

E OLA MAU

THE NATIVE HAWAIIAN HEALTH NEEDS STUDY
NUTRITION/DENTAL TASK FORCE REPORT

The Native Hawaiian Health Research Consortium

ALU LIKE, INC.

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PREFACE

In FY1984 the United State Senate Appropriations Committee included a directive in the Supplemental Appropriations Bill for the U.S. Department of Health and Human Services (DHHS) to conduct a comprehensive health needs study of Native Hawaiians. On September 7, 1984, Senator Daniel K. Inouye sent a letter to Dr. Edward Brandt, Jr., Assistant Secretary for Health, requesting follow-up information on the health care needs study. Dr. Brandt referred the matter to Dr. Sheridan Weinstein of the Department of Health and Human Services (DHHS), Region IX.

Copies of the correspondence between Senator Inouye and Dr. Brandt were sent to interested parties in the community. ALU LIKE decided to pursue the health needs study further. ALU LIKE is a non-profit community organization assisting the Native Hawaiian community toward economic and social self-sufficiency. In November, ALU LIKE called together a group of University of Hawaii and community people with interests in the health needs of Native Hawaiians. The Hawaiian Health Research Consortium (HHRC) was formed as a result of this meeting. At a subsequent meeting, HHRC members decided to submit a health needs study concept paper to DHHS. The concept paper outlined the procedures for conducting the health needs study.

Dr. Sheridan Weinstein of DHHS-Region IX acknowledged receipt of the concept paper, but deferred action until the results from another research report were submitted.

In June 1985, DHHS provided funds to the Waianae Coast Comprehensive Health Center (WCCHC) to conduct the health

needs study. WCCHC was selected as the prime contractor because the Center had existing ties with DHHS and an established system to disburse the funds. WCCHC then subcontracted the study to ALU LIKE for the overall administration of the project.

The contract called for a comprehensive review of existing health data on Native Hawaiians. The entire project was to be completed within a six-month time period. In order to accomplish the study within this short time-frame, the HHRC decided to organize the project around five task forces. Each task force would be responsible for health data within its assigned area. The five task forces included 1) Mental Health Task Force, 2) Medical Task Force, 3) Nutrition/Dental Task Force, 4) Historical/Cultural Task Force, and 5) Strategic Health Plan Task Force.

The short notice as well as the short time available to conduct this study created some limitations. The limited time prevented a thorough and comprehensive analysis of the health data and necessitated narrowing the scope of the study. The time constraint required task force members to commit a substantial portion of their time to the completion of the study, within approximately five months, and many individuals who were interested in working on the task forces could not do so because of prior commitments.

A second limitation is the relatively few number of health professionals who are Native Hawaiian. The lack of Native Hawaiians in the field prevented the HHRC from gaining more representation of Native Hawaiian perspectives on the various aspects of health and health care. This limitation is addressed in the Recommendations sections of the various Task Force Reports.

A third limitation involves the different definitions of "Hawaiian" used in various research studies. The United States Census uses a self-report definition of ethnicity. The Census asked people to select the ethnic group which best described them. The Hawaii Health Surveillance Survey uses a parentage definition - if one or more parents are Hawaiian or Part-Hawaiian, then the individual is classified as Hawaiian or Part-Hawaiian. The U.S. Census estimated that the Hawaiian population in 1980 was 118,251. The Health Surveillance Survey estimated the Hawaiian population at 175,909, a difference of over 50,000 people.

In this report, the term "Native Hawaiian" is defined as "any individual, any of whose ancestors were natives of the area which consists of the Hawaiian Islands prior to 1778." This is the definition contained in the 1975 Title VIII Native American Programs Act declaring that Native Hawaiians are Native Americans eligible for special funds to provide services "to promote the goal of economic and social self-sufficiency." Thus, this definition is an inclusive definition comprising groups of people who have been categorized as "Part-Hawaiian" or "Hawaiian." When other research studies reviewed in this report deviate from this definition, this deviation will be noted.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

I. PURPOSE

The purpose of this Task Force was to determine the nutritional and dental needs of Native Hawaiians. By assessing their needs, we would be more equipped to plan intervention programs suited to these needs. Thus, such programs may be effective in the solution of their nutritional and dental problems.

Three areas were selected as key indicators of the nutritional needs of Native Hawaiians. These areas were selected because of their importance and availability of data pertaining to the Native Hawaiians. The first area chosen was maternal and child health because of the vulnerability of this population to nutritional deficiencies which have lasting effects in later life. Second, was the relationship between diet and chronic diseases such as heart disease, diabetes, arthritis, gout and cancer. Third was dental problems because of its importance to physical health and the relationship between diet and dental health.

II. METHODS

Two major sources of data were used for this study. The first was a review of literature on the nutritional and dental status of Native Hawaiians. The nutrition literature review was arranged according to the nutrition problems of the general population and various groups such as pregnant women, infants (0-1 year), preschool children (1-6 years), school-age children (7-16 years) and adults. The review of the nutritional status of the general population traced the development of the dietary practices of Native Hawaiians from ancient times to the modern age. The account on the dietary

practices of modern Native Hawaiians started in 1954 up to the present.

The dental literature review also traced the development of dental health from ancient to modern times. The first methodical study showing a breakdown into different ethnic groups including the Native Hawaiian was done in 1940. Recent sources of data regarding utilization of dental services, dental insurance coverage and dental health manpower were obtained from reports by the Hawaii State Department of Health and interviews with dental health professionals working in the State of Hawaii.

The second source of data were based on the results of medical, dental and nutritional information obtained from records of patients who came to the Maternity and Infant Care Project (MIC) in Waimanalo, Oahu. Two time periods were selected to provide a basis for comparison of data between the 1970s and 1980s. In each time period, one year was selected for data collection, but if the number of records needed were lacking in each group, records from the preceding or subsequent year was collected. Thus, the time period selected for data collection were visits from 1970 to 1973 and 1980 to 1982 for pregnant women; 1972 to 1973 and 1981 to 1982 for infants; and 1972 to 1973 and 1982 for preschool children (1-5 years old). A total of 399 records were abstracted of which 201 were from pregnant women, 100 from infants and 98 from preschool children. In cases where records were obtained from different years such as data collected from 1970 to 1973 and from 1980 to 1982, these were pooled so that trends between the two decades could be noted.

The Waianae Coast Comprehensive Health Center (WCCHC) was the other site of data collection. The Nutrition Department of WCCHC

has a caseload of 1,300 patients of which 1,200 are WIC participants. Of the 1,300 total population, approximately 900 are Native Hawaiians. A chart audit of Native Hawaiian patients who came to the WCCHC was conducted during the week of October 14 to 21, 1985. Recent risks status for entrance into the program were obtained from the certification form and tabulated.

Information from the review of literature and data collected from the MIC Project and WCCHC were summarized. Recommendations for planning nutrition and dental programs were delineated based on the assessment of needs and problems.

III. MAJOR FINDINGS

A. NUTRITION

1. General Population

Early reports have described the ancient Hawaiians as having fine physique and being generally in good health prior to their contact with foreign civilization. Their principal foods were fish, taro, sweet potato, breadfruit, yams, banana, greens, limu (seaweed), coconut, sugar cane and mountain apple. Their diet was simple and limited in variety but adequate to promote growth and maintain good health.

As early as 1954, dietary surveys have shown a decline in the nutritional value of the diet of the Native Hawaiian. A survey conducted in 48 families in Oahu of which half were Native Hawaiians showed that 50% of them had diets that were deficient in calories, protein, phosphorous, iron and vitamin C; three-fourths had insufficient amounts of vitamin A and thiamine.

It has been noted in 1968 that the modern Native Hawaiian still use their traditional foods of taro and poi, but since they

are no longer abundant and are expensive, they have resorted to readily available foods in the supermarkets. Their choices are foods high in energy, fats and sugars. Thus, we have seen an overall decline of the diet of the ancient Hawaiian from a simple, nutritious diet of fish, taro, breadfruit, yams and greens to one that is high in energy, fat and sugar. The change in dietary practices with urbanization and westernization seems to be a pattern which occurred in various countries of the Pacific Basin.

Two other dietary surveys have been conducted recently. However, one did not include ethnicity data and the other was done on a limited extent having been conducted only in young adults aged 18-26 years. Thus, since 1954, there have been no dietary survey data about Native Hawaiian families to determine any changes in dietary practices that may have occurred since that time.

2. Pregnant Women

Compared with other ethnic groups in Hawaii, the pregnant Native Hawaiian women have poor pregnancy outcomes. They have more fetal deaths, higher infant mortality rates and have a higher percentage of low birth weight infants. They also have a high number of teenage pregnancies. MIC data showed that compared with women in the 1970s, women in the 1980s had more elective abortions and Caesarean sections; their babies also had lower birth Apgar scores at 5 minutes (measurement of the overall condition of the neonate such as heart rate, respiration, muscle tone, reflex ability and color at delivery). Pregnant Native Hawaiian women in the 1980s also had poorer diets, more women drank alcohol at the initial interview and more had lower hemoglobin values than women in the 1970s. Thus, more women in the 1980s were at greater risk for

nutritional deficiencies and poor pregnancy outcomes than their 1970 counterparts. However, women in the 1980s were less overweight, they had access to prenatal care early in their pregnancy and they utilized more of the government programs such as Medicaid and the Supplemental Food Program for Women, Infants and Children (WIC) as compared with women in the 1970s. Thus, there were some improvements in the health and practices of pregnant Native Hawaiian women such as being less overweight, having smaller family size and earlier access to prenatal care which may be due to the use of these government programs. However, it only had a minimal impact on the mother's dietary practices and her pregnancy outcome.

3. Infants

The prevalence of breast-feeding at hospital discharge in the Native Hawaiian mother had increased from 29% in 1969 to 81.5% in 1984. However, only 52% of these Native Hawaiian mothers were exclusively breast-feeding at hospital discharge and 22% stopped breast-feeding at 8 weeks. The mothers who were most likely to discontinue breast-feeding were mix feeders. The Hawaii Milk Bank survey of 1984 indicated that Native Hawaiian women were most likely to mix feed compared with mothers from other ethnic groups. The two reasons most commonly cited for discontinuance of breast-feeding was insufficient milk and sore nipples. Health professionals from the MIC Project stated that lack of support from the hospital and family contributed to the failure to breast-feed.

MIC data in the 1980s showed that bottle-feeding has declined. The introduction of semi-solid and solid foods has shifted from 2 months in the 1970s to 4 months in the 1980s. Infants in the 1980s as compared with those in the 1970s had generally good status as

evidenced by greater lengths and weights and less anemia. Infants in the 1980s were also consuming more food compared to the infants in the 1970s and this may be due to the food supplied from the WIC Program. Overfeeding has led to more children with diets greater than 120% of the Recommended Dietary Allowance (RDA) in the 1980s than in the 1970s. However, infants in the 1980s had slightly lower head circumference (measure of brain growth) and lower Apgar scores. The significance of these trends in anthropometric findings are not known and trends can only be shown but no definite conclusions can be drawn because of the small sample size.

4. Preschool Children

Both extremes of energy malnutrition (overweight and underweight) was found in the preschool population both in the 1970s and 1980s. Native Hawaiian preschool children were taller and heavier than their Oriental counterparts. Among the children attending the WIC Program in the 1980s, 10% were above the 95th percentile of weight for height indicating overweight. On the other hand, more than 10% of Native Hawaiian children at various months had low height/age and more than 10% had low weight/height at 12-23 months and 30-35 months indicating undernutrition.

MIC data also indicated that both extremes of malnutrition was present among children in the 1970s and 1980s. It also indicated that Native Hawaiian preschool children in the 1980s were shorter and weighed less than children in the 1970s. More children in the 1980s had lengths or heights that fell below the 5th percentile of the standard compared with children in the 1970s. Due to the small sample size, only trends in anthropometric findings can be shown but no definite conclusions can be drawn. Children in the 1980s also

had better diets as compared to children in the 1970s. The better diet may be due to the provision of food from the WIC Program and other programs providing resources to families in need during the 1980s. This reinforced the need for continued nutrition education among mothers on how to feed their children using foods from the WIC Program.

5. School-age Children

Native Hawaiian school-age children were as tall as mainland United States children but were heavier than mainland and Oriental children in Hawaii. A dietary assessment of the intakes of school-age children in 1980 revealed that the Native Hawaiian elementary school children had the highest energy intake among all the other ethnic groups. They also had the greatest intake of high sugar and high fat foods. At the junior high level, they had the highest intake of sugar and second highest intake of fat and calories. At the senior level, they still ranked third highest among all others in caloric intake.

6. Adults

The Native Hawaiian adult was at greatest risk for cardiovascular disease, myocardial infarction, diabetes, hypertension, arthritis, gout and cancer of the breast, lung and stomach than adults of other ethnic groups in Hawaii.

Two nutritional factors contributory to the incidence of heart disease in the Native Hawaiian were being overweight and a diet high in energy and saturated fat. Native Hawaiian adults were taller and heavier than their Oriental counterparts and this was evident from preschool years. Their diets were generally high in energy due to large intakes of food or on some occasions, alcohol. There was also

a record of a sporadic or widely fluctuating caloric intake ranging from 1000 kcal for one day and 4000 kcal during weekends. A high percentage of calories from the diet were from fat and mostly from saturated fat.

A high fat diet has also been implicated in the incidence of prostate and breast cancers. Dietary intake studies at the Cancer Research Center of Hawaii showed that Native Hawaiians had the second highest intake of fat in the diet next to the Caucasians. Another dietary factor suspected to be a risk factor in cancer was the high concentration of mutagens in some Hawaiian foods such as dry/salted fish and kalua pig.

B. DENTAL

Prior to 1778, there was very little tooth decay in the young Native Hawaiians and it was virtually non-existent in the young child. By 1930, tooth decay was endemic in Hawaii and the majority of Native Hawaiian children had dental decay. In 1960, a survey revealed that the caries attack rate in Hawaii for the permanent teeth among children 6-14 years was one of the highest in the nation. Dental caries was identified as a serious public health problem and the most prevalent chronic disease affecting the people of Hawaii at that time. Native Hawaiian children had one of the highest DMF (decayed, missing and filled teeth) rates. Subsequent studies also showed that they have one of the highest periodontal disease rates and the poorest dental hygiene.

One of the factors attributed to the decline in dental health was a change in diet from a high starch, low refined sugar diet to a high sugar, low starch diet. Native Hawaiian children had the highest frequencies of consumption of caries-producing foods such as

sweet beverages, dessert items, snacks and candy or gum. Other foods which were found to be associated with plaque formation were sweet rolls, sweet breads, manapua (Chinese dim sum or meat and vegetable wrapped in a wheat or rice flour casing) and poi. Poi, the traditional staple food of the Hawaiians, was shown to be positively associated with the number of teeth with heavy plaque accumulation.

Another factor responsible for the high caries rate in Hawaii was the negligible fluoride content of Hawaii's civilian water supply and the repeated defeats of proposals to fluoridate it. Efforts are underway to get legislation passed for fluoridation of water supply. There are various programs in the community designed to improve dental health either through education or treatment on an individual or statewide basis, but these have had only a very minimal impact on the reduction of dental problems.

IV. RECOMMENDATIONS

A. NUTRITION

1. Nutrition Education

There is a need to help the Native Hawaiians recognize the essentials of a good diet through nutrition education. Pregnant women need to be informed of the relationship between diet and intake of alcohol and other substances to pregnancy outcome. Children need to learn how to select a balanced diet at home and in school to prevent obesity, anemia and other nutritional problems. Nutrition education should be taught in day care centers and be part of the curriculum in elementary and high schools. Adults need to be shown the benefits of a sensible dietary guideline in the prevention of chronic diseases. These guidelines include eating a variety of

foods, maintaining a desirable body weight, avoiding excessive fat, saturated fat, cholesterol, sugar and salt intake, eating foods with adequate starch and fiber, and limiting the consumption of alcohol.

2. Research

Several areas were identified in which data is lacking. These areas include the nutritional status of pregnant and lactating women, infants, preschool children and adults. No studies had been done to elucidate the relationship between the diet of a pregnant Native Hawaiian woman and her pregnancy outcome. There have been no dietary intake studies of Native Hawaiian lactating women to determine the relationship of their diet to the quality of her breast milk and her infant's nutritional status. Data on the dietary intakes of Native Hawaiian infants, preschool children and adults are outdated since they have been done in the 1970s. Thus, research needs to be done and fostered through support of research funding and facilities.

3. Nutrition Surveillance

State legislators, state and county agencies and private sectors should coordinate efforts to develop a good system of nutrition data collection, retrieval, dissemination and surveillance of the general population. State agencies should coordinate efforts to compile nutritional data according to ethnicity and use this as baseline information to monitor the nutritional status of the population and as basis for formulating nutrition policies.

4. Promotion of Breast-Feeding

Although breast-feeding has increased from 29% in 1969 to 81.5% in 1984, there remains a need to encourage women to breast-feed exclusively, where possible, and follow the 1990 Objectives for

Hawaii which states that exclusive breast-feeding should be increased to 75% at hospital discharge and 65% at 8 weeks. Health professionals in the hospital and community needs to encourage women to breast-feed. Pregnant women need to be taught the advantages of breast-feeding and how to breast-feed before delivery. Establishment of support groups in the community to help new mothers to breast-feed successfully is also needed.

5. Continued Funding of Nutrition Programs

The beneficial effects of nutrition programs especially among vulnerable groups such as pregnant women, infants and children have been documented. These programs include the MIC Project, WIC, Headstart, School Lunch, Expanded Food and Nutrition Education Program (EFNEP), Nutrition Education and Training (NET) and others. There should be continued funding of these programs since they are presently being reduced under the current federal administration. These programs should also be maintained because the Native Hawaiian population have increased their use of these programs and in some instances such as the WIC Program, they were shown to be the greatest users of this program.

6. Provision and Promotion of Native Hawaiian Cultural Food Resources

Sources of Native Hawaiian foods such as fish, taro, sweet potato and yams have decreased due to urbanization. Legislation is needed to restore these food supplies by promoting economic feasibility for farming and restoration of fishing rights. The use of traditional foods should also be encouraged among the Native Hawaiians.

B. DENTAL

1. Fluoridation of Water Supply

Efforts should be enhanced to support the fluoridation of the civilian water supply. Incentives or assistance should be offered to owners of private water systems in fluoridating their water system. Alternative methods of fluoridation such as self-applied fluoride programs should be provided to all children until they have access to fluoridated water.

2. Dental Education

Educational programs addressing oral hygiene, routine preventive dental care for caries and periodontal disease control should be made available to all families. Children in public and private schools should be educated on dental health and hygiene using methods that are geared to the Native Hawaiian population.

3. Research and Early Dental Treatment

Public and private agencies should work together to do regular surveys of the dental status of Hawaii's population, especially of children. Immediate and appropriate treatment should be provided close to the survey site at no or low cost to those without dental insurance.

4. Dental Protection in Sports

There should be maximum protection against dental injuries for all youngsters involved in competitive sports such as basketball, soccer and hockey by providing them with appropriate mouth and head guards.

