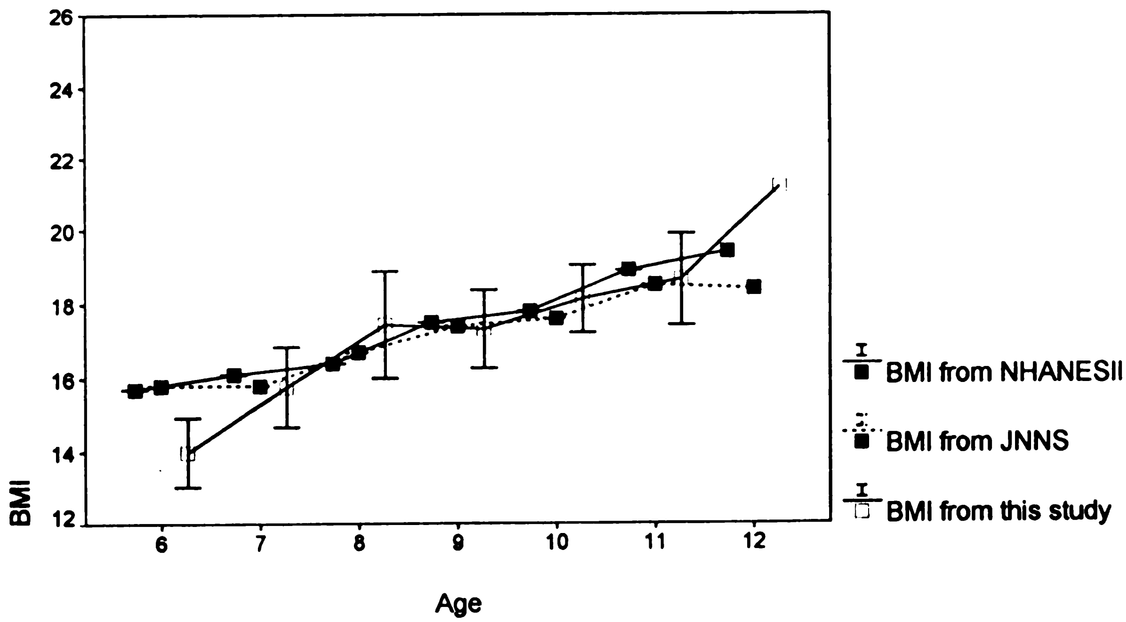

Fig 3-4. Correlation between length of stay and TSF




a) Boys

BMI for Japanese National Nutrition Survey (JNNS) is calculated form the height and weight norms by using equation of Weight (kg) / Height $(m)^2$.

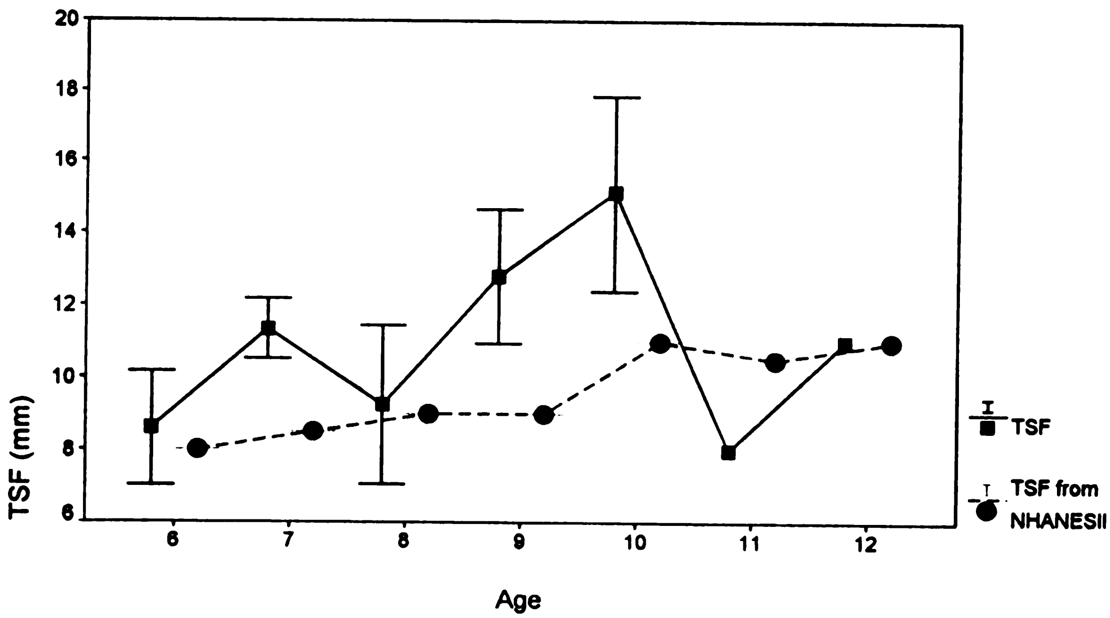
**Fig 3-5 (a). BMI in this study compared to the BMI from Japanese National Nutrition Survey and Second National Health and Nutrition Examination Survey (NHANESII).**




b) Girls

BMI for Japanese National Nutrition Survey (JNNS) is calculated form the height and weight norms by using equation of Weight (kg) / Height (m)$^2$.

**Fig 3-5 (b). BMI in this study compared to the BMI from Japanese National Nutrition Survey and Second National Health and Nutrition Examination Survey (NHANESII).**




a) Boys

Fig 3-6 (a). TSF in this study compared to the 50th %tile TSF of Second National Health and Nutrition Examination Survey (NHANESII).

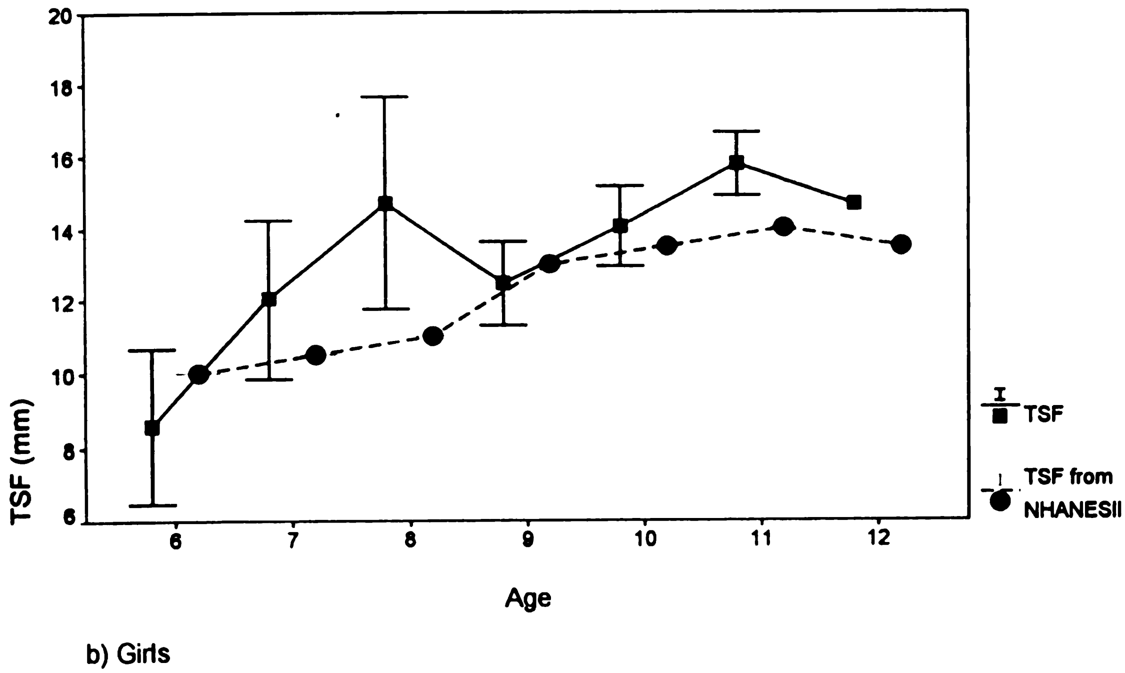



**Fig 3-6 (b). TSF in this study compared to the 50th %tile TSF of Second National Health and Nutrition Examination Survey (NHANESII).**

# CHAPTER IV

## FOOD GROUP INTAKE FROM THE FOOD GUIDE PYRAMID AND SNACKING PATTERNS OF 6-12-YEAR-OLD JAPANESE CHILDREN WHO LIVE IN THE UNITED STATES

## INTRODUCTION

The Food Guide Pyramid was developed by United States Department of Agriculture (USDA) to help people select a nutritionally adequate diet (Welsh et al., 1994). The Food Guide Pyramid graphically illustrates the recommended servings of 6 food groups which are: 6-11 servings of bread/cereal/rice/pasta group; 3-5 servings of vegetable group; 2-4 servings of fruit group; 2-3 servings of milk/yogurt/cheese group; 2-3 servings of meat/poultry/fish/legumes/eggs/nuts group; and sparse use of fats/oils/sweets group (USDA, 1992).

Several authors (Patterson et al., 1990, Krebs-Smith et al., 1995, Basch et al., 1994) have reported that people in the US do not eat as recommended in the Food Guide Pyramid, and diets are especially low in fruits and vegetables. Based on the data of the Second National Health and Nutrition Examination Survey (NHANESII), 45% of the US population consumed no servings of fruit or fruit juice, and 22% consumed no servings of vegetables (Patterson et al., 1990). Based on the data of Continuing Surveys of Food Intakes by Individuals (CSFII), only 32% of American adults' fruit and vegetable intakes met the total of 5 servings (Krebs-Smith et al., 1995). Basch et al. (1994) reported that only 6.8% of children consumed a total of 5 servings from fruits and vegetables.