THE STUDY

I. PURPOSE OF THE STUDY

The main purpose of this report of the Hawaiian Health Needs Study was to determine the nutritional and dental needs of Native Hawaiians. By assessing their needs, we would be better equipped to plan intervention programs that are particularly suited to their needs. Programs may therefore be effective in finding a solution to their nutritional and dental problems.

Three areas were selected as key indicators of the nutritional needs of Native Hawaiians. These areas were selected for their importance and availability of data and studies relating specifically to Native Hawaiians. The first area chosen was the nutritional status of pregnant and lactating women, infants and children. This choice was made because of their vulnerability to nutritional deficiencies which have lasting effects in later life. Second area was the relationship between diet and the presence of chronic diseases such as heart disease, diabetes, arthritis, gout and cancer. The relationship of obesity to the incidence of these chronic diseases was also investigated. The historical development of diet and cultural aspects as they relate to the development of these chronic diseases was also studied. Third area was dental problems because of their importance to physical health and the significant relationship of diet to dental health.

II. METHODOLOGY

Two major sources of data were used for this study. One was from a review of literature on the nutritional and dental status of Native Hawaiians, specified as Hawaiians and Part-Hawaiians.

(Note: Whenever the literature cited defines whether the population studied was Hawaiian or Part-Hawaiian, those data will be presented

by the more specific grouping).

There were several publications (1-3) on the food habits of the ancient Hawaiians and a summary of them was included to provide a frame of reference in the discussion of the overall nutritional needs of this ethnic group. Although the earliest methodical study on the dietary intake of families on Oahu was made in 1940 (4) it was not broken down into the different ethnic groups, so the results were not included. The first study on the dietary intake of families in Oahu which had a breakdown of the various ethnic groups including Native Hawaiians was published in 1954 (5). Thus, the review of the nutritional status of the Native Hawaiians started from that year. Subsequently, a published paper (6) reviewed all the nutritional status studies done in Hawaii among all the ethnic groups from 1960 to 1980. Sources of data from 1981 were collected from published papers and reports from the following sources: Special Food Supplemental Program for Women, Infants and Children (WIC) (7), Hawaii Needs Assessment Survey (8), Hawaii Mothers Milk Bank (9) and others. After the historical aspects of the diet were discussed, the review was arranged according to the nutritional problems of Native Hawaiians at various periods of life beginning from pregnancy, infancy, preschool, childhood and adulthood.

The literature review on the dental status of Native Hawaiians traced the development of dental health from ancient times (10, 11) to the modern age (5, 8, 12-14). The first study showing poor dental health in infants and children was reported in the 1930s (11); the first study with a breakdown into different ethnic groups including Native Hawaiians was done in 1940 (5). Other recent sources of data were from reports by the Hawaii State Department of

Health (13, 14), Department of Education (8) and interviews with dental health professionals regarding utilization of dental services, dental insurance coverage and dental health manpower.

The second source of data was from medical, dental and nutritional information gathered from records of patients who came to the Maternity and Infant Care Project (MIC) in Waimanalo, Oahu. The MIC Project was established as part of a national effort to prevent mental retardation and reduce infant mortality in low income, disadvantaged areas in the United States by providing comprehensive health services. It has been in existence in Waimanalo since 1966 and the predominant patient population (98%) is Native Hawaiian. Approximately 2,000 patients were seen each year of which 100 were pregnant women, 50 were infants (0-1 year of age) and the rest were children aged 1-16 years.

Two time periods were selected for data collection to provide a basis for comparison of data between the years 1970 and 1980. In each time period, one year was selected for data collection but if the number of records needed were lacking in each group, records from the preceding or succeeding year was collected. Thus, the time selected for data collection were patient visits from 1970 to 1973 and 1980 to 1982 for pregnant women; 1972 to 1973 and 1981 to 1982 for infants; and 1972 to 1973 and 1982 for preschool children (1-5 years old). In cases where records were obtained from several years, data were pooled so that trends between the two decades could be noted. The number of records abstracted for each year and the specific patient population are shown in Table 1. A total of 399 records were abstracted of which 201 were from pregnant women, 100 from infants and 98 from preschool children.

A list of Native Hawaiian patients who visited the clinic during the time period was obtained from the medical records office. Records of these patients were first checked for completeness of information and, if complete, these records were included on the list. A random sample of these records was then taken and data were obtained. Forms were designed to obtain the desired information; these were pretested until ready for use. The sample forms are shown in the Appendix. Three full-time students from the University of Hawaii were hired to collect the information.

The data obtained from the medical records included demographic information, anthropometric measurements of mother and infant, laboratory values, medical information and other risk factors which may influence pregnancy outcomes. Dietary data obtained from the nutritionist's records were dietary analysis of the 24-hour recalls, and intake of various substances such as alcohol and drugs during pregnancy. The 24-hour recalls were analyzed by using either the 1968 or 1980 Recommended Dietary Allowances (RDA) (15). Intakes or diets were rated as poor or fair if values fell below 66% of the RDA; adequate intakes were defined as greater than 66% of the RDA and excess intake was defined as greater than 120% of the RDA. In some records, the above data (demographic, anthropometric, dietary or medical) were either missing or not found, so the number of categories did not always correspond with the number of records.

Data were entered into the computer and analyzed using STAT 1, A Statistical Toolbox (16). The frequencies, means and standard deviations were calculated for the different variables. Student's t-test was applied to determine significance of differences between means (17, 18). The number and percent of women that rose above and

fell below the reference standard for height and weight based on the tables derived from the first National Health and Nutrition Examination Survey (HANES) in 1971-74 were determined (19). Total weight gain and average weight gain per week was calculated for each subject using the formula:

$$\text{Average wt. gain/wk.} = \frac{\text{wt. at last visit} - \text{wt. at initial visit}}{\text{time in wks. between final \& initial visit}}$$

For infants born to these women, lengths, weights, and head circumference were compared with the National Center for Health Statistics (NCHS) growth charts (20). Those whose weights fell below the 5th percentile were considered underweight; those who rose above the 95th percentile were considered overweight. Apgar scores which is a summary measure used to evaluate the newborn infants overall physical condition at birth was evaluated using the criteria that scores below 4 were indicative of a severely depressed status (21).

Hemoglobin and hematocrit values were compared with the standard according to Christakis (22) and Sauberlich (23).

The Waianae Coast Comprehensive Health Center (WCCHC) was the other site where limited data were collected. The Nutrition Department of the WCCHC had a total caseload of 1,300 patients of which 1,200 were WIC participants. Approximately 100 patients participated in the Department's Malama Ola Program, a clinical health education program. Of the 1,300 total patients, 900 were identified as Native Hawaiian but the total Native Hawaiian population might be underestimated. WIC regulations require that a single ethnic designation reflect the primary ethnicity of the father so that children who were Part-Hawaiian on the mother's side

were not counted. Thus, it was estimated that 100 children of Part-Hawaiian ancestry in the WIC Program were not counted. A chart audit of Native Hawaiian patients who came to the WIC Program was conducted at the WCCHC (24) during the week of October 14 to October 21, 1985. The current risk status determining their eligibility for the program were obtained from the WIC certification form for the latest certification period (past 6 months) and tabulated. For those with a diagnoses of "present regression", the initial certification period was examined. For Malama Ola clients, only the diagnosis specifically referred by the physician for intervention was recorded. In some cases, multiple diagnoses or risks have been recorded for certain individuals.

III. MAJOR FINDINGS

A. REVIEW OF LITERATURE

1. Nutrition

a. Historical/Cultural

i. Ancient Hawaiians

The ancient Hawaiians (1) were described as having fine physiques and as generally being in good health prior to their contact with foreign civilization. Ellis (2) wrote in 1823 that,

"The natives are in general rather above the middle stature, well formed, with fine muscular limbs, open countenances and features resembling these of Europeans. Their gait is graceful, and sometimes stately. The chiefs in particular are tall and stout, and their personal appearance is so much superior to that of the common people, that some have imagined them to be a distinct race. This however is not the fact; the great care taken of them in childhood and their better living,

have probably occasioned the difference".

Stewart (2), another keen observer who was in Hawaii from 1823 to 1825 states that,

"The nobles of the land are so strongly marked by their external appearance, as at all times to be easily distinguishable from the common people. They seem indeed in size and stature to be almost a distinct race. They are all large in their frame and often excessively corpulent, while the common people are scarce of the ordinary height of Europeans, and of thin rather than full habit".

This seems to indicate that the chiefly class was likely to be taller and better formed than most of the common people because an assured food supply for the chiefly class (ali'i) meant that they were never subjected to periods of hunger as were the lower classes (2).

The principal foods of the ancient Hawaiians are listed below in order of importance (2, 3). A list of foods occasionally eaten, either for variety or during famine or shorter periods of scarcity and a list of some foods forbidden for women is also given. Many of the plants and animals were utilized for non-food purposes as well.

Principal Plant Foods

Taro corm (as taro and in the form of poi)

Sweet Potato

Breadfruit

Yam

Taro leaves, stems and flowers

Loulu palm, nuts

Sweet potato leaves and tender stems

Banana (plantain or cooking bananas)

Limu (seaweed)

Coconut

Sugar cane

Mountain apple (in season)

Principal Animal Foods

Fish

Shellfish

Crustacea

Pork

Dogs

Birds and wild Fowl

Domesticated fowl

Turtle

Foods Occasionally Eaten

Cyanea, spp. (lobelia)

Ferns: stems, shoots and starchy trunks of several species

Kikawaio (*Dryopteris cyatheoides* Kaulf), several species

Kukui (*aleurites moluccana*, L.) or candlenut tree nuts,
washed and used as a relish

Noni (*Morinda Citrofolia* L.) or Indian mulberry

Pala [*Marattia douglasii* (Presl) Baker]

Popolo (*Solanum nigrum* L. or *S. nodiflorum*, Tacq) Black
nightshade)

Ti, ki root (*Cordyline terminalis*, L.)

Hapu'u, hapu'u - pulu [*Cibotium splendens* (Gaud.) Krajina]

'ama'u (*Sadleria cyatheoides* Kaulf.)

Hapu'u - i'i (*Cibotium chamissoi* Kaulf.)

Pia (*Dioscorea pentaphylla*, L.)

Papapa (*Dolichos lablab*, L.)

Nena (*Heliotropium curassavicum*, L.)

Koali - 'ai (*Ipomoea cairica*)

Hoi (*Dioscorea bulbifera*, L.)

Foods Forbidden For Women to Eat

Banana (plantain)

Coconut

Certain choice fishes

Pork

Turtle

Other Forbidden Foods

Niuhī shark

Porpoise (naia)

Whale

The ray (hihimanu)

The food of the lower classes consisted primarily of fish and such plants as yams, sweet potatoes, taro, plantains, sugar cane and breadfruit. To these, the people of higher rank added the flesh of hogs and dogs. They also ate fowl but they were not plentiful nor held in esteem by the people. The main source of energy in the diet was taro, followed by sweet potatoes, breadfruit and yams, all of which have relatively large amounts of starches and sugars but only 1-2% protein. They all were capable of being stored for use during times of less available food. Taro was the most useful food, as it was used in three ways: steamed or baked, called ai pa'a; this was mixed with water and pounded into poi; and the leaves were cooked as greens, called luau. The Hawaiians were the only Polynesians to

consume most of their taro in the form of poi. Poi was made by cooking the taro in an underground, earth oven (imu) of hot stones. This was followed by pounding the cooked corms to a smooth paste with the addition of a small amount of water. Although eaten fresh, most Hawaiians prefer poi that is 4-5 days old after fermentation has taken place and when it has an acidity approximating that of acid fruits. Sugar cane was not a routine food but was used in times of famine and as an emergency ration. Coconut was a food of minor importance to the ancient Hawaiians but played a major role in island groups south of the equator.

Fish was the main protein food for all classes of Hawaiians but its availability was influenced by phases of the moon and the weather. The fish from the ancient fish ponds were probably the property of chiefs and their families and were reserve sources of protein for times of famine in a region or area. Chickens and a few wild birds were eaten occasionally; pigs and dogs were reserved for the chiefly class. The opihi (*Cellana* spp.) or Hawaiian limpet was one of the favored shellfish of the ancient Hawaiians and available to all classes of people. This is a good source of minerals, vitamins and protein. The soft parts, which were among the first foods fed to young infants, contain a larger proportion of minerals and vitamins than the tougher foot and mantel.

The calcium and phosphorous needs of the ancient Hawaiians were met from both plant and animal sources. Taro has small amounts of these two minerals but when eaten in large quantities, they contribute a significant amount in the diet. In poi, these two minerals are well utilized and the amount of oxalic acid present does not interfere with the absorption of calcium. Taro and its

leaves also contain iron which is 90% available for absorption and utilization. Fish, shellfish and crustacea were the other good sources of calcium and phosphorous in the aboriginal diet. Limu, or seaweeds, which was eaten mostly as a relish was also a good source of calcium.

Taro and sweet potato supplied adequate amounts of thiamin and other B vitamins; taro and sweet potato tops which were the most frequently used greens also provided pro-vitamin A. Additional sources of vitamin A in the diet were whole fish, shellfish and viscera of some larger fish, and of mammals and fowl when available. The principal energy foods would have provided sufficient ascorbic acid to prevent scurvy. Vitamin D was obtained from seafoods and abundant sunshine. Thus, the diet of the ancient Hawaiians was simple and limited in variety but was of sufficiently high nutritive value to promote growth and maintain health.

ii. From 1954 to the Present

An assessment of the nutritional status of 117 families living in rural Oahu and Kona, Hawaii was made between 1938-1941 (5). Forty-eight of these families (41%) were Native Hawaiians and the remaining were Japanese and Chinese. Families were asked to keep records of their total food consumption for four consecutive weeks and this became the basis for dietary assessment. Analysis of dietary data indicated that most families had poor diets. Table 2 shows the number of diets and the percent of all family diets that were deficient in each of the 8 dietary essentials. About half of the Native Hawaiians had diets that were deficient in calories, protein, phosphorous, iron and vitamin C. Three-fourths had insufficient amounts of vitamin A and thiamin; only one Native

Hawaiian family had a calcium intake that met the recommended amount. For this group a high percentage of calories was derived from the use of taro and poi. The low calcium intake was due to low milk consumption; inadequate thiamin intake was due to extensive use of refined cereals. Table 3 shows the average number of families whose diets failed to meet the recommended amounts; the average number was 5.2 for Native Hawaiians. Figure 1 gives a graphic representation of the percentage distribution of the 4 groups of family diets among the 4 dietary classes. As shown, almost 40% of Native Hawaiians and Chinese had diets that were deficient in 7 or 8 nutrients.

No dietary studies have been done on Native Hawaiian families since 1954. However, it was frequently noted in the 1970s that the modern Native Hawaiian still like their traditional foods such as taro and poi and use them whenever possible (25). However, much of the land used for cultivation of taro is now in housing. Water rights have been lost; free access to beaches and reefs have also been cut off or are on private property. Thus, many foods such as fish, shellfish, seaweed, taro, poi, breadfruit and yams are available only in specialty markets and are expensive. Like all other ethnic groups in Hawaii the foods commonly consumed by Native Hawaiians of today are a mixture of foods and dishes adopted from other ethnic groups. For example: (25)

- Chicken with long rice has replaced chicken luau at luaus.
- Rice, bread and macaroni have replace poi, sweet potatoes and breadfruit as everyday foods.
- The use of greens as food has decreased.
- Fruit flavored drinks have replaced fruit and fruit juices.

The Native Hawaiians became part of the great snacking society with the emphasis on sweets and empty calories. Protein foods are used in large amounts at feasts. For daily use, a one to twelve ounce portion of canned corned beef in a large pot of chopped head cabbage and onion is used as a main meal for 10 or more persons. Breakfast may be bread or rice with a soft drink or well sugared coffee. For a snack, "saloon pilot" crackers broken into coffee are a favorite treat. Coffee is sweetened and evaporated milk is added in varying amounts.

A more recent study, the Hawaii Food Consumption Survey was conducted in the state of Hawaii in 1978 (26). This was done in conjunction with the Human Nutrition Information Service of the U.S. Department of Agriculture. The survey included 1,256 households and 3,086 individuals. The dietary intake data (27) were not analyzed according to ethnicity, hence, results may not reflect the dietary pattern of Native Hawaiians. This survey showed that the average percent of calories from fat was 38%; this was slightly lower than the U.S. mainland rate of 40%. The range in fat intake was from 35-40% of calories. The major sources of fat in the diet were from meat, poultry and fish with milk and grains contributing a minor part. Ninety-five percent of the population consumed grains daily; 90% ate meat, poultry and fish daily. More people ate vegetables than drank milk. Milk was consumed more by children younger than 15 years; adult consumption ranged from 50-92%. Fruits were less likely to be consumed than vegetables, and legumes were only eaten by 25% of the population. The most notable finding was that items such as coffee, tea, soft drinks and non-carbonated fruit flavored beverages made up the largest percentage of the diets of individuals

over the age of 18 years in Hawaii. More than 90% of adults over the age of 34 years reported daily consumption of these beverages. Thus, the foods consumed and the percent consumption in descending order were: grains (95%), meat, fish, poultry (90%), tea, soft drinks, coffee (90%), vegetables (74-93%), milk (50-92%), fruits (36-76%) and legumes (25%). Some trends in the dietary intakes of people living in Hawaii, such as a high sugar diet, may reflect the dietary pattern of the modern day Native Hawaiian but other aspects of the diet are not known.

The survey (27) also reported that 1/3 of adults in Hawaii were above their acceptable weight range. More men (34%) than women (29%) were above their weight range. This was a similar proportion to that reported for the total U.S. population.

A survey of the food habits and attitudes of 240 male and female young adults aged 18-26 years was done in Oahu between April, 1981 and October, 1982 (28). Thirty six students (15%) were Native Hawaiians. A 3-day food record and questionnaire to determine salt, sugar and fat intake was collected. There were no significant differences in the frequencies of use of high salt, fat and sugar items per week of Native Hawaiians compared with the other ethnic groups. Filipinos had significantly higher sugar consumption and the Japanese had a significantly lower consumption as compared with the rest of the ethnic groups.

Since 1954 there have been no comprehensive dietary surveys done on Native Hawaiian families to determine any changes that may have occurred since that time.

b. Pregnancy and Nutrition

In the state of Hawaii, the Kauai pregnancy study in 1953 was

the earliest study investigating the factors affecting pregnancy outcome (6). This broad epidemiologic approach was to determine the many conditions associated with the qualitative and quantitative outcome of pregnancy (29-32). This study was done in the whole community on the island of Kauai. All pregnant women from 4 weeks of gestation were followed throughout pregnancy, labor and delivery. The liveborn infants were followed for 2 years. Past pregnancy histories of all women were recorded. The racial breakdown of the women in the study was 35% Japanese, 23% Filipino, 19% Native Hawaiian and 14% Caucasian. The epidemiological factors found to have an effect on pregnancy outcome were order of pregnancy, age of the mother, interval of pregnancies and past reproductive performance. A retrospective study and a prospective study were made. The retrospective study showed a high incidence of early fetal deaths. The prospective study revealed that 24% of pregnancies at 4 weeks of gestation ended in loss of conceptuses. In this study, Native Hawaiians and Filipinos had the highest proportions of total births ending in early fetal death. At age 2, 40% of surviving infants had perinatal handicaps requiring special medical service.