In contrast, the native Asian diet is one which provides a high intake of complex carbohydrates in the form of grains (rice, noodles), fruits and vegetables (Kim et al., 1993). However, as acculturation occurs in immigrants to the US, their diets tend to become high in meat/poultry/fish/legumes/eggs/nuts and milk/yogurt/cheese groups, and low in grain, fruits and vegetables (Yang et al., 1979).

This study was designed to investigate the number of servings of food from the various food groups that were selected by Japanese children who lived in the US from 1 month to 8 years. Their selections were evaluated according to the recommended servings in the Food Guide Pyramid. Specific hypotheses tested were as follows: (1) Japanese children who have lived in the US for 5 years or more consume fewer servings of bread/cereal/rice/pasta, fruits and vegetables than those who have lived in the US for 1 year or less. Those who have lived in the US for 2-4 years eat intermediate amounts of bread/cereal/rice/pasta, fruits and vegetables, (2) Japanese children who have lived in the US for 5 years or more consume more servings of meat/poultry/fish/legumes/eggs/nuts, milk/yogurt/cheese and sweets/fats/oils group than those who have lived in the US for 1 year or less. Those who have lived in the US for 2-4 years eat intermediate amounts of meat/poultry/fish/legumes/eggs/nuts, milk/yogurt/cheese and sweets/fats/oils. In another aspect of this study, the energy intake from snacks was investigated. The hypothesis tested was that Japanese children who lived in the US for 5 years or more consumed more energy (kcal) from snacks than those who lived in the US for 1 year or less. Those who lived in the US for 2-4 years consumed intermediate energy from snacks.

**METHOD**

**Subjects**:

Subjects are 59 healthy Japanese children (33 females, 26 males), ages 6 to 12 years, who attend Saturday school in Battle Creek, Michigan. They were born in Japan, but now they live in Michigan or Indiana with their families, as temporary residents. One or both of their parents work for Japanese companies that have branches in Battle Creek, Jackson, Coldwater or Kalamazoo, Michigan or Goshen, Indiana. The Japanese children attend US schools during the week, but attend Saturday school to study Japanese language and mathematics classes. It is assumed that these children are exposed to Western culture outside of the home at the public school, while they have a traditional family life at home.

After the approval of the University Committee on Research Involving Human Subjects (UCRIHS) at Michigan State University fall, 1994 (IRB # 94-501, Appendix A), subjects were recruited by letters to the parents of the subjects. The consent form (Appendix B), and questionnaires were handed out to the students in the Japanese school classes. The signing of the consent form by subjects' parents indicated a willingness to participate in the study. Fifty nine out of a potential of 83 students, or 71% participated in the study. All 55 households responded for at least one of the children in their house, and 4 households responded for 2 children.

An instrument had been developed to elicit demographic data (Appendix F). This questionnaire asked questions about the child's age, sex, number of years of residence in the US and previous residence in the US. Subjects were divided into five groups based on the length of residence in the US; 1-12 months, 13-24 months, 25-36 months, 37-48 months and 49 months or more.

**Data collection procedure**:

Food intakes for three days (3-day food record form, Appendix C) for all subjects were recorded by their parents in Japanese language. They were asked to include amounts of food eaten, brand names and recipes for mixed dishes. Also requested were the time of day the food was eaten and where the food was eaten. Written directions included two-dimensional food model pictures for filling out portion size (Appendix D) were given to the parents. The three-day food record included two weekdays and one weekend day. Subjects submitted their food records to an investigator (J.I.) at school. If the food record needed further clarification, the investigator interviewed the parents over the telephone.

**Data analyses**:

***Dietary intake measurements.*** Computer analyses of the food records were done by using Nutritionist IV, Version 3.0 (N-squared computing, Salem, OR, 1993). Servings of food for each subject were classified into the 6 food groups based on the Food Guide Pyramid [(1) bread/cereal/rice/pasta group; (2) vegetable group; (3) fruit group; (4) milk/yogurt/cheese group; (5) meat/poultry/fish/legumes/eggs/nuts group; and (6) fats/oils/sweets group], and the quantity of servings from each food group were computed for each subject.

Total daily energy intake (kcal) and daily energy intake from snacks were computed. The percent of energy (kcal) from snacks was calculated. The percent of energy (kcal) from each snack (morning, afternoon, and evening) compared to energy from all snacks was determined for each child.

***Statistics.*** Means and standard errors of means were calculated by using the Statistical Package for the Social Science, Version 6.1 (SPSS Inc., Chicago, IL, 1994). Analyses of variance were done for the five groups, based on the length of residence in the US, in relationship to each of the six food groups. Percentage of individuals who consumed less than the recommended servings, the recommended servings, and more than the recommended servings were calculated for each food group. Duncan's multiple range test was used to identify the significant difference among the means.

Analysis of variance (ANOVA) was done for the percent energy intake from all snacks among five groups based on length of residence. ANOVA was also done for the percent of energy from each snack (morning snacks, afternoon snacks, and evening snacks).

## RESULTS AND DISCUSSION

Means and standard errors of the mean for consumption of foods based on the Food Guide Pyramid are presented in Table 4-1 relative to length of residence in the US. Percentage of individuals who consumed the servings of food groups recommended in Food Guide Pyramid are presented in Fig. 4-1 to Fig. 4-5.