As part of the study, a dietary survey was done of 67 women of different ethnic origins which was a subsample of the population. Results indicated (33) that only half of the women met the Recommended Dietary Allowance (RDA) for vitamins A and ascorbic acid. One-third of the subjects consumed less than half of the RDA for calcium and iron; one sixth to one seventh consumed less than 50% of the RDA for thiamin, riboflavin and ascorbic acid.

From the years 1966 to 1969, the highest infant mortality rate

in Hawaii was for mothers under 20 years of age (34). The infant mortality rate for mothers 20-34 years was 16.2/1,000 live births while for those under 20 years of age, the rate was 27.7/1,000 live births. In connection with this, a study (35) described the characteristics of young parenthood in Hawaii from 1968 to 1972. Table 4 shows the total live births by age (19 years and younger) and race of mother from 1968 to 1972. As shown in the table, there was a total of 10,170 live births to women ages 11-19 years. Native Hawaiians had 3,459 births or 34% of total births born to women 19 years and younger. This was the highest among all the ethnic groups. In the 11 to 12 year old mothers, three were Native Hawaiians and in the age group 13 to 14 years, fifty-five were Native Hawaiian women. Prematurity is highly associated with mortality and developmental problems. The number of premature infants born during these periods was also tabulated. As shown in Table 5, Native Hawaiians ranked third in the percent of premature births among women age 10-14; they ranked fifth in the number of premature infants born to women age 15-19 years. The percent of infant deaths for Native Hawaiian mothers under 20 years of age from 1968 to 1972 was 24.4/1,000 live births.

In the 1984 Statistical Report of the Department of Health (36), the infant mortality rate of mothers 20-34 years was 9.6/1,000 live births and for mothers under 20 years, the rate is 10.5/1,000 live births. Thus, there was an overall decline in infant death rates after 14 years. There was a total of 1,931 live births to women aged 19 years and below for all races. Native Hawaiians had 807 live births or 42% of total live births born to women 19 years and younger. This figure has not changed significantly from the

1970 estimate of 34% which means that close to 40% of births among women 19 years and younger were still from Native Hawaiian women.

A study (37) was conducted in 1979 to evaluate the effectiveness of the Maternity and Infant Care (MIC) Project in Hilo, Hawaii. The purpose of the study was to compare pregnancy outcome of women receiving and not receiving MIC services and to analyze confounding factors that might affect pregnancy outcome such as age of the mother, education and illegitimacy. The study population were mothers who had single births and delivered at the Hilo Hospital from 1968-1975. There was a total of 624 live births from MIC mothers and a total of 3,992 births from non-MIC mothers. In the MIC group, there was a significantly higher proportion of mothers below 19 years, more Native Hawaiian women, more subjects with a schooling of 9-11 years, and a higher proportion of illegitimate births (Tables 6 to 9). Thus, the MIC group represents a higher risk group than the non-MIC patients. The birth weight of infants from both groups of subjects were similar (Table 10). However, there was a higher proportion of infants of 33 weeks gestation or less and a higher proportion of infants 43 weeks or greater in the MIC group (Table 11). When the variables age, education and illegitimacy were controlled for in the Native Hawaiian population, the percent of low birth weight infants and low gestational age infants were lower in the MIC group (Table 12). This suggested that the group of high risk women who received comprehensive maternity services at the MIC project had comparable outcomes to a group of women of low risk. This showed the beneficial effects of an MIC project in improving pregnancy outcomes.

The neonatal death rate (infant deaths from birth to 28 days/1,000 live births), infant death rate (infant deaths from birth to 1 year of age) and percent of low birth weight infants for the state of Hawaii was analyzed for the year 1981 (38). It was shown that the fate of an infant born in Hawaii varied considerably according to the ethnicity of the mother (39). Infants born to Native Hawaiian women had higher neonatal mortality rates (Figure 2), higher infant mortality rates (Figure 3) and a higher percentage of low birth weight infants (Figure 4) than the overall state rate.

The Medical Task Force of this Study also showed recent data describing the greater risk status and poor pregnancy outcomes of Native Hawaiian women (see Medical Task Force Report).

Although several studies have been done to describe the characteristics of pregnant women and their pregnancy outcomes among the different ethnic groups in Hawaii, only 2 studies have been reported on the dietary intakes of pregnant women. The first one was in connection with the Kauai Pregnancy study in 1953 (33); the dietary intake data were not analyzed by ethnicity. The second one was conducted in 1985, but was on the dietary intakes of pregnant Filipino women (40). Thus, no studies have been made to determine the dietary intakes of pregnant Native Hawaiian women and to investigate whether these dietary patterns have an effect on their pregnancy outcome.

c. Infant Nutrition (0-1 year)

1. Dietary

Breast-Feeding Patterns

The superiority of breast milk for the infant and the mother is

well documented in the scientific literature (41). For the baby, it is the nutritionally ideal food; it is fresh and safe from bacteria, prevents infections, minimizes allergies, promotes good jaw and tooth development and leads to less overfeeding. It is also more convenient for the mother, helps her to lose weight, get back into shape more quickly and generally costs less than bottle-feeding. Breast-feeding also provides closeness between the mother and the baby.

Breast-feeding trends in the U.S. have fluctuated since the early 1900s. The practice of breast feeding decreased from nearly 100% early in the 1900s to approximately 22% in 1972 (42-44). From 1972 to 1980, a marked increase in the prevalence of breast-feeding has occurred. In a national study done in 1981 to determine the extent of breast-feeding, it was revealed that 57.6% of infants were breastfed in the hospital (45).

In Hawaii, a retrospective study was made in 1969 to determine the infant feeding practices of low and middle income families (46, 47). The low income group was comprised of families which qualified for food stamps and clinic services of the Hawaii State Department of Health. The total sample consisted of 2 and 3 year old children, 147 of which were from the low income group and 134 were from the middle income group. The predominant ethnic background of mothers from the low income group was mostly Part-Hawaiian. Only 25% of total mothers sampled were completely breast-feeding and 11% were partly breast-feeding. Sixty percent of mothers terminated breast-feeding before 3 months and by 6 months, 80% of mothers terminated breast-feeding. Fewer lower income mothers (1/5) tended to breast feed as compared to mothers from the middle income group

(1/3). Twenty nine percent of Native Hawaiian women breast-fed at hospital discharge. The prevalence of breast-feeding was more related to the mother's education rather than to her socioeconomic status or ethnicity.

In 1984, a survey was initiated by the Hawaii Mother's Milk Bank to determine the extent of breast-feeding on Oahu (9). A questionnaire was sent to 1,600 mothers who had given birth from March 1983 to March 1984. Five hundred sixty women responded, of which 20.3% were Native Hawaiians (Table 13). The percent response was consistent with the number of Native Hawaiians who gave birth in 1983. Overall results indicated that 57.7% of mothers were exclusively breast-feeding and 23.5% were partially breast-feeding at hospital discharge. At 8 weeks, only 50% of mothers were exclusively breast-feeding. At six months of age, only 30% of Hawaii's babies were receiving breast milk. Table 14 shows that for Native Hawaiians, 52.6% were completely breast-feeding at hospital discharge and 28.9% were partially breast-feeding. This shows an overall rate in breast-feeding of 81.5%. This was an improvement from the studies in 1969 (46, 47) which reported a 29% rate of breast-feeding at hospital discharge for Native Hawaiian women.

Data (9) also indicated that 22% of Native Hawaiian women stopped breast-feeding before 8 weeks. This were mostly women who were partially breast-feeding or were mixed feeding. Compared with mothers from other ethnic groups, Native Hawaiian women were more likely to mix feed. Mixed feeding leads to problems in breast-feeding as it adversely affects the establishment of the milk supply (41). The Hawaii Mother's Milk Bank survey (9) also indicated that insufficient milk and sore nipples were the most common reasons

cited for the discontinuance of breast-feeding. Health professionals from the MIC Project stated that lack of support from the hospital and family contributed to the failure to continue breast-feeding.

Bottle-Feeding and Introduction of Semi-Solid and Solid Foods

The above cited survey of 1969 (46, 47) revealed that 1/3 to 1/2 of Hawaii mothers were giving specially prepared formulas, and that this practice was more prevalent among the low income mothers. Most babies were started on formulas in-Honolulu hospitals and mothers were also provided a supply on hospital discharge so they probably assumed that the formula was the preferred method of infant feeding. Health workers and some island cultural groups also believe that special formulas are high status foods, that infants are highly prized and should be given special care. Thus, the giving of the formula was looked upon as a way of providing special care and love for the child. Evaporated cow's milk was the next most popular formula. The feeding of fresh cow's milk prior to 4 or 6 months of age was rare. The amount of milk consumed by the infants increased from birth to 6 months of age and then declined as more solid foods were added to the diet.

The time at which solid foods were introduced and the type of food varied considerably. Feeding of cereals and other semi-solid/solid foods during the first month of life was rare. By the second month, 1/3 to 1/2 of infants were getting cereals, fruit or fruit juice and vegetable-meat combinations. By six months, meat and eggs were fed. Commercial baby foods were used almost exclusively. Mothers of Hawaiian ancestry favored feeding meat and poi at an earlier age than mothers of other ethnic groups (46). It

was commonly used as a substitute for cereal for allergic infants, and many pediatricians favor poi as an infant cereal because of its hypoallergenic properties (48). The iron content of poi does not compare favorably with enriched infant cereal. The availability of poi has also decreased steadily due to urbanization, so that commercially prepared poi is an expensive item. Hence, the continued use of poi by the Native Hawaiian population is due to preference and tradition. Rural Hawaiians tend to feed infants very early the same foods served to the family, and it is not uncommon for the mother to prechew foods to form a suitable consistency for ingestion by the infant. Vitamin and iron supplementation was nil for both low and middle income mothers. Very few low income women gave supplements to their infants. Thus, the increased use of artificial feeding especially the use of commercial formulas and early introduction of semi-solid and solid foods among infants in Hawaii in 1970 closely followed the national trend.

Another survey in the 1970s was made by Hughes-Ho and Brown (49) to determine the adequacy of diet and food sources of 52 Honolulu infants coming from low income families and attending two well baby clinics in Honolulu. The infant's ages ranged from three weeks to 10 months. Among the 52 women who participated in the survey, half of them were Part-Hawaiian in origin. However, dietary intake data from the different ethnic groups were not analyzed separately but were pooled together and reported as mean intakes of calories and the different nutrients for 3 age categories namely, under 4 months, 4 to 6 months and over 6 months. There was an overall increase in nutrient intakes between the less than 4 months and the 4-6 month categories as anticipated; but there was a

decrease in total nutrient intake for infants over six months of age. Results also indicated that, with the exception of iron, nutrient intakes met at least 2/3 of the recommended allowances for most infants, and intakes of protein were well above recommended levels. Iron intakes of slightly more than half of the infants were below 50% of the allowances for their respective age groups. Iron supplements provided by the clinic were not always given in the prescribed dosage, or often not at all. Sodium intakes were above the requirement for growth; in many instances infants consumed amounts of sodium which approached or exceeded suggested maximum levels.

d. Preschool Nutrition (1-6 years)

i. Dietary

Children 2 to 3 years old in the above study (46, 47) appear to be less well fed than infants. Diets of low income children contained less milk and citrus fruits and more cereal grain than the middle income group. Consumption of eggs, green and yellow vegetables and citrus fruits were low in both groups. Low income children had lower intakes of calcium, riboflavin, vitamin A and C (50). This was due to the low consumption of milk, leafy greens and citrus products. Table 15 shows the data on nutrient intake of low and middle income Native Hawaiian and middle income Japanese children. Energy, iron and niacin intakes of Native Hawaiian children tended to be higher than those of Japanese children. Differences in caloric intakes may be due to size. Native Hawaiian children were taller and heavier than Japanese children (51, 52). Energy and asorbic acid intakes were lower among low income Native Hawaiian children than among middle income Native Hawaiian children.

Energy intakes of low income Native Hawaiian children were similar to those of Japanese children. Four percent of low income children had hemoglobin (Hb) levels below 10g/100ml; only 1% had hematocrit levels below 30%. Thus, the incidence of anemia was lower than the United States mainland children (47, 50).

In another study, the typical dietary pattern of the 2-3 year old was shown to consist of American foods for breakfast and lunch (53) and ethnic foods for dinner or snacks. Soy sauce and soybean curd (tofu) were widely used in cooked dishes and as snacks. Combinations of meat and vegetables were common among all ethnic groups. Certain Oriental snack foods such as preserved seeds, sushi, dried squid and others were popular and were introduced by the sixth month of life. Poi remains preferred and widely consumed after infancy by families of Native Hawaiian ancestry.

11. Anthropometry

Anthropometry is an important component in the assessment of nutritional status. It includes measurement of height, weight, arm muscle circumference and skinfold thickness. Height and weight are measures of physical growth; arm muscle circumference is a measure of muscle stores; triceps skinfold is a measure of fat stores.

A physical examination of 553 children and youth from families in Oahu and Kona was done in 1938-1941 (5). Forty six percent (256) were Native Hawaiians, forty eight percent (267) were Japanese and 2% (27) were Chinese. Results indicated that Native Hawaiian children were taller and heavier than Japanese children. Sixty seven percent of Native Hawaiian children were classified as being of good nutritional status.

Eight body measurements of 281 two and three year old healthy

preschool children were conducted in Honolulu between November 1966 to June 1967 (51, 52). The age and ethnic background of the study population is shown in Table 16. One hundred eighteen children were Native Hawaiian. The measurements included weight, height, recumbent length, trunk length, mid upper arm circumference (MAC), triceps, biceps and subscapular skinfolds. Males were significantly heavier than females and significantly longer in total body measurements. Trunk length was not significantly different suggesting that the body length differences between the sexes were due to a difference in leg length. Native Hawaiian children were significantly taller on standing height and total recumbent length as compared with Japanese children (Table 17). These groups were not significantly different in trunk length indicating that body length differences were due to leg length. Malnutrition or the presence of infection could not explain the short stature of Japanese children. Thus, hereditary factors are important determinants in the growth of children even in a relatively well-nourished population.

There were no significant differences in MAC, and skinfold thickness between the sexes and ethnic groups. There were also no significant differences in any of the body measurements between the low and middle income group suggesting that the nutritional status of both groups were comparable. According to the Fels standard, Honolulu children were short for their age. Twenty-six percent of the children were below the 5th percentile for height for age. This was probably due to a high percentage of Oriental subjects in the sample population. On the basis of the skinfold thickness, it was estimated that 3/4 of the children appear normal, 10-20% may be

considered lean and 5-10% might be considered fat.

In 1973, the Center for Disease Control (CDC) began working with various states to develop a system for continuously monitoring the nutritional status of a specific high risk population group. This system was based upon utilization of readily available data from selected health service delivery systems (54). These nutrition related data is useful in program planning and evaluation. Subsequent to that, data from children (birth to 9 years) in various states were submitted to the Pediatric Nutrition Surveillance system coordinated by CDC. These children were part of the WIC Program, Headstart, Early and Periodic Screening, Diagnosis and Treatment (EPSDT), Maternal and Child Health (MCH) and various other programs. Data included demographic information such as race, age, sex and measurements of height, weight, hemoglobin and hematocrit values. The data tabulated represent the initial screening examination at the time the child entered the nutrition program or health center. Data were compared with a reference population for height, weight, hemoglobin and hematocrit values. The Hawaii WIC Program of the State Department of Health sent data to CDC beginning in 1982. Figures 5-9 represents a summary of some of the data submitted to CDC from January 1982 to February 1984 (7). Figure 5 shows that WIC services were utilized by age groups less than 6 months to 60 months (5 years), with the less than 6 months age group as the predominant user. Figure 6 shows that the Hawaiians used the WIC Program more than any of the other ethnic groups with 43% utilizing the services. Figure 7 shows the prevalence of anthropometry risk by ethnicity. A height for age (ht/age) of less than the 5th percentile was a sign of undernutrition; a weight for height (wt/ht) greater than the 95th

percentile indicates obesity. Approximately 20% of Native Hawaiians were below the 5th percentile for ht/age using NCHS standards (20). This signified the third highest as compared with Caucasians and Filipinos. Native Hawaiians ranked second in the percentage of subjects (10%) with wt/ht greater than the 95th percentile. Figure 8 represented the prevalence of low ht/age for Native Hawaiians. More than 10% were of low ht/age from less than 6 months to 47 months. At 36-41 months and 18-23 months, more than 25% were of low ht/age. Only the Filipino population outranked the Native Hawaiian in having more than 30% of the population of low ht/age between 6 to 35 months. Figure 9 shows the prevalence of low wt/ht for the Native Hawaiians. Low wt/ht was evident from 6 months up to 47 months. Approximately 10% had low wt/ht at ages 12-23 months and 30-35 months. Again, only the Filipino population outranked the Native Hawaiian in having more than 15% of the population with low wt/ht in the age group 12-23 months.

e. School-Age Nutrition (6-16 years)

1. Dietary

As part of the Hawaii State Plan for Nutrition Education and Training, an assessment was done to provide data for use in developing and improving nutrition education in Hawaii (8). The nutritional quality of diets of 890 students at ages 10, 13 and 16 at grade levels, elementary (grade 5), junior high (grade 8) and senior high (grade 11) were collected by means of a 24 hour dietary recall. The ethnic distribution of the students who participated in the study is shown in Table 18. Twenty-six percent of elementary children, 22% of junior high and 22% of senior high students were Native Hawaiians. Diet recalls were compared with the 1980 RDA and

recommendations of the U.S. Senate Select Committee on Nutrition.

There were variation among ethnic groups for many of the nutrients (55). Table 19 shows the mean intake of elementary school children by ethnicity. Native Hawaiians had the highest mean caloric intake among all ethnicities. They also had the greatest intake of high sugar foods and a high mean fat intake. They were third highest in the percent of calories contributed by fat to the total diet (Table 20). Only thiamin intake was below the RDA; sodium intake greatly exceeded recommended amounts.

The junior high Native Hawaiians had the second highest mean intake of fat and energy; they were the champion high sugar food consumers (Table 21). Their proportion of calories from fat, carbohydrates and protein were similar to that of the elementary school Native Hawaiians and other ethnic groups (Table 22). Calcium and iron intakes were below the RDA. At the senior high level, Native Hawaiians no longer accounted for the highest caloric intake but were still the third highest among all others (Table 23). The proportion of calories from protein, carbohydrate and fat was similar at the senior high grades and for all the ethnic groups (Table 24). Calcium and iron intakes were below the RDA.