When the mean servings of bread/cereal/rice/pasta group were compared among the five groups for length of residence in the US, the consumption tended to decrease as subjects lived in the US longer, although the decrease was not significant (Table 4-1). Subjects in the first group, the group with 1-12 months residence in the US, met the recommendation by Food Guide Pyramid (Table 4-1).

Mean of bread/cereal/rice/pasta group consumption by all subjects was 5.8 servings(Table 4-1). The value is slightly lower than the minimum of 6 servings, that were recommended in Food Guide Pyramid. Sixty one percent of subjects did not consume the minimum of 6 servings of bread/cereal/rice/pasta group (Fig. 4-1).

About 40% of bread/cereal/rice/pasta group was consumed as rice, and about 20% was consumed as breads in all subjects. Noodles were the third most popular starch. Rest of the bread/cereal/rice/pasta group was consumed as breakfast cereals, potatoes, corn and wheat flour. None of the foods in bread/cereal/rice/pasta group seemed to have change among the five groups for length of residence in the US.

There was not significant difference in servings of vegetable group among the five groups for length of residence in the US. However, the fifth group was the only group that did not meet the recommendation in vegetable group.

Mean of vegetable group consumption was in the range of the recommended 3-5 servings in Food Guide Pyramid (Table 4-1). About 60% of all subjects consumed the recommended or more than the recommended servings of vegetables (Fig. 4-2). However, 40% of subjects did not consume the recommended servings of vegetables. Popularly consumed vegetables were iceberg lettuce, Chinese cabbage, cabbage, carrots, onion, green onion, spinach, tomato, broccoli, cucumber, daikon radish, bean sprouts, and a variety of seaweeds such as wakame, kombu, and hijiki. Less frequently used vegetables were asparagus, bamboo shoots, burdock root, egg plant, green beans, green pepper, and pea pods. Varieties of Japanese mushrooms such as shiitake, enoki and shimeji were also frequently used.

There was not significant difference in servings of fruit group among the five groups for length of residence in the US. However, the fifth group was the only one that did not meet the recommendation of 2-3 servings for fruit group. Mean of fruit group consumption by all subjects was in the range of the recommendation of 2-3 servings in Food Guide Pyramid (Table 4-1). Forty four percent of the subjects consumed the recommended or more than recommended servings of fruit (Fig. 4-3). However, 56% of subjects did not consume the recommended servings of fruits.

About half of fruit group was consumed as fresh fruits, and half was consumed as fruit juice. The most frequently consumed fruits were oranges, bananas, strawberries, peaches, apples and watermelons. The most frequently consumed fruit juices were apple and orange.

In general, the consumption of milk/yogurt/cheese increased as children lived in the US longer (Table 4-1). The increase from 0.6±0.2 servings to 1.7±0.2 servings between first and third groups, and from 0.6±0.2 servings to 1.7±0.5 servings between first and fifth groups were significant ($p<0.05$). Mean of servings in all groups did not meet the recommendation of milk/yogurt/cheese group. Mean consumption of milk/yogurt/cheese by all subjects was fewer than 4 servings, which was recommended for children in Food Guide Pyramid (Table 4-1). Only 3% (2 individuals) of all of the subjects consumed 4 servings of milk/yogurt/cheese group per day (Fig. 4-4). More than 80% of all subjects did not even consume 2 servings of milk group, which was the recommendation for adults.

Over 90% of milk/yogurt/cheese group was consumed as fluid milk. Yogurt and cheese comprised about 5% each. About 40% of fluid milk was skim or lowfat milk. Consumption of skim or lowfat milk tended to increase as subjects stayed in the US longer, whereas consumption of whole milk did not have much change among the five groups for length of residence in the US. This tendency indicated that Japanese children consumed more milk, especially as lowfat milk as they lived in the US longer. Lowfat milk was introduced to Japan relatively recently, but the citizens of Japan still prefer whole milk to lowfat milk.

There was not significant increase in meat/poultry/fish/legumes/eggs/nuts consumption among the five groups of length of residence in the US. All five groups consumed excessive servings of meat/poultry/fish/legumes/eggs/nuts group. Mean consumption of meat/poultry/fish/legumes/eggs/nuts by all subjects were more than 3 servings of meat/poultry/fish/legumes/eggs/nuts group, which was recommended in Food Guide Pyramid (Table 4-1). About 85% of subjects consumed more than 3 servings of meat/poultry/fish/legumes/eggs/nuts group (Fig. 4-5). Subjects who consumed the recommended amount of 2-3 servings of meat/poultry/fish/legumes/eggs/nuts were 11.9%.

About 40% of meat/poultry/fish/legumes/eggs/nuts group was consumed as meat or poultry, and about 20% was consumed as legumes. About 20% of meat/poultry/fish/legumes/eggs/nuts group was consumed as eggs, and about 20% was consumed as fish. Nuts were not consumed very much. Consumption of meat and poultry tended to increase as the subjects stayed longer in the US. Frequently consumed meats were pork, chicken, beef and ham. Variety of fish was consumed by subjects, mainly at breakfast and dinner. The most frequently consumed fish or seafood were tuna, mackerel, flounder, pike, sardine, clam, shrimp, squid, and octopus. Legumes were consumed mainly at breakfast and dinner. The most frequently consumed legumes were soy products such as tofu, fried tofu, natto and miso.

Subjects consumed 5.7 servings of fats/oils/sweets group. There was no significant difference in consumption of fats/oils/sweets group among the five groups of length of residence. Fats and oils were frequently consumed as vegetable oils for stir fried or pan fried food in the meals. Sweets were mainly consumed between meals. Frequently consumed sweets were candies, cookies, cakes and carbonated beverages.

In Japan, average consumption of bread/cereal/rice/pasta group, vegetable group, fruit group meat/poultry/fish/legumes/eggs/nuts group and milk/yogurt/cheese group were 355g, 255g, 112g, 285g and 129g, respectively (Japanese National Nutrition Survey, Ministry of Health and Welfare, Japan, 1993). They are expediently converted to 13oz of dry rice, 1-2 cups of raw vegetables, 0.5-1 cup of raw fruits, 10 oz of meat and half cup of milk (Zeman, 1991). Except for the milk/yogurt/cheese group, all the groups seems to meet the servings recommended by Food Guide Pyramid. Base on this information, it was assumed that Japanese children who have lived in the US for 1 month to eight years would have adequate food intake of all the food groups except for milk/yogurt/cheese group based on Food Guide Pyramid.

There were not significant differences in energy intake from snacks among the five groups for length of residence in the US. Therefore, data were collapsed to assess the energy intake from snacks for all children. Japanese children in the US consumed 17.2±1.0% of energy (kcal) from snacks (Table 4-2). Morning, afternoon and evening snacks were consumed 2.7%, 11.2%, 3.7% of the total day's energy intake, respectively. Ninety eight percent of the subjects consumed the afternoon snack. Children had the greatest kilocalorie from afternoon snack. It is assumed that Japanese children living in the US did not change their snacking patterns.

In summary, Japanese children who lived in the US for 1 months to 8 years consumed recommended serving of fruits and vegetables in Food Guide Pyramid. They consumed 4-5 servings of bread/cereal/rice/pasta group. They consumed fewer milk/yogurt/cheese group than recommended, and they consumed more meat/poultry/fish/legumes/eggs/nuts group than recommended. There was a significant increase in milk group among the five groups for residence in US, indicating that Japanese children who lived in the US longer consumed more servings of foods from milk/yogurt/cheese group. However, there was no change among the other food groups in relationship to the length of residence in the US. There was no significant change in energy intake from snacks in relationship to the length of residence in the US.

Table 4-1. Consumption of food groups from Food Guide Pyramid in relationship to length of residence in the US.

| Length of residence in US (months) | n | Bread group (servings) | Vegetable group (servings) | Fruit group (servings) | Milk group (servings) | Meat group (servings) | Fats, oils & sweets group (servings) |
|---|---|---|---|---|---|---|---|
| 1-12 | 14 | 6.9±1.0 | 3.9±0.5 | 2.4±0.4 | 0.6±0.2[1,2] | 5.3±0.7 | 6.5±0.6 |
| 13-24 | 12 | 5.7±0.9 | 3.9±0.5 | 3.1±0.6 | 0.9±0.2 | 4.6±0.5 | 4.7±0.6 |
| 25-36 | 12 | 5.6±0.7 | 3.7±0.4 | 2.0±0.3 | 1.7±0.2[1] | 4.1±0.4 | 5.4±0.6 |
| 37-48 | 9 | 5.1±0.9 | 3.9±0.6 | 2.3±0.4 | 0.9±0.3 | 4.6±0.6 | 5.9±1.0 |
| >49 | 12 | 5.1±0.7 | 2.7±0.4 | 1.9±0.3 | 1.7±0.5[2] | 5.4±0.6 | 5.9±0.6 |
| Total | 59 | 5.8±0.4 | 3.6±0.2 | 2.3±0.2 | 1.2±0.1 | 4.8±0.3 | 5.7±0.3 |
| ANOVA (p) | | 0.4994 | 0.3805 | 0.3319 | 0.0175* | 0.4515 | 0.4444 |
| Food Guide Pyramid Recommendation | | 6-11 | 3-5 | 2-4 | 4 (2-3 for adults) | 2-3 | Use sparingly |

Means±SEM
*Significant ($p<0.05$)
The same superscript numbers indicate a significant difference between the values in the same column.
(Duncan's multiple range test $p<0.05$)