Caloric intakes of Native Hawaiians from the lower to upper grades decreased proportionately when compared with the other ethnic groups. However, the proportions of protein (15%), fat (40%) and carbohydrate (50%) remained the same. The proportion of protein calories was within the suggested values; fat should be 30% of calories and carbohydrates, 60% of calories. Two goals in preventive nutrition are to reduce the total fat in the diet and to increase the intake of complex carbohydrates and reduce total sugar

consumption. Calcium and iron were the other nutrients consumed in amounts consistently below the RDA in the upper grades.

11. Anthropometry

Height, weight and measurements of triceps skinfold (TSK) and mid-upper arm circumference (MAC) were made of 14,166 children aged 5-15 years (grades kindergarten to ninth grade) attending public and private schools on five islands in Hawaii (56). The children were of 7 different racial backgrounds including Native Hawaiians which constituted 11.19% of the survey population (Table 25).

Average heights are shown in Table 26 for all the ethnic groups. Stature or height in percentiles for Native Hawaiian females and males are shown in Tables 27 and 28. Growth in height of Native Hawaiian children and Caucasians matched that of U.S. mainland children sampled by the National Center for Health Statistics (20). Samoan children were taller than Native Hawaiian children at all ages. Chinese children reached parity in height with Native Hawaiian children by 15 years of age. Native Hawaiian children were marginally taller than Japanese, Filipino, Chinese and Korean children.

Average weights are displayed in Table 29. Weights by percentiles for Native Hawaiian females and males are given in Tables 30 and 31. Native Hawaiian and Caucasian children were somewhat heavier than mainland children. There was little difference in weight between Native Hawaiian and Caucasian children. Samoans were significantly heavier than Native Hawaiian children. Tables 32 and 33 show the weight for length index (WLI) averaged by percentiles for Native Hawaiian female and male children. The WLI can be used to assess whether a child is fatter or thinner than

usual for a child of that sex, age and background.

Table 34 represents an abbreviated comparison between the TSK in Hawaii at the 50th percentile and on the U.S. mainland. TSK in percentile for the Native Hawaiian children is given on Tables 35 and 36. The TSK of girls were significantly greater than those for boys at all ages. For both sexes, there was an initial steady, slow increase of TSK with age. There was also a small, but early and even, drop-off of values at the onset of adolescence. This occurred between 12-13 years for boys and between 10-11 years for girls.

Table 37 shows the 50% percentile values for MAC for Hawaii and U.S. mainland children. Percentile values for Native Hawaiian children are found in Tables 38 and 39. MAC of Native Hawaiian children like the rest of the other ethnic groups were indistinguishable from those of mainland children.

In summary, Native Hawaiian children have achieved a height that is as great as the mainland children; however, their weights were slightly greater. They had similar height and weights as Caucasian children in Hawaii. They were also taller and heavier than the Japanese, Filipino, Chinese and Korean children. Samoans were the heaviest and the tallest among all the ethnic groups including the U.S. mainland children. There were few differences in TSK and MAC between the Hawaii children and U.S. mainland children.

f. Adult Nutrition

1. Heart and Vascular Disease

In 1957, research efforts in the field of cardiovascular and renal disease was initiated by the Hawaii Heart Association and the State Health Department with the assistance of the U.S. Public Health Service (57). Certificates received in the State Office of

vital statistics for deaths during the period 1949 to 1956 where the underlying cause of death was due to cardiovascular renal disease (CVR) and where the deceased was within the age limit of 35 to 74 years were studied. Approximately 6,782 certificates qualified for the study. Table 40 gives the major racial groups of Hawaii according to the 1950 census and percentages reported with mixed ancestry. These percentages of the age group 35-74 years to which this report was confined would be less. The bulk of CVR in Hawaii fall into 3 categories: coronary heart disease, hypertension with or without heart disease and cerebrovascular diseases. The age adjusted CVR rate for Hawaii males was 27% lower than U.S. mainland rates, and Hawaii female rates were slightly higher than those for their mainland counterparts. The CVR age adjusted rates for the Native Hawaiians (Polynesians) were higher than for any other ethnic group (Figures 10 and 11); rates for all other ethnic groups were 45% lower. Compared with U.S. mainland rates, these were 25% lower for men and 50% lower for women. For hypertension, the Native Hawaiian rates were more than three times higher than mainland rates; for renal disease, the Polynesian rates were more than twice as great.

The hospital records of all Native Hawaiian and Japanese males aged 35-64 in the island of Oahu who had been hospitalized with acute myocardial infection (MI) between 1955 to 1964 were investigated (58). A total of 505 cases were discovered; 173 of these were in Native Hawaiian men. The incidence of MI in Native Hawaiian males was higher than in the Japanese males and was higher in the Hawaiian than in the Part-Hawaiian males. Hospital mortality rates after an acute MI was higher in Native Hawaiians than in the

Japanese and higher in Hawaiians than in Part-Hawaiians. Both the Hawaiian and Part-Hawaiian and Japanese males who suffered acute MI had a higher prevalence of clinical diabetes than the general populations. The incidence with MI has increased in Japanese males, between 1955-1965 but a similar pattern has not been noted in Native Hawaiians.

A study (59) conducted in a group of 254 patients with acute MI who were admitted to the Kaiser Foundation Hospital in Honolulu from 1959-1967 showed that Caucasians accounted for 63.7% of the MI patients, followed by Part-Hawaiian (13.6%), Japanese (9.5%) and Chinese (4.1%). The purpose of the investigation was to assess the long-term effects of the follow-up care of MI patients.

The Hawaii cardiovascular study was initiated in 1962 as a retrospective study of cases of coronary heart disease to evaluate the reasons for the difference in CHD rates between Hawaiians and Japanese. A study was conducted in 1963 on 30 Hawaiian males living in an isolated island of Niihau (60) to evaluate the reasons for these differences. This number represents 50% of the adult males on the island and the inhabitants of the island are nearly all of Hawaiian ethnicity. The height, weight, blood pressure, subscapular skinfold thickness and upper arm muscle circumference of these men with ages ranging from 22-64 years were taken by a team of 5 physicians. Laboratory values obtained were for serum cholesterol, triglycerides, uric acid and hematocrit. A three day diet record representing dietary intakes for 2 weekdays and 1 weekend day was provided by 26 of the subjects. A review of the State Health Department death certificates revealed that 14 Niihauans died between 1954-1963 and 9 of these deaths were due to cardiovascular

causes (60). Seven subjects gave a history of diabetes mellitus. At least 8 diabetics were found among the 60 males and this indicated a prevalence of diabetes of at least 12%.

Table 41 gives the mean cardiovascular, metabolic and anthropometric values of the subjects by 10 year age grouping. The mean weight/height index of 2.83 was very high for a population mean indicating overweight. The index was highest between the ages 35-44 years. The mean cholesterol level was 30-40% lower than in most population having a high prevalence of coronary heart disease. Serum uric acid was normal. Hematocrit values were elevated; serum triglyceride levels were abnormally high in 9 subjects and blood pressure was moderately elevated with a tendency to rise during the ages of 45-54 years. Dietary intake showed a mean of 2,072 kcal/day (Table 42) with a wide range of average daily caloric intake in some subjects reporting 1,000 kcal/day on one day and intakes of 2,000-2,500 kcal the next day. The percent of calories from fat was only 28.5% (9.6% derived from saturated fatty acids, 7.3% from polyunsaturated fatty acids (PUFA) and 11.6% from monounsaturated fatty acid, oleic acid). The intake of PUFA was high due to the significant consumption of fish. Average cholesterol intake of the diet was lower than in the U.S. mainland. No calories from alcohol were reported. The dietary intakes of the Niihauans were described to be of meager variety, resembling that of the ancient Hawaiian only to the degree that poi and fish were consumed daily as staples. Poi was transported from the neighboring island of Kauai as were supplies of ham, rice, sugar, canned milk, corned beef and soda crackers. Due to the lack of water, there were very few island grown fruits and vegetables. In addition to cattle, a small number

of sheep were raised for food.

Another study was done to examine differences in suspected risk factors between Native Hawaiians and Japanese. This was done in a population consisting of 68 Japanese and 42 Native Hawaiian men on Oahu who were hospitalized for myocardial infarction when they were aged 35-64 years between 1955 and 1964 (61). A group of age, sex and race matched hospital controls were chosen to provide a group similar to the cases in that they were hospitalized but were free of detectable heart disease. A second control group was chosen (population control) which would be a representative of the general population matched by sex, age and race of the cases. Anthropometric values, serum lipids, serum triglycerides, plasma glucose, hematocrit, blood pressure and various ecologic factors known or suspected to be high risk factors in the genesis of cardiovascular heart disease (CHD) were determined. Nutrition history was taken by keeping a diary of intake for 2 weekdays and one weekend. In most instances there was no difference in the results obtained for the hospital and population controls so that the data were pooled together. Results as indicated in Table 43 showed that the Native Hawaiian cases and controls were taller and heavier than the Japanese men. Bulk index (weight in grams/[height in centimeters]²) which is an expression of overweight, was higher in the Native Hawaiian men. Native Hawaiians also had a much thicker subscapular and triceps skinfold indicating that the cause for overweight was due to increased adipose tissue stores. There was no difference in the serum cholesterol concentration between the 2 groups of subjects. However, Native Hawaiians had somewhat higher serum triglyceride levels than the Japanese. Native Hawaiian

controls had a higher average diastolic blood pressure which was related to their overweight. Native Hawaiian cases also had a higher work history index showing that they were engaged in heavier work over their working lives and presumably expended more physical energy in this work. There was also a slightly higher percent of Native Hawaiian cases with a history of diabetes. Of the well-established CHD risk factors, overweight, carbohydrate intolerance and hypertension seem to relate most closely to the high disease rates in Native Hawaiian men.

The effect of diet as a risk factor for CHD was reported in a separate paper (62). Table 44 shows the average daily caloric intake and average daily intakes of protein, fats, carbohydrates, alcohol and fiber. As shown, Native Hawaiians reported slightly higher caloric intakes than their Japanese counterparts. The percent of calories derived from protein were similar for both groups but the Native Hawaiians consumed significantly more energy in the form of fat (35%) than the Japanese (31%). The Native Hawaiians consumed more cholesterol and a higher percentage of fat as saturated fat (Table 45). They also consumed more oleic and less linoleic acid so that the saturated fatty acid/PUFA ratio was higher for them than for the Japanese. The Native Hawaiians consumed significantly lower proportions of carbohydrate (43-46%) than the Japanese (48.6%-50%) (Table 44). They also consumed less fiber, less sucrose and fructose (Table 46) and caffeine (Table 47) than their Japanese counterparts. Native Hawaiian cases and controls consumed more alcohol. An examination of individual dietary intakes revealed that a greater percent of Native Hawaiians had very high caloric intakes and had a history of higher alcohol intakes. They

also had a pattern of a widely fluctuating caloric intake (modified feast or famine pattern); some consumed a large amount of beer on weekends. Seven of 126 Native Hawaiians reported caloric intakes exceeding 4,000 kcal per day. The dietary factors that may contribute to the diabetes, carbohydrate intolerance and obesity in Native Hawaiians are -

- 1) a history of sporadic heavy caloric intake either from total nutrients or, on occasion, from alcohol.
- 2) a greater day to day variation in daily caloric intake which could induce the process of adaptive hyperlipogenesis and give rise to carbohydrate intolerance.
- 3) a higher saturated fat and total fat intake.

Certain ecologic factors such as cigarette smoking, diet, stress and physical activity were also examined to determine which of these factors were related to age at time of examination and to CHD risk status (63). The analysis included comparison of nutrient intakes between young and older men and between control subjects at low versus high risk status. Six items (calories, fat, protein, unsaturated fatty acids, cholesterol and caffeine) were consumed in greater amounts by Native Hawaiian controls aged 35-44 than those age 55-64. Fiber was consumed in larger amounts by older Native Hawaiian controls. The principal ecologic factors which appear related to CHD for the Native Hawaiians were cigarette smoking, cholesterol and linoleic acid intakes (negatively related), saturated fat intake, stress and a greater body surface area.

In view of the relation of hyperuricemia to heart disease, obesity and diabetes, a study was undertaken to determine the uric

acid levels in the pure Hawaiian population (64). Previous studies (65) have described hyperuricemia in the Maori of New Zealand, a South Pacific Polynesian group. Forty-nine Hawaiians (11 from the Hawaii State Hospital, 28 from Niihau and 10 from Queens Hospital), age 22-72 years were recruited for the study. Anthropometric values were taken and blood was withdrawn for uric acid, cholesterol and triglyceride measurement. Results from Table 48 indicated that the Hawaiians were as tall, heavy and obese as the Maori but their serum uric acid was lower than in the Maori. Therefore, there was little correlation between body size, uric acid and serum lipids in the Hawaiian.

Serum cholesterol concentrations were measured in samples from Hawaii residents of Caucasian, Chinese, Filipino, Native Hawaiian, Japanese or mixed descent (66). Table 49 shows the serum cholesterol analyses for Honolulu men by ethnic and age groups. The serum cholesterol levels of the different ethnic groups were essentially the same with some exceptions. Native Hawaiians had the second highest cholesterol level in the age group 20-39 years but this was not statistically significant. Table 50 shows that Native Hawaiians had a significantly higher level of serum cholesterol compared with the Filipinos at age 50-59 years. These results were consistent with the view that race is of negligible influence in determining serum cholesterol concentrations, whereas environmental factors are of great influence.

Obesity, although not a chronic disease, is often associated with the incidence of coronary heart disease, diabetes, arthritis, gout and others. Besides the studies cited (60, 61, 64) which showed the prevalence of obesity among the Native Hawaiians, one

other study documented the existence of obesity among the Native Hawaiians. This was performed in 1970 on 1,171 Honolulu policemen and firemen to determine the extent of overweight or obesity (67). Overweight was defined as weight in excess of a standard of height and weight. Obesity was measured by estimation of body fat using measurements of body skinfolds. The heights, weights and triceps skinfold of 619 firemen and 552 policemen were measured during the 1968 annual examination (Table 51). According to the height-weight standard a large proportion of men were overweight; only a small percentage were classified as obese (Table 52). Policemen were taller, heavier and had larger triceps skinfolds than the firemen. Classification into the ethnic groups indicated that more Native Hawaiians and Caucasians were overweight and obese than Orientals (Table 51). This difference remained even after the ethnic groups were classified by occupation. The ethnic factor, therefore, could not explain why policemen were more obese than firemen. A study of a subsample of men hired between 1962 and 1968 showed that the difference in weight between policemen and firemen occurred after the men entered the service. Once policemen were admitted, their mean weight increased more than that of firemen. It was shown (in Table 53) that Native Hawaiians gained significantly more weight than the Orientals. The Native Hawaiian and Caucasian policemen gained more weight than the corresponding Native Hawaiian and Caucasian firemen.

A study was done to investigate the relationship between ethnicity and blood pressure among 240 male and female young adults (aged 19-26) from six ethnic groups in Hawaii (68). Body weights, electrolyte excretion which may be taken as an estimate of sodium

intake and blood pressures were obtained from the subjects. Fifteen percent of subjects (31) were Native Hawaiians. No significant difference was shown for body weights, heights for Quetelet's Index (QI) which is a reflection of body fatness (Table 54). However, there is a tendency for Native Hawaiians and Caucasians to be taller and heavier than their Oriental counterparts. Both systolic and diastolic pressures were significantly higher in males than in females. Significantly increased diastolic pressures were found in both men and women of Native Hawaiian ancestry (Table 55) and women of Chinese origin. Dietary intakes including salt consumption was determined and there was no significant difference among the ethnic groups in salt intake (28).

More recently, the Molokai Heart Study (69) was proposed and is presently being conducted to examine the patterns of blood pressure, salt intake and other cardiovascular risk factors in Native Hawaiians. It will test the hypothesis that differences in blood pressure between populations are strongly correlated with differences in sodium intake, that there is an inverse correlation of blood pressure with potassium intake and there is a positive correlation with the Na/K intake ratio. A census on Hawaiian Home Lands will be conducted to identify all eligible adults. All adults (over 18 years) will be asked to complete a questionnaire of their medical history and have their blood pressure and weight measured. In the 20-59 years, a random sample of 250 individuals will be asked to collect 24-hour urine samples and blood will be drawn. Urine samples will be analyzed and descriptive information on blood pressure, salt intake and other variables by age and sex will be tabulated for the Native Hawaiian population. Data gathered on the

ethnic mix or percentage of Hawaiian ancestry will be tabulated to determine if there are increased risk factors with increasing percent of Hawaiian ancestry. Data from this study will also be pooled from other 20 sites around the world as part of the International Study of Electrolytes and Hypertension, a cooperative project sponsored by the International Society and Federation of Cardiology and the World Health Organization. This study is an important one for Hawaii since it will be a population-based data on cardiovascular risk factors on Native Hawaiians which is adjusted and correlated with possible confounding factors. It will also help in elucidating the relationship between salt intake and high blood pressure.

ii. Diabetes, Arthritis and Gout

In order to discover possible ethnic differences with respect to the prevalence of diabetes mellitus, blood samples were secured from 38,103 employed persons (70). The sample, taken from a finger, 2-1/2 hours after a meal containing at least 50 grams of carbohydrate was tested by an instrument which automatically determines whether the concentration of glucose is above or below 130 mg/100 ml. Those whose blood glucose was elevated were referred to their physicians for further diagnostic study. The age-adjusted prevalence of diabetes was 18.4/1,000. The rate for unmixed Hawaiians was six times that for persons classified as Caucasian (Figure 12). Part-Hawaiians showed a rate much lower than pure Hawaiians. Table 56 shows that the diluting factor is overwhelmingly Caucasian, Chinese or both; and these two have lower than average prevalences. Another reason for the difference was the age distribution: the Part-Hawaiians were younger than the total

participating group, while the Hawaiians were definitely older.

Data were obtained from the Health Surveillance Program of the State Department of Health to determine the incidence of diabetes, arthritis and gout among the population in the state of Hawaii (71). The data were derived from the Hawaii Health Survey for the period 1974-76. Information from these surveys were collected by means of interviews conducted by trained interviewers using standardized questionnaires. Diabetes was most abundant on the island of Oahu. Increased frequency of diabetes was associated with those whose age was over 45, resided in a rural area, if the respondent was a woman, or if they came from a lower income family. Among the various ethnic groups, diabetes appeared to be more common among persons of Hawaiian extraction (Table 57). There was also an ethnic association with the perception of varying levels of disability caused by diabetes. People of Hawaiian extraction perceived diabetes to have little effect on their daily activities whereas the Filipinos appear to perceive diabetes as having a detrimental effect (Table 58).

The prevalence of gout and arthritis also varied with age, sex and ethnicity. Arthritis and gout was also highest in the island of Oahu. Arthritis was more common in women whereas gout was more often found in men. Native Hawaiians and Caucasians appeared to be more susceptible to arthritis than did Asians (Table 59). Native Hawaiian, Chinese and Filipino males had a higher frequency of gout than Caucasians (Table 60).