Table 4-2. Energy intake from snacking of Japanese children who live in the US in relationship to length of residence in the US

| Length of residence in US (months) | Age | Energy intake from all snacks (% total kcal) | Energy intake from morning snack (% snack kcal) | Energy intake from afternoon snack (% snack kcal) | Energy intake from evening snack (% snack kcal) |
|---|---|---|---|---|---|
| 1-12 | 8.3±0.3 | 17.5±1.8 | 14.3±3.7 | 66.5±7.0 | 19.1±5.2 |
| 13-24 | 9.0±0.5 | 17.1±1.9 | 17.2±5.6 | 64.2±5.5 | 18.6±6.3 |
| 25-36 | 7.7±0.4 | 15.5±2.2 | 10.9±4.4 | 64.5±6.7 | 21.1±6.3 |
| 37-48 | 8.9±0.7 | 19.8±3.5 | 14.6±6.7 | 73.3±5.5 | 12.1±3.9 |
| >49 | 8.3±0.5 | 16.9±2.1 | 20.7±7.7 | 50.1±7.7 | 27.0±8.1 |
| Total | | 17.2±1.0 | 15.6±2.5 | 65.4±3.1 | 21.4±2.8 |
| ANOVA (p) | | 0.7941 | 0.7895 | 0.2233 | 0.6367 |

Means±SEM

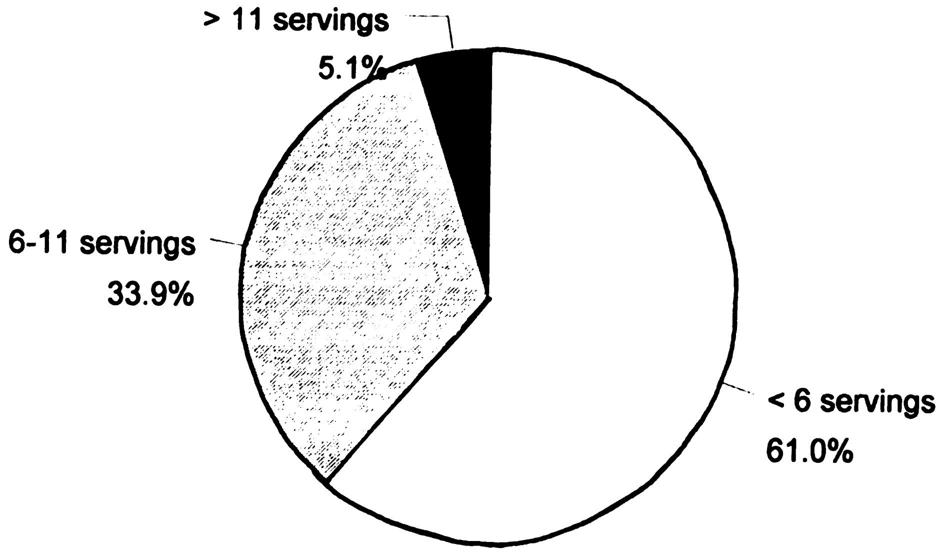



Fig 4-1. Percentage of Japanese children who consumed the servings of bread/cereal/rice/pasta group recommended in Food Guide Pyramid

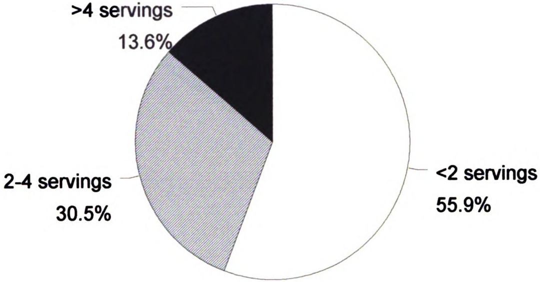



Fig. 4-2 Percentage of Japanese children who consumed the servings of vegetable group recommended in Food Guide Pyramid

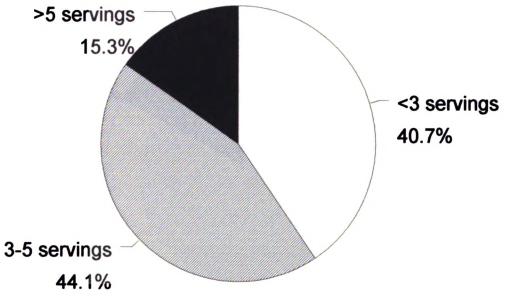



Fig. 4-3 Percentage of Japanese children who consumed the servings of fruit group recommended in Food Guide Pyramid