Although some studies have been done to determine the incidence of these chronic diseases among the various ethnic groups, the authors did not encounter any studies that attempted to

relate diet to the incidence of these diseases.

iii. Cancer

Epidemiologic studies and experimental research suggest that dietary factors are commonly related to major types of cancer (72). Diet is most likely involved in the etiology of several major cancers including stomach, colon, breast and others. Food items may contain natural carcinogens that irritate body tissues such as the gastro-intestinal tract. Food additives such as nitrite may be carcinogenic. Furthermore, studies suggest that some nutrients may be carcinogenic and others protective. Increased calories, fat and some trace elements may produce tumors in rats. Conversely some vitamins such as A, C and E function as antioxidants and may prevent tumors when the body is exposed to carcinogens. Diet may also alter the internal environment of the body, resulting in increased exposure to carcinogens or increased susceptibility to cancer. For example, dietary fat may alter the bacterial composition of the GI tract and thus affect metabolites, rendering them carcinogenic.

Hawaii provides a useful geographic area for epidemiologic studies because the population includes a variety of ethnic groups living in a common physical environment. These groups, who tend to retain many of their cultural practices, reveal variation in cancer incidence patterns. As shown in Figure 13, the age adjusted incidence rate for breast cancer during the 5 year period 1973-77 is highest among the Native Hawaiians and Caucasians and lowest for Filipinos. Figure 14 reveals that among males, the age adjusted incidence rate for stomach cancer is highest among Native Hawaiians, followed by the Japanese. For colon cancer rates, the incidence among Chinese males is twice that of Native Hawaiian males (Figure

15). Another site which may have dietary implications is the lung cancer. Incidence is highest in Native Hawaiians, followed by Caucasians with the lowest rate among the Filipinos.

In 1977-79, a representative sample of 4,657 adults, 45 years and over from five main ethnic groups (Caucasian, Japanese, Chinese, Filipino and Native Hawaiian) were interviewed regarding their diet by researchers at the Cancer Center of Hawaii (73). Of the total male population, 9.1% were Native Hawaiian and of the total female population, 11.8% were Native Hawaiian. Quantitative food consumption histories were obtained from which average daily intakes of fat, protein, carbohydrate, and vitamins A and C were calculated. A protocol was developed to obtain the usual intakes of 83 food items or groups consumed during a seven-day period. Analysis of food intake revealed considerable variation among the ethnic groups in food and nutrient intakes. Table 61 shows the mean food and nutrient intakes for selected components of the diet (74) for the five major ethnic groups in Hawaii. The Native Hawaiian males and females have the second highest intake of fat in the diet next to the Caucasians. Total protein intake of Native Hawaiian male was high and comparable to the Caucasian male; the Native Hawaiian female was third highest in protein intake among all the ethnic groups. A multiple regression analysis with sex as a controlled variable was done to assess the relationship between the ethnic-sex specific dietary intakes and corresponding population based cancer incidence rates at 15 selected sites. There was a significant positive association in six of the cancer sites: breast cancer with fat (total, saturated, unsaturated and animal) and animal protein; endometrial cancer with the same components as breast cancer;

prostate cancer with fat (saturated and animal) and protein (total, animal); and stomach cancer with fat (fish only) and protein (fish only); and lung and laryngeal cancer with cholesterol. Breast and endometrial cancer also showed significant negative associations with carbohydrate intake. This indicated that nutrients in the diet may increase or decrease the risk for cancers at certain sites. Of the various macronutrients, the evidence for the potential harmful effect of fat is strongest for prostate cancer and to a lesser extent, for breast cancer. Figure 16 shows the relationship of total fat intake and breast cancer incidence in women 45 years of age and older. Although fat has been associated with colon cancer in other populations, the Native Hawaiian is an exception to this finding. The evidence for vitamin A suggests an inverse association with lung cancer risk especially in men and the possibility of a direct effect on prostate cancer for older men. No clear relationship between vitamin C and these cancers have been seen. Presently, more studies are being planned to investigate further the diet of the Native Hawaiians and to relate them to various types of cancer. Another dietary factor which was suspected to be a risk factor in the Native Hawaiian population is the high concentrations of mutagens in some Hawaiian foods such as dry/salted fish and kalua pig (75).

Case control studies are also being conducted, comparing persons with and without cancer for prior exposure to dietary and other factors. Food consumption data for these studies are being obtained for a usual week or month before diagnosis of cancer for cases and for a similar time period for the controls. The aim is to compare usual dietary intakes of cases and controls at a potentially

critical time in the past. This may be important due to a probable long incubation period of some cancers. This study will further help in the elucidation of the role of dietary factors in the genesis of cancer.

2. Dental Health and Nutrition

a. Aspects of Dental Health

Good dental hygiene and regular dental care have long been recognized as the most important means of dental care. Recent research into environmental aspects of tooth development have identified the critical role that diet plays on plaque formation and dental caries development (76-78). Dental caries occurs when bacteria accumulate on tooth surfaces as part of dental plaque which then react with fermentable carbohydrates found in food. The acids which are formed can erode the mineral structure of teeth causing caries. Alfano (76) cites four factors essential to the development of dental caries: a susceptible tooth, microorganisms on the tooth surface, fermentable carbohydrates in the mouth and time for interaction of these factors. Alfano shows a figurative depiction of the four caries producing factors which underscores the importance of diet and nutrition in caries production (Figure 17).

Observations from animal research strongly suggest that nutritional factors available during tooth development can impact on resistance to dental caries through adulthood. Changes in tooth structure, size, composition, alignment, eruption and caries susceptibility are caused by nutritional insufficiencies (76).

Several researchers have assessed the cariogenic properties of certain foods. Sticky, sugar foods have been identified as having a high potential for increasing acidity in the mouth (76-78). These

foods promote the formation of plaque by the microorganisms. Some foods, such as cheese, peanuts and sugarless gum can actually raise the pH in the mouth, thus buffering the effect of mouth acids. Eating foods with this protective property a few minutes after offending foods can negate their destructive potential (76, 78) (Figure 18). The flow and bicarbonate concentration of saliva are two of the natural protective mechanisms of the body. Eating stimulates an increase in saliva and a change in its bicarbonate content. This results in a lowering of acidity in the internal environment of the mouth, neutralizing the harmful effects of acids of plaque (78).

Every food which contains fermentable carbohydrates can cause the production of harmful levels of acids on caries-prone tooth surfaces. Frequent snacking may subject the teeth to continual attack from plaque acids (78). A number of agencies and institutions, including the American Dental Association, are focusing on the problem of identifying the methodology to assess the cariogenicity of foods. Most research has used a combination of animal testing and measuring pH changes in the plaque of human teeth to generate the information on cariogenic properties of food (76). There are two measurements used currently to identify the caries promoting foods-- Cariogenic Potential Index and Caries Scores: (Tables 62 and 63)

Fluoridation

Fluoridation of community water systems is the most effective and efficient means of controlling and preventing dental caries. Yet, about half of the U.S. population does not have access to optimally fluoridated drinking water and Hawaii's civilian community

is without fluoridated water. The decline in dental caries within the U.S. has been attributed to fluoride use from a variety of sources which include fluoride tablets and drops, fluoride rinses and dentifrices and clinically applied fluorides, in addition to fluoridated water (79, 80). Comparison of figures gathered by the National Center for Health Statistics in 1973 with 1979-1980 figures compiled by the National Institutes of Dental Research show a significant reduction in the prevalence rates of dental decay among school age children in the United States (80) (Figure 19).

The optimal amount of fluoride needed to reduce dental decay is 0.7 to 1.2 PPM (0.7 to 1.2 mg/liter). Fluoride occurs naturally in water in most areas of the U.S., but is not always present within the effective range. Hawaii's water has an average of 0.1 PPM, providing no protection against dental caries (81). The practice of adjusting fluoride levels in community water systems started in 1945 and the number with access to water with dentally significant levels of fluoride has increased steadily to an estimated 123 million U.S. citizens in 1983. It is estimated that in 1983, 56.5 percent of the total U.S. population were on public water systems which were fluoridated (80). Honolulu is one of nine of fifty largest cities in the United States without a fluoridated public water system. The cost of water fluoridation was estimated by the National Preventive Dentistry Demonstration Program to be less than a dollar per child per year (80).

Fluoride is most effective in reducing dental caries if it is ingested at optimal levels prior to the eruption of the permanent molars. The expected reduction in caries rates would be between 50-60 percent. This reduction in caries can be maintained if

protective levels of fluoride are continued for a lifetime (82). If general nutritional status and food choices are not good, the protective effects of fluoride will be diminished.

During the first stages of tooth development, prior to eruption of the tooth, fluoride is incorporated into the structure of the tooth. Later the topical effect of daily, repeated washing of tooth surfaces with fluoridated water provides the additional benefit of further incorporation of fluoride into the crystal spaces of the tooth (82). The process of fluoride incorporation into teeth and bones continues until age fifty. Besides prevention of caries, fluoride use can reduce malocclusion due to early extraction by 75 percent and reduce severe jaw bone destruction in adults (82). Reduced vertebral fractures in women and reduced abdominal calcifications in men have been reported among people living for lifetimes in areas with a water fluoride content of 3.5 mg/liter or 8-10 mg/liter (82). Fluoride therapy is used in treatment of osteoporosis in elderly patients. Epidemiological evidence points to benefits of smaller doses of fluoride started at an earlier age and continued over a longer period of time (82).

Richmond reports that some resistance to fluoridation of water supplies came from unfounded fear of fluorine poisoning. Early publications on the subject apparently discussed fluorine, the gas, rather than fluoride, the ionic component in water. Small amounts of fluorine gas can be poisonous and was used in insect poisons, causing the question of safety to be raised in the public mind. Concern about "mottling" of teeth creates another barrier to water fluoridation. The spotting of teeth, or mottling, once presumed to be caused by fluoride, is produced by factors other than fluoride.

Fluoride is not a mutagen nor an allergen; it does not cause kidney damage and it does not cause increased bone resorption. The National Institutes of Occupational Safety and Health and the Occupational Safety and Health Administration have set standards of safety for fluoride which are much higher than levels needed to assure dental benefit.

Fluoride is not a medicine; it does not cure any disease. It is a nutrient which, similarly to iodine, is unevenly distributed in nature. Fluoride enhances the stability of teeth and bone and acts as a partial preventative of caries. The many benefits of adding fluoride to waters deficient in it outweigh any unfounded or perceived detriment.

b. Historical/Cultural

Prior to 1778, the young Hawaiians had very little tooth decay and, in fact, it was virtually non-existent in the young child (10, 11). In 1920, Chappel (10) examined the jaws and teeth in the skeletal remains of ancient Hawaiians at the Bishop Museum. The collection came from six of the eight Hawaiian islands (79 crania without mandibles, 66 crania without mandibles and 43 mandibles with crania). He wrote:

"The Hawaiians had teeth of excellent structure and development, so that little caries due to developmental faults existed. There is proof that their diet was of the right quality. Little caries of the teeth appear up to 35 to 40 years of age, the males showing only 1.48 percent; the females 6.69 percent. From 40 to 60 years of age, caries increases considerably, being present in the males as high as 27.1 percent and in the females, 27.0 percent. Beyond 60 years of

age the males show 45.9 percent of carious teeth and the females, 51.5 percent.... One very noticeable fact is that after 40 years of age more cavities are found in the gingival region than in any other portion of the teeth."

Teeth were recognized as something very important to the human condition in ancient Hawaii. This was evidenced by the custom of knocking out the incisor teeth upon the death of a chief or a dear friend as an expression of great love for the departed and of grief at his passing. Chappel (10) found evidence of this practice in about 17 percent (17.2%) of the skulls he examined at the Bishop Museum.

Many of the first visitors to Hawaii remarked on the beautiful physical appearance of the native Hawaiian (11, 83, 84). Body molding to obtain desired shapes and straight limbs was practiced immediately after birth (11, 85). Development of strong jaws and teeth was a special consideration. As teeth emerged the infant was allowed to chew on his mothers fingers, and later pieces of dried squid and sugar cane were offered. Teeth were cleansed with wood ash or charcoal and rinsed with fresh or sea water (85). Hawaiians understood well the connection between diet and dental health. Regarding teething, Pukui said, "If the mother's diet was pono (correct), infant teething problems were believed to be prevented" (85).

By the 1930s, tooth decay was endemic in Hawaii. Jones and her colleagues (12) investigated the prevalence of tooth decay among infants and children who were primarily offspring of plantation workers and who had come from the Orient. They found 80 percent had odontoclasia at one year of age and the prevalence increased to 98

percent at two years. The decay process was so rampant as to necessitate the extraction of one or more teeth before the infant was one year old. The perplexing fact was that the teeth of many of the parents of these infants were entirely free from decay. Jones (12) set up an infant feeding clinic on a large sugar plantation and experimented with foods during pregnancy and infancy. They concluded that the decay problem was due to a shift in the acid-base balance in the diet. A change from tubers to grain products (rice) as the staple carbohydrate food brought about a significant change in the acidity of the diet which affected the mineralization of the teeth.

Several studies conducted among Hawaii's school children have found that the Native Hawaiians rank among the highest for poor dental health status as measured by caries attack rates, DMF, (decayed, missing and filled teeth) periodontal index and dental hygiene scores.

In 1940 (5), a dental examination was done in families in Oahu and Kona; 545 subjects from 2-20 years of age and 8 adults were examined by a dentist; 98% of the Native Hawaiians had dental decay and the mean DMF rate of Oahu Native Hawaiians were 8.35. Table 64 shows the dental condition of children and youth; 35 children and youths or a little more than 6%, had perfect teeth. For the Native Hawaiians, 25% of these were in the 2-5 year age group. The mean DMF rates for all Native Hawaiians were lower than those for Japanese. There was a gradual increase in DMF rates for ages 6-8 years and a significant decrease in the next oldest age group due to the bad condition of the deciduous teeth and their gradual replacement with permanent teeth. Six to eight years seemed to be

the period when deciduous teeth were most serious. Figure 20 shows the condition of the first molars of Native Hawaiian subjects. Only 25% of the 1st molars in 165 subjects of Hawaiian ancestry were sound and most of them were in the 6-8 year old children. Native Hawaiian children ages 9-14 years had the greatest percentage of abscessed first molars.

In 1961, Kau (86), published findings of a statewide survey which investigated the dental health status of 90,000 public school and 6,000 Catholic school children in Hawaii between the ages of 5 to 16 years. The results were compared with 12 other non-fluoridated areas in the U.S. It was concluded that the caries attack rate in Hawaii for the permanent teeth among children 6 to 14 years of age was one of the highest in the nation, ranking third among the twelve areas compared (Table 65). Kau identified dental caries as a serious public health problem and unquestionably the most prevalent chronic disease affecting the people of Hawaii at that time (86). The study included an analysis by race of the DMF rate of permanent teeth. The Part-Hawaiian group was found to have the second highest DMF rate (4.67), with an age-adjusted rate only 16.2 percent lower than the Japanese group (5.57) which had the highest rate. The Hawaiians ranked fourth (4.38) among the seven ethnic groups studied (Table 66). At that time dental treatment rates in Hawaii were higher than any other area in the U.S. An Oahu survey showed an average of 2.9 annual dental visits per person as compared to only 1.6 visits on the mainland.

One study looked at the relationship between the frequency of consumption of various foods and dental caries rates by ethnic group (87). Native Hawaiian children were found to have the highest DMF

scores, the Japanese children had the second highest and Caucasian children had the lowest. The frequencies of candy eating and gum chewing were found to be positively correlated with DMF rates, whereas, bread and cereal eating was negatively associated with DMF. The Native Hawaiian children had the highest frequencies of eating sweet beverages, dessert items, snacks and candy or gum (Table 67) in addition to consuming the highest frequencies of bread and starchy foods.

Earlier reports (1961) showed that Japanese children had the highest prevalence of dental caries, followed closely by children of Hawaiian ancestry. The present study indicates that the Native Hawaiian group ranks as the uncontested highest in mean DMF teeth. Chung (87), attributes this change to environmental factors, such as changes in dental health practices or dietary patterns or both. The authors were cautious in their interpretation of this finding and called for prospective studies among younger children.

Chung, et al (88), studied the effects of race, racial variations and several other epidemiological factors on the prevalence of caries and periodontal disease in 9,912 public school children between 12 and 18 years of age in 1970. Selection of the school population studied was based on an attempt to maximize the proportion of Hawaii born children and to minimize fluoride exposure. The caries of permanent teeth was scored by the number of DMF, periodontal disease by the periodontal index (PI), and the oral hygiene assessment by the technique of Greene and Vermillion (OHI-S). They found that children of Oriental or Native Hawaiian parentage had, in general, higher prevalence of caries and DMF scores than Caucasian children. Children of Native Hawaiian,

Filipino and Puerto Rican parents showed higher proportions of DMF. High oral hygiene scores (OHI-S) were positively associated with the components of Hawaiian parentage. Periodontal index (PI) was associated with the Hawaiian parentage and increased linearly with the amount of Hawaiian blood. Children of Hawaiian ancestry had distinctly higher prevalence of periodontal disease than other racial groups. The data suggests that recessive genes may play a role in the development of periodontal disease (Table 68).

Another study by Chung, et al (89), published in early 1977, related the level of dental plaque to consumption of sucrose-containing sticky foods. In an earlier study (90) which focused on the increase in caries with more frequent consumption of sweet sticky foods, primarily candy and gum, it was found that the Native Hawaiian children had the highest mean DMF score followed by the Japanese children and the Caucasian children had the lowest score. Chung, et al., (89) correlated dietary intake pattern to the degree of plaque formation. The study demonstrated a highly significant association between the consumption of desserts or sweet snacks and the number of teeth with heavy plaque accumulation. Eating poi, the traditional starchy food of Hawaiians, was positively associated with the number of teeth with heavy plaque accumulation. The highly sugared, sticky foods that enhanced the formation of plaque were sweet rolls, sweet bread, manapua and poi. Fruit drinks were shown to have a retarding effect on plaque growth. The formation of plaque was significantly associated with periodontal disease (Table 69).

As an extension of his earlier works, Chung and his colleagues (89) conducted an investigation designed to examine racial

differences along with other epidemiological factors among 939 teenagers and adults in Hawaii's multiracial population. The epidemiological factors which had a significant negative effect on periodontal disease were age, sex and smoking history. Years of education had a significant positive effect. No evidence of an association with periodontal disease was found with eight genetic, medical and dental characteristics studied, including inbreeding, blood and heart diseases, diabetes, allergy or pregnancy. The analysis of data for racial effects on periodontal disease showed that Native Hawaiians, Samoans and Filipinos had the highest periodontal disease scores and relatively poor periodontal health status (Table 70).

It was shown that the racial differences in this study was consistent with earlier studies of school children in Hawaii in that individuals of Hawaiian ancestry were generally marked by poor periodontal health. Poor oral health in childhood in this racial group carried over into adulthood.

Though the research has found a clear dichotomy between the Filipinos, Hawaiians or Part-Hawaiians, and Samoans from the rest of the racial groupings, the differences in periodontal health status could not be attributed to genetics.

c. Community Efforts

The dental health problems among the people of Hawaii do not appear to be due to a lack of dental manpower, services or dental health insurance. A survey of dental service utilization (14) conducted in 1979 by the Department of Health's Health Surveillance Program confirmed an earlier finding of frequent dental visits by Hawaii residents. They found a total of 80.5 per cent received

preventive services and 65.2 per cent had dental visits within the previous year. Several community agencies, organizations and institutions have developed plans and services and have conducted research in an effort to ameliorate the dental health problems. However, these efforts are not well-coordinated nor do they serve all segments of the community equally.

The following are some of the current efforts within our community and a brief description of their services and activities. No attempt is made to rank or prioritize them.

Hawaii State Department of Education (DOE)

In May 1979, the Hawaii State Department of Education established the Nutrition Education and Training Program (NET) as part of their Office of Instructional Services. The purpose of NET is to provide children with learning experiences regarding the relationship of nutrition to health. In addition NET allows for opportunities to use this knowledge to develop food and nutrition attitudes plus practices fundamental to their health and well-being throughout life. NET works with teachers, parents, school food service personnel and community groups to assure positive nutrition experiences for the entire public school population. This includes 163,535 children, 9,000 faculty and staff and approximately 970 food service personnel.

The ethnic distribution of students on a statewide basis in 1979 was as follows: (Table 18). The Native Hawaiian is 20% of the total student population. The Department of Education's (DOE) Hawaii's Nutrition Education Needs Assessment Report (8), published in May 1980, identified a number of nutrition related student health problems. Dental conditions are listed third among the problems and

rank fourth in occurrence behind overweight, underweight and anemia. (Table 71) The school health nurses indicated the following caries-producing nutrition practices among students: 1) skipping meals, 2) poor food choices, 3) snacking on empty calorie foods and, 4) fad diets for weight reduction. Other school personnel including administrators had the same concerns about student nutrition practices.

This report included a 24-hour dietary recall which showed a general decrease in the nutritional quality of diets as the students got older. One of the major problems was the lack of calcium in their diets (70% of the high school girls and 66% of the junior high girls had diets that contained less than 2/3 of the RDA for calcium.) Girls at the secondary level ate more candy than the boys, but drank less soda. Boys at the secondary level drank on the average about one 12-ounce can of soda per day.

University of Hawaii

The Dental Hygiene Program at the University of Hawaii has been in existence since 1931. The Department of Dental Hygiene offers two programs, the Certificate in Dental Hygiene and the Bachelor of Science in Dental Hygiene. The current enrollment of students is 46 and the average number of students completing the course each year is about 20, and about 95-100 percent of the graduates remain to work in Hawaii.

The Department of Hygiene offers dental hygiene preventive services and dental health education at no charge to the public in their clinic. The Department Chairman and faculty generously cooperate as consultants in the community to develop or establish dental health programs. For ten years now, about 40 Oahu based Head

Start children have received dental hygiene services and, this year, 103 received sealant applications at the department's clinic. The clinic served a total of 3,728 patients during a 6,428 patient contacts within the Fall of 1984 and Spring of 1985 semesters.

Dr. Jean Hankin and Dr. Chin Chung, of the School of Public Health of the University of Hawaii have done several research studies (87-90) in cooperation with the State Department of Education and the State Department of Health Dental Health Division. They have made significant contributions in the study and investigation of Hawaii's dental health problems. Both scientists have worked diligently to elucidate factors relating to the dietary and nutrition practices and racial and genetic factors which are involved in dental disease. They participate generously as consultants in the planning of many community efforts to develop dental health studies and programs in Hawaii.

Department of Health - State Health Planning and Development Agency

The State Health Planning and Development Agency (SHPDA) developed a Health Services and Facilities Plan for dental health services in 1979. A revision of this chapter on Dental Health Services was completed in July, 1985 and is ready for adoption. The purpose of this plan is to "assure that all individuals in the State of Hawaii be provided the opportunity to achieve and maintain an optimal level of oral health." The plan describes the dental health status and dental care delivery system. It identifies some of the problems in planning and implementation.

The plan determines that regarding:

- 1) Manpower: There are no dental manpower shortage areas in the State of Hawaii. The Health Manpower Shortage standard

for dentists developed by the DHHS, Office of Data Analysis and Management, Distribution and Shortage Analysis Bureau is 1:3,000. The table below of the ratio of dentists to population shows that there are no shortage areas in the State and its counties.

State.....1:1465

City & County of Honolulu.....1:1401

Hawai'i County.....1:1633 (1:1497)

Maui County.....1:1811 (1:1633)

Kaua'i County.....1:1858 (1:1487)

(Based on dentist inventory, January 1985 and latest population data available - 1984.)

- 2) Cost: It is estimated that approximately 48 percent of the State's total dental costs are covered by public funding and private insurance payments. Therefore, approximately 52 percent of the cost of dental services are paid by the consumer.
- 3) Insurance coverage: Table 72 shows that more families, whether employed or unemployed, have medical insurance than dental insurance coverage.

The State Health Planning and Development Agency (SHPDA) Dental Task Force has made several recommendations to solve the dental problems in Hawaii. These recommendations are (13) -

- A. The Hawaii Statewide Health Coordinating Council (HSHCC) and SHPDA negotiate with the Hawaii Dental Association to do a clinical survey to document the current dental health status of the State.
- B. That HSHCC and SHPDA work with community and professional

groups to establish community water fluoridation for the State.

- C. In the absence of community water fluoridation, other means of applying fluorides to teeth should be made available or implemented statewide.
- D. That HSHCC and SHPDA in cooperation with the Hawaii Dental Association (HDA) hold community meetings to raise the level of information for both consumers and dental program purchaser groups regarding reimbursement options.
- E. That HSHCC and SHPDA make a request to the Department of Health (DOH) Health Surveillance Program to add dental health insurance inquiry to their ongoing health survey.
- F. That HSHCC and SHPDA make a request to the DOH to coordinate with the DOE and the HDA to develop a community dental education program.

The Dental Health Division of the State Department of Health provides group dental education to about 10,000 school children annually, in addition to chairside dental health instruction and topical fluoride application to a large segment of the public school population. In Fiscal Year 1983-84, 74,113 children received topical fluoride application. In addition to providing topical applications to school children, dental hygienists inspect the mouths of children for defects and inform parents of the need for professional attention when appropriate. Parents of children who need care are encouraged to obtain dental treatment in this manner. Periodically records are kept to determine the percentage of children who are free from tooth decay. Between 1958 and 1968 the tooth decay rate for 14-year-old school children declined from 11.43

DMF teeth per person to 8.14 per person. A major portion of this decline can be attributed to the initiation of a topical fluoride application program for school children in 1960. Lack of funding prevents the program from conducting any extensive research to obtain detailed data on the dental health status of children. More research is needed to determine in more detail the variation in decay and gum disease patterns among different racial groups in Hawaii and the possible causes of these differences. Additional information is needed to show how the referral program conducted by hygienists benefits the health of the school population. Recent shortages in dental hygienists to serve in neighbor island schools raises the question of how these areas can best be served with alternative programs such as the Rinse Program.

The State Department of Health provides direct treatment services to approximately 5,000 people each year. Patients in State mental retardation and mental health institutions, care homes and institutions for the care of leprosy patients managed by the Department of Health are provided dental care by dentists and assistants of the Dental Health Division. On Oahu, where three-fourths of the State's population resides, the Dental Division also operates six dental clinics for the treatment of the needy. The needy group is composed of people who are in need of assistance due to unusual circumstances including the handicapped, aged, and the marginal income individual.

The State's dental programs under the Department of Health are unique in that the services for the entire State are administered by the Dental Health Division. In most other States the administration of county service programs are funded and administered by the County

Health Departments.

Records of the Department of Health's Maternity and Infant Care Project and the Children and Youth Project were studied for dental treatment services as well as for the nutrition services reported earlier. A total of 201 records were abstracted from pregnant women, half from the 1970-73 time period and the other half from 1980-82. Table 73 includes information on dental insurance coverage, types of dental work done and the cost of restoration for individuals without insurance coverage. A great percentage of women were without dental insurance in both time periods. The most common dental work done in both periods was prophylaxis followed by fillings, x-ray, examination and extraction. The percentage for all dental work, except oral surgery, in 1980-1982 fell to fifty per cent or less of that done in the earlier period. Fifty-eight per cent of the 1980-82 services cost \$149.00 or less compared to forty-three per cent in that group in the earlier time frame. With dental insurance cost being less available in 1980-1982, only half the services are being provided but more are in the \$50.00 to \$150.00 cost range than in the earlier time period.

Honolulu Community Action Program - Oahu Head Start Program

The Oahu Head Start program began in the summer of 1965. Dental caries ranked high among the health needs of the program, therefore a dental component, including dentists, became a part of the health component at its inception. All Head Start programs must emphasize prevention and early identification of all health problems. The Oahu program presently has a dental hygienist who coordinates the treatment, education and prevention phase of the dental program to parents, children and staff.

The Oahu Head Start dental goals are:

1. To introduce plaque control in the classrooms through daily brushing and flossing by parents of children.
2. To have all dental work completed by a dentist.
3. To have good nutrition/good snack activities.
4. To provide parents, children, and staff with education on practices of good oral health.
5. To provide daily fluoride supplement as an alternative to water fluoridation until fluoridation is achieved on Oahu. This supplement program began in 1977.

A new dental pit and fissure sealant treatment for selected children with fully erupted first permanent molars and primary molars was initiated as a demonstration program in the 1984-85 school year. The sealant program offers the children of Oahu Head Start a total dental preventive program.

The program for the 1985-86 school year will service 824 low income children between 3 and 5 years of age on the Island of Oahu. 50% of these children are of Native Hawaiian ancestry.

All children must receive dental examination and needed restorative work during the school year. For the 1984-85 school year, 893 children (actual enrollment) received dental examinations. 554 of those children needed dental treatment. At the end of the school year, 532 children had completed dental treatment and 22 children were completing dental care treatments.

The Oahu Head Start dental hygienist acts as a consultant to the neighbor islands Head Start programs. There are approximately 200 children in the Maui and Hawaii Head Start Programs and 90 children on Kauai. Clinical resources, such as the UH Dental

Hygiene programs or Strong-Carter Clinics, are not available to the neighbor islands children. The Head Start Dental Hygienist has cooperated with efforts within the community to develop dental health services and programs.

Thus, there are several organizations on Oahu that offer dental treatment for low income persons. These include the Head Start Program, six Department of Health clinics, outpatient clinics at three hospitals, two neighborhood health clinics and three community dental clinics. They provide services for approximately 3,610 patient centers per month and of this number an estimated 970 contacts are with Native Hawaiians. An additional 6,428 patient visits were provided at the UH Dental Hygiene Clinic's 1984-85 year.

Kokua Kalihi Valley (KKV) has a staff of three dentists and provide treatment services to over 400 dental patients each month. The clinic has established its own fee schedule and is open 5-1/2 days a week. The KKV dental patients must live within three census tracts immediately surrounding the clinic in the Kalihi Valley area except for Southeast Asian refugees who are accepted from any part of Oahu. An estimated 40 to 50 patients each month are Native Hawaiian children and adults.

Hale Hoola Hou Dental Clinic, located in the Palama area, provides dental treatment from Monday through Friday to between 250 and 300 patients each month. Native Hawaiian adults and children comprise about one-third (80-100) of those monthly patients. The clinic is staffed by two dentists, one full-time and one half-time, and a full-time hygienist. Each treatment visit costs \$35.00 and emergency visits are \$25.00. Medicaid and all dental insurance plans are accepted.

The Queen Emma Clinic provides dental treatment to about 200 patients per month mostly from the Medicaid or gap group. Payments from all insurance companies are accepted. Approximately 50% of the patients are Native Hawaiians of all ages. The Queen Emma Clinic is staffed by two dentists, one hygienist, two dental assistants, one dental aide and a receptionist. The Queen Emma Clinic, situated in the Queen's Medical Center, is open Monday through Friday.

The St. Francis Neighborhood Health Center Dental Clinic, located in Kalihi on North King Street, is staffed by a dentist and a dental assistant. Dental services are provided to about 100 patients a month and only a few of the patients are Native Hawaiians. The Department of Social Services and Housing (DSSH-Medicaid) fee schedule is used. The dental clinic is open Monday through Friday.

St. Francis Hospital and Outpatient Dental Clinic, located at the hospital site, is staffed by one dentist, three dental residents and four dental assistants, a hygienist and an administrator. The clinic is open to the public; the DSSH fee schedule is used here also and dental visits are by appointment only. This clinic serves 300 to 350 patients a month of which less than one-fourth (75-86) are estimated to be Native Hawaiian.

The Strong-Carter Dental Clinic, is also located in the Palama area. The staff includes five dentists, five dental hygienists, four office staff and a director. This program treats only children from 3 years of age to high school who received DSSH assistance. If the patient is eligible, there is a charge of twenty-five cents per visit. The Clinic sees approximately 800 patients each month and fewer than one-fourth (< 200) are Native Hawaiians.

The Waianae Coast Comprehensive Health Center is the only clinic located on the Leeward side of the island in Waianae. The clinic is staffed by one dentist, a dental aide, a dental hygienist and a clerk. The clinic is open 4-1/2 days a week and accepts the payment schedules of almost all dental insurance plans and charges \$28.00 for emergency visits. An estimated 150 patients are seen each month and between 25 to 30 are Native Hawaiians.

The Department of Health's Health Promotion and Education Office sponsored the Governor's Conference on 1990 objectives on December 2 and 3, 1985. The objective of the conference was to plan for the achievement of the Hawaii health objectives for 1990 (91). Various task forces met to analyze the status, services and needs of Hawaii.

d. Summary

Dental caries, periodontal disease and poor dental hygiene, especially in infants and children, have been recognized as a major health problem in Hawaii since the 1920's (86). Early studies in Hawaii (12) describe dental caries as rampant among infants in the first two years of life. In 1960 (86), dental caries was described as a serious public health problem and a major one for Hawaii's school children and more recently (87, 90), studies implicate dietary changes and choices as a probable cause of the problem. Studies relating to incidence of dental caries among the various ethnic groups, demonstrates that the percentage of DMF in Native Hawaiian children has been increasing. Native Hawaiian children have one of the highest DMF rates in the United States.

Diet, an environmental factor in dental health, has undergone a major change from post World War II until the present. Before that,

the Native Hawaiian diet was high in starches and low in refined sugar and this was supplemented by Eastern and Western foods. Frequent snacking among present day Americans further increased the number of highly sweetened, sugary foods consumed.

The change from native foods to a conglomerate of various ethnic foods have occurred steadily since the discovery of the Hawaiian Islands by the Europeans. Meals containing more refined sugar and frequent consumption of sweet snacks have been identified as a major factor causing dental disease. There is agreement that a higher risk for dental caries have resulted with these dietary changes. The proliferation of sugary snacks and drinks in the American food chain make increased consumption of them a near certainty, especially among school children.

Hawaii's drinking water is superior in taste to that of most cities and states in the U.S. The water from Manoa Valley placed third after Olympia, Washington and Boston in a recent American Water Works Association taste test of water samples from cities in the U.S. and Canada. However, the fluoride content of Hawaii's water is negligible, averaging < 0.1 PPM and ranging from trace amounts to 0.3 PPM (81). Proposals to fluoridate the community water supply have been brought repeatedly before the legislative bodies of the Territorial, State and Municipal Governments of Hawaii. Each time, of more than two dozen times, the issue of fluoridation was considered and it has failed to bring about any change. Actually there were about 16 pro-fluoridation bills and resolutions, seven anti-fluoridation and four others of rather neutral stance. Fluoridation of the civilian drinking water would result in a 60 to 65 percent reduction in caries. Currently,

efforts are underway to again try to get legislation passed which will allow fluoridation of the community water supply.

There are a number of community programs providing dental services to the low income and the modest income group who are without adequate dental coverage. The total number served through these programs is small. Estimates show about 7,000 to 9,000 monthly patient contacts in the community clinics and less than a thousand (970) are estimated to be Native Hawaiians. These clinics are on Oahu and most of them are within the city of Honolulu. Many dental professionals desire to document any progress being made in reducing dental caries and peridontal disease.

The professional dental community is a concerned one. Many are actively involved in task force groups and individual efforts to improve the dental health picture in Hawaii. They are generous with their time and expertise to individual researchers or groups who call upon them for assistance. They are up against great odds of the environmental factors of diets high in sugars and fluoride-poor drinking water. In addition, the low income population of Southeast Asian immigrants, South Pacific islanders and the Native Hawaiian population, all who need low-cost dental services, has grown.

Private dentists and dental clinics indicate that poor dental hygiene and delayed dental visits are significant factors in their practices. The problem of poor dental hygiene is probably the most difficult factor to address as it involves not only education but habit formation. Most clinics provide patient education but the contact needed to establish a habit is a definite limitation. Early childhood education appears to be the best approach to this problem.

The plight of the Native Hawaiian in dental health appears dismal. The studies indicate their dental health has statistically declined over the years (84-85, 87-90). Concern has developed among Hawaiian health professionals and community groups. The State Association of Hawaiian Civic Clubs recently presented a proposal to the federal government for funding (92). Their idea was to use kupuna, Hawaiian grandparents, as classroom aides to assist the classroom teachers with dental education, habit formation and developing family support, resource networking and dental health awareness. Networking and outreach were important parts of the Civic Clubs proposal.

Therefore, in spite of the recognition of dental problems, creation of a few treatment programs and education and development of community-wide plans to improve and assure dental service levels have not been able to effect a significant reduction of the DMF and periodontal disease rates. Fluoridation of community water supplies would probably be easiest and most effective. However, the repeated defeat of all legislative efforts demonstrates a state of confusion and misinformation in the community. A ban on the sale of candy and sugary drinks on the Hawaii public school campuses was recently passed by the Board of Education of the Hawaii Department of Education. This ban on candy sales, although a victory for proponents of good dental health, is unpopular among school children as it removes their best means of fundraising for school clubs and organizations.

B. COLLECTION OF DATA

1. Maternity and Infant Care Project Data

a. Pregnant Women

Table 74 shows the demographic characteristics of the pregnant Native Hawaiian women during the years 1970-1973 and 1980-1982. The mean age of subjects was 22 years. For both years, approximately 15-16% were below 18 years at the time of pregnancy. The average years of schooling was 11.4 to 11.7 years and this was comparable to the state median number of years of education for adults over 25 years in 1970 which was 12.3 years (93). The mean number of pregnancies (gravity) and number of live births (parity) in 1980-1982 was significantly lower, indicating a smaller family size in the later years. The average weeks of gestation at the initial visit was significantly lower in the 1980s. This suggests that pregnant women were coming to the prenatal clinic earlier in their pregnancy compared with women in the 1970s. The average weeks of gestation at delivery was 38 weeks for both groups of subjects.