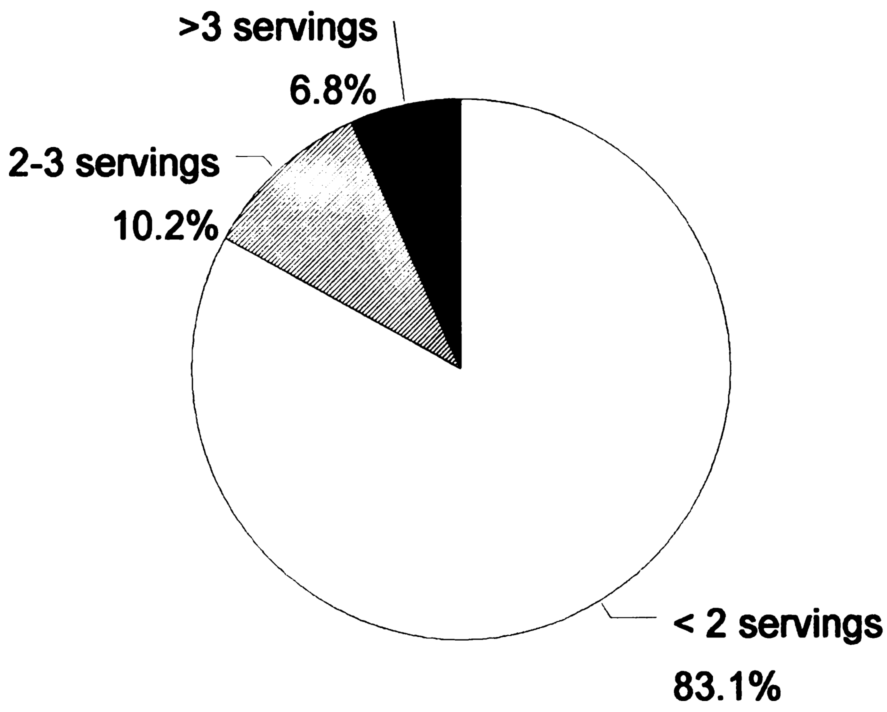



Fig. 4-4 Percentage of Japanese children who consumed the servings of milk/cheese/yogurt group recommended in Food Guide Pyramid

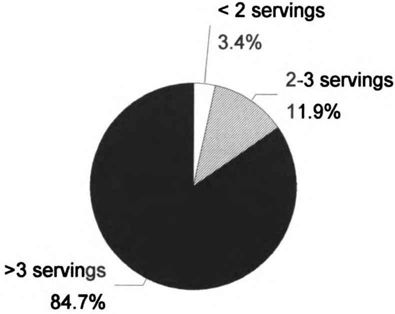



Fig. 4-5 Percentage of Japanese children who consumed the servings of meat/poultry/fish/legume/egg/nut group recommended in Food Guide Pyramid

# CHAPTER V
# APPLICATION OF THIS RESEARCH

Although there have been several investigations relative to changing eating behavior, hoping thereby to improve diets, there has been little or no research relative to maintenance of the positive qualities of native diets, as people migrate to the US. This research was an unique one which addressed the latter issue by exploring the rate at which food habits change and the impact of dietary changes on nutritional and anthropometric status.

Japanese children who lived in the US for one month to eight years had relatively good quality of diet such high intake of fruits and vegetables and lower intake of fat compared to the various data of American children. However, the findings from this study also indicated that Japanese children who were exposed to the Western society changed their anthropometric status. Although stereotype of Asian children is usually thin and small, it is important for dietitians to be aware that Asian children can be in the risk of obesity when they stayed in the US for several years.

The foods that were eaten frequently by Japanese children in this study can be used to develop a food frequency questionnaire for Asian population. To investigate the dietary intake of Asian population is necessary, and data from this study will provide the selections that Japanese children would make.

Finally, the data from this study can be a comparative data when dietary and anthropometric assessment of Asian population is done in the future. Data of Asian people are necessary because the Asian is the third increasing race in the US.

# APPENDICES

# APPENDIX A
## Approval from University Committee on Research Involving Human Subjects (UCRIHS)

MICHIGAN STATE
UNIVERSITY

December 2, 1994

TO: Rachel Schemmel
302 G.M. Trout FSHN Bldg.

RE: IRB#: 94-501
TITLE: CULTURAL IMPACT ON DIET CHANGES, DIET QUALITY AND PREVALENCE OF OBESITY IN CHILDREN OF JAPANESE HERITAGE LIVING IN THE UNITED STATES
REVISION REQUESTED: N/A
CATEGORY: 2-C
APPROVAL DATE: 11/30/94

The University Committee on Research Involving Human Subjects'(UCRIHS) review of this project is complete. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the UCRIHS approved this project including any revision listed above.

**RENEWAL:** UCRIHS approval is valid for one calendar year, beginning with the approval date shown above. Investigators planning to continue a project beyond one year must use the green renewal form (enclosed with the original approval letter or when a project is renewed) to seek updated certification. There is a maximum of four such expedited renewals possible. Investigators wishing to continue a project beyond that time need to submit it again for complete review.

**REVISIONS:** UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please use the green renewal form. To revise an approved protocol at any other time during the year, send your written request to the UCRIHS Chair, requesting revised approval and referencing the project's IRB # and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

**PROBLEMS/ CHANGES:** Should either of the following arise during the course of the work, investigators must notify UCRIHS promptly: (1) problems (unexpected side effects, complaints, etc.) involving human subjects or (2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of any future help, please do not hesitate to contact us at (517)355-2180 or FAX (517)336-1171.