Table 75 shows the physical characteristics of the subjects. The mean height of women aged 22 years based on the first National Health and Nutrition Examination Survey (HANES) data in 1974 was 163 cm (19, 94); this value was close to the mean height of women in the 1970s but was 2 cm less than the heights of women in the 1980s. Mean pre-pregnancy weight and weight at initial visit of the women in the 1980s was significantly lighter than that of women in the 1970s. This may be due to the fact that pregnant women in the 1980s were shorter and therefore weighed less. It is also possible that women in the 1980s were more conscious of their weight due to education emphasizing the benefits of weight control. The mean

pre-pregnancy weight of women in the 1980s was 0.4 kg lighter than the average weight of women based on the 1st HANES survey (19, 94). The mean pre-pregnancy weight of women in the 1970s was 5 kgs heavier than the average weight of women based on the HANES data (19,94). The average weight gain per week for both years was within the recommended amount of weight gain during pregnancy which is 0.99-1.8 kgs for the first trimester and 0.45 kg/week thereafter (41). The mean total weight gain was 2.7 kgs (6 lbs) greater than the total weight gain recommended during pregnancy which is 24-30 lbs (10.8-13.6 kgs) (41). On the other hand, the minimum total weight gain of women in the 1970s was 2.7 kgs and 4.7 kgs for women in the 1980s. Looking at each individual values, more women in the 1980s fell below the 5th percentile of weight for height compared with women in the 1970s (Table 80); however this was not statistically significant. In contrast, more women in the 1970s had pre-pregnancy weights that were above the 95th percentile of weight for height compared with women in the 1970s. Again, these differences were not statistically significant.

Table 76 shows the hemoglobin values of the pregnant Native Hawaiian women during the 1st, 2nd and 3rd trimester of pregnancy and postpartum period. Overall, there was a tendency for women in the 1980s to have lower hemoglobin than women in the 1970s. However, this was only statistically significant during the second trimester for women in the 1980s compared with women in the 1970s. The Hb levels of women in the 1970s were significantly lower in the 3rd trimester as compared with the 2nd trimester; in the 1980s the Hb levels were significantly lower in the 2nd trimester as compared with the 1st trimester. There was an increase in hemoglobin levels

during the postpartum period in both groups of subjects. This was consistent with the known physiologic adjustments in pregnancy (41, 95). However, none of the mean Hb values fell below 11 gm/100ml. Looking at each individual value (Table 80), Hb values below 11 gm/ml were found in each trimester of pregnancy for both decades but more were found during the 2nd and 3rd trimester of pregnancy. More Hb values less than 11 gm/100 ml were found in the 1st and 2nd trimester of pregnancy in the 1970s than in the 1980s. However, there were more Hb values less than 11 gm/100 ml during the 3rd trimester of pregnancy and the postpartum period in the 1980s than in the 1970s. These differences were not statistically significant.

Table 77 shows the birth outcome characteristics of the pregnant women in the MIC Project. There were no significant differences in the mean birth weight, birth head circumference and Apgar scores of infants at 1 minute between the 2 groups of subjects. There was no significant difference in the number or percent of low birth weight infants (less than 2.5 kgs) for both decades in both groups of subjects (8% in the 1970s and 11% in the 1980s) (Table 80). Three percent of infants in the 1970s and 4% in the 1980s had Apgar scores at 1 minute of below 4 (Table 80). Compared with the State of Hawaii for 1984 (96), 2.3% of babies born in the state were assigned a 1 minute Apgar score of 0 to 3. The MIC data for both years was slightly greater than the Hawaii average. Birth lengths of infants in the 1980s were significantly longer compared with infants in the 1970s. There were 2% more males in the 1980s than in the 1970s (46% males and 52% females in the 1980s; 44% males and 54% females in the 1970s). Apgar scores at 5 minutes were also significantly lower in the 1980s than in the

1970s. Only 1 infant (1%) in the 1980s and none in the 1970s had 5 minute Apgar scores of less than 4 (Table 80). Compared with the state average, 0.4% of newborn babies were assigned 5 minute Apgar scores of 0 to 3. Thus, there was a comparable number of infants in the 1980s that had low Apgar score at 1 and 5 minutes compared with infants in the 1970s. Overall, the data indicated that a slightly greater number of infants born to Native Hawaiian women had lower Apgar scores at 1 and 5 minutes compared with the state average. The significance of these data relating to the Apgar scores cannot be ascertained.

Table 78 shows other demographic, medical and nutritional characteristics of the pregnant Native Hawaiian women in the project. There was a significant increase in the use of Medicaid in contrast to private insurance as a source of medical insurance in the 1980s as compared with the 1970s. Almost 90% of pregnant women in the 1980s were enrolled in the WIC Program compared to none in the 1970s. The WIC program started in Waimanalo during the mid 1970s. The use of breast-feeding for infant feeding in the hospital has significantly increased in the 1980s as compared to the 1970s. The latter showed the beneficial effects of the health and nutrition education done in the clinic.

There was no significant difference in the occurrence of miscarriage or spontaneous abortion in the 2 groups of subjects; however, there was a significant increase in elective abortion and Caesarean rates in the 1980s as compared with the 1970s. The increase in Caesarean rates during the 1980s was a trend also reported by the National Center for Health Statistics (97).

In the 1980s, there were significantly more women drinking

alcohol at the initial interview than women in the 1970s. The number of women who smoked and took drugs were equal for both decades. Current reports have shown that the Native Hawaiians were one of the highest consumers of alcohol and tobacco among the ethnic groups in Hawaii (98). The intake of vitamin-mineral pills during pregnancy was high for both groups of women i.e. 93-95% takes supplements during pregnancy.

Table 79 shows the medical and nutritional problems of the pregnant Native Hawaiian women. The most common complications during pregnancy in the 1970s were infections, anemia, asthma and psychological distress; in the 1980s, the most common complications were infections, anemia, and backache. There was no significant difference in the kind and number of maternal complications that occurred in both groups of subjects.

The most common nutritional problems of these women during pregnancy for both years was nausea, vomiting and poor appetite. More women were constipated in the 1980s than in the 1970s, but this was not statistically significant. This may be due to their low intake of fruits and vegetables as evidenced from the dietary recalls (Table 81). Cravings for certain foods were common in both groups of women. The most common foods craved during pregnancy were sweet and salty foods. This was consistent with studies (99, 100) showing that sweet and salty foods were the ones that pregnant women mostly craved for.

The intake of different food groups by the pregnant women is found in Table 81. As shown in the table, more women in the 1970s were consuming daily or several times/day the food groups of milk, meats/alternates, vitamin A and C rich vegetables and fruits, other

fruits and vegetables, and cereals than women in the 1980s. Snacks and sweets consumption were similar in both groups. More coffee, tea and condiments were being consumed in the 1980s than in the 1970s. This table indicates that pregnant women in the 1980's were eating less of the nutritious foods and more sweets, tea and coffee than women in the 1970s.

The dietary analysis of the diet of the pregnant women at the initial interview is found in Table 82. This was based on a 24-hour recall of the woman's previous day's food intake. The diet was evaluated by the MIC Project for adequacy of the diet according to the 1968 (for the 1970-73 records) and 1980 (for the 1980-82 records) Recommended Dietary Allowances (15). An adequate intake of a nutrient, or calories, is defined as an intake that is greater than 66% of the RDA; fair intake is greater than 50% of the RDA, low intake is equal or less than 50% of the RDA, poor intake is less than 25% of the RDA, and excess intake is greater than 120% of the RDA (101). Our nutrient analysis were grouped according to intakes > 66% of RDA (this included > 120% for all nutrients except calories) and < 66% of RDA (this included fair, low and poor intakes). Figure 21 shows a graphic representation of the percent of diets falling below 66% of the RDA in calories and nutrients between the two time periods. As shown in the figure, more than 50% of women in the 1980s had diets that were below 66% of the RDA in the following nutrients: calcium, iron, vitamin A and vitamin C. In contrast, less than 50% of the pregnant women's diet in the 1970s fell below 66% of the RDA in the nutrients mentioned above. These showed that pregnant women in the 1970s had better diets than women in the 1980s. This may be due to the fact that since pregnant women

in the 1980s were coming earlier to the clinic, dietary recalls were being taken at the time when nausea was occurring in most women. Nausea will lead to a reduction in food intake and a decline in the overall quality of the diet.

The above data on pregnant women showed some of the positive effects of the health and nutrition education done in the MIC Project. This was seen in the health status and practices of pregnant women in the 1980s which included a smaller family size, earlier visit to the clinic for prenatal care, less overweight and greater use of government aid such as Medicaid and enrollment in the WIC Program.

Some factors have been noted showing that pregnant women in the 1980s were at greater risk for nutritional deficiencies than women in the 1980s. More women in the 1980s had low hemoglobins and had infants with lower Apgar scores at birth than women in the 1970s. Also, more women in the 1980s were drinking alcohol and had poorer diets at the initial interview compared with women in the 1970s. This showed that more women in the 1980s were at greater risk for nutritional deficiencies and thus poorer pregnancy outcomes than women in the 1970s. The target for nutrition education should be to teach women to avoid alcohol and tobacco before and during pregnancy, consume foods in the right amounts from the Basic 4 food groups particularly those rich in calcium, iron and vitamins A and C such as milk, meats, fruits and vegetables. More vegetable and fruits should be consumed to prevent constipation. Consumption of vitamin and mineral pills should be maintained. There should also be continued participation in the health and nutrition education program of the MIC Project.

b. Infants (birth to 12 months)

Table 83 shows the demographic and physical characteristics at birth of the two groups of subjects. There were slightly younger infants and smaller family size in the 1980s compared to the 1970s but this was not statistically significant. There were 56% males and 44% female infants in the 1970s and 54% males and 46% females in the 1980s. Approximately 18% of mothers were below 18 years in the 1970s; compared with the 1980s where there were only 12% of women below 18 years (not shown on table). The lengths of male infants in the 1980s were significantly greater than males born in the 1970s; this was not true with the female population nor in the total infant population. More infants in the 1980s had birth lengths that rose above the 95th percentile of the standard compared with infants born in the 1970s (Table 89); this was not statistically significant. In both years, birth length of females were generally shorter than males but this was not statistically significant.

There was no significant difference in the birth weight of infants between the two groups of subjects. The number of infants that were of low birth weight (below 2.5 kgs) was 12% (6 infants) in both years (Table 89). Female infants born in the 1980s had a tendency to be lighter than male infants born in the 1980s but this was not statistically significant.

Birth head circumference was obtained for the years 1980-82 and only three samples were collected from 1972-73. There was no statistically significant difference in the birth head circumference between male and female infants in the 1980s. Twenty three percent (10 infants) of infants in the 1980s had birth head circumferences below the 5th percentile of the National Center for Health

Statistics (NCHS) growth charts; 2% (one infant) had a head circumference that rose above the 95th percentile. In the 1970s, two out of three infants had birth head circumference that fell below the 5th percentile (Table 89). Due to the small sample size, the differences in head circumference cannot be ascertained.

Birth Apgar scores at 1 minute were not significantly different between the two groups of subjects; however, the Apgar scores at 5 minutes in infants born in the 1980s were statistically significantly lower than those of infants born in the 1970s. Three percent (one infant) of infants in the 1970s had Apgar scores less than 4; six percent (3 infants) of infants born in the 1980s had Apgar scores less than 4. There were no infants in both years with Apgar scores at 5 minutes of less than 4.

Table 84 shows the length of the male and female population in the 1970s and 1980s at 4 time periods, namely: 1-3 months, 4-6 months, 7-9 months and 10-12 months. Lengths of the total infant population in the 1980s were greater at 4-6 months, 7-9 months and 10-12 months than infants in the 1970s but this was only significant at 7-9 months. At 1-3 months, lengths were greater in the 1970s than in the 1980s. There was a tendency for female infants to be shorter than males in both decades but this was only statistically significant at 4-6 months for both decades, and female infants in the 1980s during 10-12 months. Twelve percent (5 infants) of infants in the 1970s fell below the 5th percentile for length during 1-3 months; five percent (2 infants) at 4-6 months; nine percent (2 infants) at 7-9 months and five percent (2 infants) at 10-12 months (Table 89). In contrast, no infant in the 1980s fell below the 5th percentile for length at 1-3 months; seven percent (3 infants) at

4-6 months, 3% (one infant) at 7-9 months and none at 10-12 months. Thus, there were fewer infants in the 1980s that fell below the 5th percentile for length compared with infants in the 1970s.

Nine percent (4 infants) of infants in the 1970s rose above the 95th percentile for length at 1-3 months; ten percent (4 infants) at 4-6 months, five percent at 7-9 months (one infant) and 10-12 (2 infants) months (Table 89). In contrast, 2% (one infant) of infants born in the 1980s rose to greater than the 95th percentile for length at 1-3 months, none at 4-6 months, 15% (5 infants) at 7-9 months, and 11% (5 infants) of infants at 10-12 months. More infants in the 1980s rose above the 95th percentile for length compared with infants born in the 1970s. This showed that infants in the 1980s had the tendency to be longer than infants born in the 1970s.

Table 85 shows the weights of the male and female population in the 1970s and 1980s at 4 time periods namely: 1-3 months, 4-6 months, 7-9 months and 10-12 months. There was a greater weight in the total population of infants born in the 1980s during 4-6 and 7-9 months compared with infants born in the 1970s but this was not statistically significant. However, the weight of male infants born in the 1980s at 4-6 months was significantly greater than those born in the 1970s. Weights at 1-3 and 10-12 months were similar for both groups of subjects. Female infants had the tendency to be lighter at the different time periods in both years but this was only statistically significant at 4-6 and 7-9 month old infants born in the 1980s.

Seven percent (3 infants) of infants at 1-3 months in the 1970s were below the 5th percentile of weight for length; none at 4-6 and

7-9 months and 2% (one infant) at 10-12 months. No infant in the 1980s fell below the 5th percentile of weight for length at 1-3 months, 2% (one infant) at 4-6 months; 3% (one infant) at 7-9 months and 5% (2 infants) at 10-12 months.

Twelve percent of infants (5 infants) at 1-3 months in the 1970s had weight for heights that rose above the 95th percentile of the reference standard; 10% (4 infants) of infants at 4-6 months, 9% (2 infants) of infants at 7-9 months and 7% (3 infants) at 10-12 months. In the 1980s, two percent (one infant) of infants at 1-3 months rose above the 95th percentile of weight for height; 9% (4 infants) at 4-6 months, 10-12 months (4 infants) and 7-9 months (3 infants). There was no difference for both years in the percent of infants that fell below or above the NCHS standard of weight for height.

Table 86 shows the head circumference of the male and female infant population in both years at 4 different time periods namely: 1-3, 4-6, 7-9 and 10-12 months. There was a tendency for the head circumference of infants born in the 1980s to be lower than the head circumference of infants born in the 1970s. This was only statistically significant during the 10-12 month period for the total population of infants and male infants in the 1980s compared with those born in the 1970s.

Female infants in both years had smaller head circumferences than male infants at the different time periods; this was only statistically significant at 4-6 and 10-12 months in the 1970s and 1980s and 7-9 months in the 1980s.

No infant in the 1970s had a head circumference that was below the 5th percentile of the reference standard at 4-6, 7-9 and 10-12

months. At 1-3 months, 5% (2 infants) of infants in the 1970s had head circumferences that fell below the 5th percentile. In contrast, 2% (one infant) of infants born in the 1980s had a head circumference that fell below the 5th percentile at 4-6 months and 10-12 months and 3% (one infant) at 7-9 months; there was none at 1-3 months. Ten percent (4 infants) of infants in the 1970s at 1-3 months, 12% (5 infants) at 4-6 months, 11% (2 infants) at 7-9 months and 12% (4 infants) at 10-12 months had head circumferences that rose above the 95th percentile. In the 1980s, 7% (3 infants) at 1-3 months, 5% (2 infants) at 4-6 months, 6% (2 infants) at 7-9 months and 2% (1 infant) at 10-12 months had head circumferences that rose above the 95th percentile. There were more infants in the 1970s with head circumferences that rose above the 95th percentile of the standard compared with infants in the 1980s.

Table 87 shows the hematocrit values at the different time periods, namely: 1-3, 4-6, 7-9 and 10-12 months. Very few values were collected for both years. As shown among infants in the 1980s, there was a gradual decline in hematocrit values from 1 month to 12 months. Due to variable sample size, no definite conclusions can be drawn. Only one infant in both years had hematocrit values that were below the standard (Table 89). This occurred at 4-6 months in the 1970s and 10-12 months in the 1980s.

Table 88 shows other demographic, medical and nutritional characteristics of the infant population in both years. Again, there was an increase in the use of Medicaid as a form of medical insurance and a significant increase in the number of parents participating in the Food Stamp program. Seventy eight percent of infants in the 1980s were enrolled in the WIC Program.

Breast-feeding in the hospital had increased in infants born in the 1980s compared to those born in the 1970s; this was not statistically significant. Mixed feeding (breast and formula) had also significantly increased in the 1980s. There was also an increase in Caesarean rates among mothers in the 1980s. The most common neonatal problem in both years was jaundice. The rate of congenital anomaly was similar in both years. Reports (102) have shown that the rate of births with congenital defects in Honolulu County for 1968-1972 and 1978-1982 were the same. Similar findings were shown by this data.

The prevalence of neonatal anemia was similar in both years. However, anemia in infancy seemed to be higher in the 1970s than in the 1980s but this was not statistically significant. The most common medical problems at infancy for both years were: cough, fever, diarrhea, vomiting and upper respiratory tract infections.

Table 90 shows the intake of the different food groups and vitamin/mineral supplements by the infant population. Breast milk was more popular in the 1980s than in the 1970s; also more women were breast-feeding at the latter months in the 1980s. Whole milk was started later in the 1980s as compared with the 1970s where women started giving whole milk at 1 month to the infants. The intake of fruit juice, cereals, vegetables, fruits, meats and alternates, high meat dinners, desserts, table foods and finger foods was greater in the 1980s than in the 1970s. A tendency towards an earlier introduction of these solid foods was seen in the 1970s; in the 1980s, more women introduced them at about 4-6 months. More infants in the 1980s than in the 1970s were taking vitamins and minerals and fluoride and this intake continued up to 1 year of age.

Table 91 shows the dietary analysis of the diets of the infant population starting at one month to 12 months of age. As shown on the table and Figure 22, more infants in the 1970s had diets that fell below 66% of the RDA in all time periods. However, more infants in the 1980s had diets that were above 120% of the RDA at all time periods. No infant in the 1970s at 2-12 months had diets that rose above 120% of the RDA. This data indicated that more infants in the 1970s had inadequate diets; and that more infants in the 1980s had diets leaning toward excessive intakes. The lack of food in the 1970s due to the absence of the WIC Program may be responsible for the larger number of infants that had inadequate diets. On the other hand, overfeeding in the 1980s may be due to lack of knowledge by the mothers on how to feed their infants with the food obtained from the WIC Program.

In summary, infants born in the 1980s were taller and slightly heavier than infants born in the 1970s. Fewer infants in the 1980s fell below the 5th percentile for length and weight for length compared with infants born in the 1970s. Generally, female infants were shorter and lighter than male infants for both years. There was also less anemia and more infants with adequate diets in the 1980s compared with the 1970s. The above improvements may be due to the beneficial effects of the health and nutrition education provided by the MIC clinic and the WIC Program. The positive effects of the WIC Program on heights, weights and hemoglobin status have been documented by other studies (103, 104).