Sincerely,

David E. Wright, Ph.D
UCRIHS Chair

DEW:pjm

OFFICE OF
**RESEARCH AND GRADUATE STUDIES**

**University Committee on Research Involving Human Subjects (UCRIHS)**

Michigan State University
225 Administration Building
East Lansing, Michigan
48824-1046

517/355-2180
FAX: 517/432-1171

# APPENDIX B

Date ______________

You and your child are being asked to participate in a study by the Department of Food Science and Human Nutrition and the Department of Family and Child Ecology at Michigan State University. One of our investigators, Junko Ishihara, is a Japanese graduate student studying in the U.S. and will use the information to obtain thesis material for her Masters graduate degree in Human Nutrition. The purpose of her study is to investigate dietary habits, nutrient quality and growth parameters in 6-12 year old children of Japanese heritage who live in the US and a similar U.S. group of children.

You will be completing a 3-day food intake record and 24-hour activity record for him/her and to answer a few questions about length of stay in U.S.. It will take approximately 15 minutes to fill out the food intake record for one day. The investigators will supply directions on how to fill out the food record. We will measure your child's height, weight, and triceps skinfolds at school, which will take 15 to 30 minutes. He/she will be asked some questions about how frequently he/she eats certain foods. All information collected is confidential. You will receive a personal feedback about your child's physical growth compared to the standards for Japanese and American children and about your child's nutrient intake.

Participation in the study is entirely voluntary. You may withdraw from the study at any time without penalty. You may also decide not to answer certain questions if you wish. You indicate your voluntary agreement to participate by completing and returning this form. If you have any questions regarding this study, you may call (517) 355-3944 (Ishihara) or (517) 353-9629 (Schemmel).

Thank you!

Please print your name: ______________________________

address: ______________________________________________

______________________________________________

telephone number: ______________________________________

Please sign your name ______________________________

Investigators' signatures

______________________________
Junko Ishihara
Graduate Student in Human Nutrition

______________________________
Rachel Schemmel, Ph.D.
Professor of Human Nutrition

______________________________
Norma Bobbitt, Ph.D.
Professor, Family and Child Ecology

# APPENDIX C

## TWENTY-FOUR HOUR DIET RECORD

Day _______ Date_________

| Food | Ingredient (How prepared) | Amount | Time of day and where eaten |
| --- | --- | --- | --- |
| Breakfast | | | |
| Snack | | | |
| Lunch | | | |
| Snack | | | |
| Dinner | | | |
| Snack | | | |

Do you eat these foods regularly? Yes No

# APPENDIX D

## Directions for filling out the

## TWENTY-FOUR HOUR DIET RECORD

(1) Fill out the day and date of the diet record for three days, including two week days and one weekend day.

(2) Record the names of foods eaten for meals and snacks for three days. Please indicate if you skip meal.

(3) For mixed dishes, mention if they are home made or manufacture made. If home made, provide the names of ingredients for recipes and how it was prepared at home. If manufacture made, identify brand name and as precise as possible.

(4) List amount eaten in cups, grams, servings. (Please refer to the sample of the diet record and pictures.)

(5) Record the time of day that you ate the food for each meal. Record where the foods were eaten such as at home, school lunch, carried lunch, restaurant etc.

APPENDIX E

**Food Frequency Questions**

Check how often you eat the following foods.

| | Less than once per month | 2-3 times per month | 1-2 times per week | 3-4 times per week | 5+ times per week |
|---|---|---|---|---|---|
| Hamburgers or cheeseburgers with bun | | | | | |
| Beef, such as steaks, roasts | | | | | |
| Fried fish, chicken, or pork | | | | | |
| Hot dogs, franks | | | | | |
| Cold sandwich meats, ham, etc. | | | | | |
| Salad dressings, mayonnaise (not diet or low calorie) | | | | | |
| Margarine or butter | | | | | |
| Peanut butter | | | | | |
| Eggs | | | | | |
| Bacon or sausage | | | | | |
| Cheese or cheese spread | | | | | |
| Whole milk | | | | | |
| Deep fried vegetables (French fried potatoes, vegetable tempura etc.) | | | | | |
| Potato chips, corn chips (Doritos, etc.) | | | | | |
| Ice cream | | | | | |
| Donuts, sweet rolls, cakes, cookies, pies | | | | | |

Adapted from: Block, G., et al. 1989. J. Nutr. Educ. 21:199-207.

# APPENDIX F

## Demographic Questions

Answer following questions about your child.

1. What is his/her age?

__________years

2. What is his/her sex? (Check one)

___Girl ___Boy

3. Does he/she take any vitamins? (Check one)

___Yes ___No

4. How long has he/she been living in the United States?

___________years and_________months

5. Did he/she live in Japan before coming to the U.S.?

___________years and_________months

6. Fill in the average number of hours per 24 hours that you perform each activity.

| ACTIVITY | Hours per 24 hrs |
|---|---|
| Sleeping | hours |
| Sitting (Studying, watching TV, Car/bus riding, etc.) | hours |
| Eating | hours |
| Walking | minutes |
| Vigorous sports (Swimming, Bicycling, Aerobics, Basketball, etc.) | minutes |

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