However, infants in the 1980s had statistically lower birth Apgar scores at 5 minutes and statistically lower head circumferences during the first year of life compared with infants

born in the 1970s. The significance of this finding cannot be ascertained. Due to the small sample size, trends can only be shown but no definite conclusions can be drawn. More infants in the 1980s tended to consume excessive diets as compared to infants in the 1970s. This indicated a lack of knowledge on the part of the mothers on how to feed their infants. Therefore, a target for nutrition education is to teach mothers how to feed their infants to avoid overfeeding them.

c. Preschool Children (1 to 6 Years)

Table 92 shows the demographic and physical characteristics at birth of the preschool population during 1972-73 and 1982 (the number of records needed were obtained in one year so only 1982 records were utilized). The mean age of the subjects was between 2.3-2.7 years old. The age of the subjects in the 1980s were slightly older but this was not statistically significant. Fifty three percent were males and 47% were females in the 1970s; sixty three percent were males and thirty seven percent were females in the 1980s. Only 2% (1 mother) of women were below 18 years in both groups of subjects (not shown on table). There were fewer number of children in the family in the 1980s compared with the 1970s but this was not statistically significant.

There was a tendency for the total population of infants in the 1980s to be longer at birth particularly the male infants but not the female infants compared with those born in the 1970s but this was not statistically significant. There was also a tendency for the male and female infants in the 1980s to be heavier at birth than infants born in the 1970s but this was not statistically significant. The percent of low birth weight infants for both years

were approximately the same, 4% (2 infants) in the 1970s and 6% (3 infants) in the 1980s (Table 97). Eight percent (4 infants) of infants born in the 1980s had birth weights that rose above the 95th percentile of weight for height; there was none in the 1970s (Table 97). No data was collected for the birth head circumference for the 1970s. There was no significant difference in the birth head circumference between male and female infants in the 1980s. Twelve percent of infants (4 infants) in the 1980s had birth head circumference less than the 5th percentile; 3% (one infant) had a head circumference that was above the 95th percentile (Table 97).

Mean birth Apgar scores at 1 minute and 5 minutes of infants born in the 1980s were lower than that of infants born in the 1970s; this was only statistically significantly lower at 5 minutes. Five percent of infants (2 infants) born in the 1980s had Apgar scores at 1 minute of less than 4; in contrast, no infant born in the 1970s had Apgar scores at 1 minute of less than 4. There were no infants with Apgar scores at 5 minutes of less than 4 in both groups of subjects (Table 97).

Table 93 shows the mean length or height and age at three time periods, namely: 1-2, 3-4 and 5-6 years between the two groups of subjects. There was a tendency for children born in the 1980s at the different time periods to be shorter than children born in the 1970s with the exception of boys at 1-2 and 5-6 years in the 1980s. However, this was not statistically significant. The mean age between the two periods were approximately the same except that the total population of 3-4 year olds and boys in the 1980s were significantly younger. Girls were generally shorter than boys in most time periods in both years except in girls 5-6 years born in

the 1970s. Girls 1-2 years in the 1980s were significantly shorter than boys in the 1980s; they were also significantly younger in age than the boys in the 1980s.

Six percent (2 infants) of infants at 1-2 years in the 1970s fell below the 5th percentile for length according to the reference standard; 9% (2 infants) at 3-4 years and none at 5-6 years. For infants born in the 1980s, 7% (3 infants) fell below the 5th percentile for length at 1-2 years; 6% (2 infants) at 3-4 years and 14% (one infant) at 5-6 years. More infants in the 1980s fell below the 5th percentile for length or height compared to those born in the 1970s.

Three percent of infants (1 infant) at 1-2 years in the 1970s rose above the 95th percentile for length; none at 3-4 years and 6% (1 infant) at 5-6 years. For the 1980s, seven percent of infants (3 infants) at 1-2 years rose above the 95th percentile for length; none rose to greater than 95th percentile at 3-4 and 5-6 years.

Table 94 shows the mean weight and age of the boys and girls at three different time periods between the two groups of subjects. Preschool children in the 1980s had a tendency to be lighter compared with preschool children in the 1970s with the exception of boys 5-6 years in the 1980s. However, this was only statistically significant for girls aged 1-2 and 3-4 years and the total population of boys and girls aged 3-4 years in the 1980s. The mean age of the total population of boys and girls aged 3-4 years in the 1980s were significantly younger compared to children in the 1970s. This may account for the lighter weight of preschool children age 3-4 years in the 1980s. Girls in both years tended to be lighter than boys at the three time periods; this was only significant for

girls aged 1-2 years in the 1980s. Girls 1-2 years in the 1980s were also significantly younger and this may account for their significantly lighter weight.

No children in the 1970s fell below the 5th percentile for weight at the three time periods (Table 97). In contrast, 12% of subjects (5 children) at 1-2 years and 6% of subjects (2 children) at 3-4 years in the 1980s fell below the 5th percentile of weight for length. No children aged 5-6 years in the 1980s fell below the 5th percentile for weight. Thus, more children in the 1980s fell below the 5th percentile of weight for height as compared with children in the 1970s.

Nine percent of children (9 children) at 1-2 years, five percent (1 child) at 3-4 years and 6% (1 child) at 5-6 years in the 1970s rose above the 95th percentile of weight for height. In the 1980s, 5% of children (2 children) at 1-2 years, none at 3-4 years and 14% (1 child) had weights that rose above the 95th percentile. More children in the 1970s had weights for heights that were above the 95th percentile compared with children in the 1980s.

Table 95 shows the head circumference at 1-2 years in the preschool population for both groups of subjects. There was no difference in the head circumference of the total population of subjects, boys or girls between the 1970s and 1980s. This was true even if the age of the children in the 1980s were significantly older. Girls in both years tended to have a smaller head circumference compared with boys but this was only significant for girls in the 1980s. For the children born in the 1980s, 5% (2 children) had head circumferences that fell below the 5th percentile and none in children born in the 1970s (Table 97). Two percent (1

child) of children in the 1980s and 8% (1 child) in the 1970s had head circumferences that rose above the 95th percentile.

Table 96 shows the mean hematocrit values of the two groups of subjects at three different time periods. Although the hematocrit values of children born in the 1980s tended to be higher compared to those born in the 1970s, this was not statistically significant. There was also no difference in the mean ages at the different time periods between the two groups of subjects.

Eight percent (1 child) of children in the 1970s at 1-2 years, 14% (1 child) at 3-4 years and none at 5-6 years fell below the standard as outlined in Table 97. Three percent (1 child) of children in the 1980s at 1-2 years, 5% (1 child) at 3-4 years and 13% (1 child) at 5-6 years fell below the standard (Table 97).

Table 98 shows other demographic, medical and nutritional characteristics of the preschool population during the years 1972-73 and 1982. There were more children using Medicaid as a form of medical insurance in the 1980s than in the 1970s. Sixty eight percent of children in the 1980s were enrolled in the WIC Program compared to none in the 1970s. There was an increase of breastfeeding in the hospital in the 1980s as compared to the 1970s. The number and percent of women with Caesarean rates also increased significantly in the 1980s as compared with the 1970s. All the above data supports the findings in the pregnant women and infant report.

There were fewer neonatal problems in the 1970s as compared with the 1980s. The most common problems in the 1980s were jaundice and phototherapy. The prevalence of jaundice was significantly higher in the 1980s compared with the 1970s. The number of

congenital anomalies tended to be higher in the 1980s but because the sample size is small, no definite conclusions can be drawn. Reports (102) have indicated no change in the rate of congenital anomalies between the 1970s and 1980s in the County of Honolulu. This report (102) also showed that Native Hawaiians have the highest rate of reported birth defects in the state for the years 1968-1982.

The most common medical problem of childhood in both years was upper respiratory tract infections. Allergy, obesity and behavioral disorders were more common in the 1970s as compared to the 1980s. Anemia was significantly higher in the 1970s. However, dental caries, and asthma was more prevalent in the 1980s than in the 1970s. Otitis media was also significantly higher in the 1980s than in the 1970s.

Table 99 shows the dietary analysis of the diets of the preschool population in both years. Figure 23 shows in graphic form the percent of subjects that fell below 66% of the RDA, greater than 66% and 120% of the RDA for the three time periods. As shown, more children in the 1970s for all three time periods had diets that fell below 66% of RDA compared with children in the 1970s. More children in the 1980s had diets that were greater than 66% of the RDA in the three time periods compared with children in the 1970s. This may show the beneficial effects of the health and nutrition education program through the MIC and WIC Programs. Again, because of the small number of records at the latter years, only trends could be shown but no definite conclusions can be drawn.

In summary, data showed that the mean age of the 1980 preschool population were slightly older and there were more male infants than

female infants compared with children born in the 1970s. This may account for the slightly greater mean length and weight at birth of 1980 infants compared with 1970 infants. The significance of a lower Apgar score at 5 minutes of 1980 infants compared with 1970 infants cannot be ascertained.

In the follow-up of these infants through the 6th year of life, it was noted that children in the 1980s were shorter and lighter than children in the 1970s. Girls in both time periods were generally shorter than boys. In some instances, as in the 3-4 year old group, the difference in weight was due to a younger age of the 1980 population compared with the 1970 population.

In looking at individual data, it was also noted that more children in the 1980s had lengths or heights and weights that fell below the 5th percentile of the standard. More children in the 1970s had heights and weights that rose above the 95th percentile of the standard compared with children in the 1980s.

There was no difference in the head circumference of children born in the 1980s and the 1970s inspite of the greater age of children in the 1980s. Hematocrit values also were not different between the two groups of subjects although data on prevalence of anemia (Table 97) was greater in the 1970s as compared with the 1980s. The prevalence of neonatal jaundice, dental caries, asthma and otitis media was higher in the 1980s than in the 1970s. The significance of the difference in anthropometric (height, weight, head circumference), laboratory and clinical findings between the two groups of subjects show trends but no definite conclusions can be drawn because of the small sample size.

The increased use of Medicaid as a form of medical insurance,

the increase in Caesarean rates, use of the WIC Program and increased prevalence of breast-feeding in the 1980s were similar to the findings reported in the pregnant women and infant data. Dietary analysis also showed that children in the 1980s had better diets than children in the 1970s and this may be due to their enrollment in the WIC Program.

There were some improvements in the general health and nutritional status of children in the 1980s as compared with children in the 1970s. This included less anemia and better diets of children. This may be due to the nutrition and health education done in the clinics. However, there were still some children in the 1980s who were below the 5th percentile of height, weight for height and head circumference. This indicates a need for more nutrition education among the mothers on how to feed their children. Also, to ensure proper growth and development, good nutrition should be emphasized during the prenatal period for this will influence the future physical and mental development of their offspring. Again, due to the small sample size, only trends are shown but no definite conclusions can be drawn.

2. Waianae Coast Comprehensive Health Center

Table 100 shows the identified risk conditions by age group in the 900 Native Hawaiian subjects who came to the WCCHC. As shown in this table, the 4 leading nutrition or health risks identified were underweight, obesity, anemia and perinatal complications (miscarriage, stillbirth, neonatal death and prematurity). There were 51 cases of diabetes and 32 cases of cardiovascular hypertensive disease; 719 clients were also shown to have inadequate diets.

The patient sample provided above is not truly a representative sample, but results are suggestive of the number of nutritional related problems existing in the Native Hawaiian population.

IV. DISCUSSION

Early studies beginning with the Kauai Pregnancy Study of 1953 (29-32) and later reports in the 1980s by the Hawaii State Department of Health (34, 38) have documented that the pregnant Native Hawaiian women had poor pregnancy outcomes. Infants born to Native Hawaiian women generally had higher fetal deaths, higher neonatal mortality rates, higher infant mortality rates and have a higher percentage of low birth weight infants than infants born to women of other ethnic groups. In addition, a large number of these infants were born to mothers age 19 years and younger (35), a situation which may account for the high incidence of low birth weight and premature babies in the Native Hawaiian population. Good nutrition is important for the proper growth and development of the fetus and for the optimal health of the mother. Poor nutrition leads to fetal wastage, low birth weight or prematurity, congenital malformations or varying forms of functional disabilities in the fetus depending upon the time when nutrient deficiencies occur. Although nutrition is known to be one of the environmental factors which affect pregnancy outcome, no studies have been done to determine the dietary intakes of the Native Hawaiian pregnant women and to relate this to their poor pregnancy outcomes. Thus, this kind of study is necessary to ascertain their needs and to plan nutrition intervention programs based on these needs.

An attempt was made to get an overview of the dietary practices of pregnant Native Hawaiians through the MIC data. Analysis of the

data revealed some changes in the dietary practices, nutritional status and pregnancy outcomes of these women during the period between 1970 to 1980. More women in the 1980s had poorer diets, drank alcohol at the initial interview and had lower hemoglobins; however, fewer women were overweight. More women in the 1980s had elective abortions and Caesarean sections; their babies had lower Apgar scores but were longer at birth. Improvements were a smaller family size, earlier access to prenatal care, more use of government programs such as Medicaid and WIC and greater prevalence of breast-feeding. These data showed that there were some improvements in the health and conditions of the pregnant woman due to advances in medical care, health, education, and government aid. However, this had only a moderate impact on her pregnancy outcome. Data also indicated that more women in the 1980s were at greater risk for nutritional deficiencies and thus, poorer pregnancy outcomes. Therefore, much work remains to be done to improve the mother's dietary habits and thus improve her pregnancy outcome. There is a need for nutrition education on what constitutes a balanced diet and avoidance of substances such as alcohol, nicotine, caffeine and others that may have an adverse effect on her fetus. It seems that there have been adequate education in other areas but not enough on the nutritional area to create an impact on the women's dietary practices.

It was shown from studies in the 1970s (46, 47) that trends in breast-feeding, bottle-feeding and introduction of semi-solid/solid foods for infants in Hawaii closely followed the national trend. These studies refer to a decline in breast-feeding, increase in formula feeding and early introduction of solid foods. The practice

of early introduction of solid foods to infants in the 1970's, especially of meat and poi by the Native Hawaiian mothers, may lead to overfeeding and obesity in later years. Data from the MIC Project revealed some significant changes that have occurred in the nutritional status and dietary practices of infants in the 1980s. These infants generally had greater length and weighed more than those born in the 1970s. Females for both years were generally shorter and weighed less than their male counterparts. There was also less anemia in the 1980s. However, the 1980 infants had slightly lower head circumference and lower Apgar scores. The significance of the anthropometric findings cannot be ascertained and due to the small sample size, no conclusions can be drawn. Breast-feeding has increased in the 1980s and the use of whole milk from one to four months has declined. Infants in the 1980s were also consuming more foods such as fruits, juices, cereals, vegetables, meat and desserts and they were consuming these foods at a later age. Therefore, the introduction of solid foods has shifted later to 4-6 months in the 1980s as compared to 2 months in the 1970s.

The intake of more foods in the 1980s was responsible for the greater number of infants with diets greater than 120% of the RDA. More infants were also taking vitamin and mineral supplements in the 1980s; this was in contrast to the 1970s when supplementation was nil. Additional data showed that there were more Caesarean sections and greater use of government programs such as Medicaid and WIC in the 1980s. The reason for the better nutritional status of infants in the 1980s may be due to the use of these programs which involved the provision of resources and nutrition education. However,

mothers still need to be educated to avoid overfeeding their infants. The significance of a lower head circumference and lower Apgar scores among infants in the 1980s is not known and due to the small sample size, no definite conclusions can be drawn.

Although the prevalence of exclusive breast-feeding in the Native Hawaiian mothers has increased from 29% in 1969 (46) to 82% in 1984 (9), there remains a need to encourage more mothers to breast-feed. The encouragement of breast-feeding will further reduce infant morbidity and mortality and lead to better health of infants due to the known nutritional and immunological benefits of breast milk.

Obesity or overweight in the Native Hawaiian population was a problem that was evident even from the preschool years (51, 52). Native Hawaiian preschool children were found to be taller and heavier than their Oriental counterparts (52). Among the children attending the WIC program, 10% were found to be above the 95th percentile of weight for height indicating obesity (7). On the other hand, among these high risk populations of children utilizing WIC services, more than 10% of them at various ages were found to have a low height/age and low weight/height indicating undernutrition. Thus, both extremes of energy malnutrition, undernutrition and overnutrition, were found in the Native Hawaiian population. MIC data on the preschool population also showed extremes of malnutrition both for the year 1970 and 1980. The mean heights and weights of children in the 1980s were slightly lower than those from the 1970s. More children in the 1980s were shorter and underweight than children in the 1970s. This occurred despite a better diet among children in the 1980s as compared to the 1970s.

The better diet may be due to the provision of food by the WIC Program and other programs which provided additional resources to families in need during the 1980s. This again showed the need for nutrition education among mothers on how to feed their children using foods from the WIC Program. Additional data on the preschool population further reinforced the findings from the pregnant women and infant report. It included the fact that more infants in the 1980s had a lower Apgar score; and more women breast-fed their infants and were doing it for longer periods of time compared to the 1970s. Due to the small sample size from the preschool population, only trends can be shown and no definite conclusions can be drawn.

A survey of the dietary intakes of preschoolers in 1969 (50) showed that calcium, riboflavin, vitamin C and vitamin A were the nutrients most commonly found to be low in the diet. This was due to the poor intake of milk, green and yellow vegetables and citrus fruits. The more recent 1978 Hawaii Food Consumption Survey (27) indicated that children aged 1-5 were the lowest users of vegetables; and fruits were considerably less likely to be consumed than vegetables in a single day. However, 85% to 95% of children under 15 years were found to be the greatest consumers of milk and milk products on a given day. This was due to the availability of milk in school lunch, school breakfast and child feeding programs. Data from the MIC Project also showed that in the 1980s more children were drinking milk and consuming fruits, vegetables, cereals and meat. This was due to their enrollment in the WIC Program which provided them with these foods. The beneficial effects of a food supplemental program was evident.

Studies in 1984 (56) have also shown that Native Hawaiian

school age children were as tall as mainland children but were found to be heavier than U.S. mainland children and Oriental children in Hawaii. An assessment of the diet of school-age children based on the Hawaii Nutrition Education Needs Assessment in 1980 (8, 55) revealed that Native Hawaiian elementary school children consumed the highest amount of energy among all the other ethnic groups. They also had the greatest intake of high sugar foods and a high mean fat intake. They were second highest in the percent of calories contributed by fat to the total diet. At the junior high level they had the highest consumption of sugars and were second highest in the mean intake of fat and calories. At the senior level, although they no longer accounted for the group with highest caloric intake, they still ranked third highest among all others. The proportion of fat in the diet which was 40% of caloric intake, remained the same at all grade levels. Calcium and iron were the 2 nutrients found low in the diets of older children. Sodium intakes exceeded the recommended amounts among the elementary school children.

The Native Hawaiian adult was found to be at greater risk for cardiovascular disease, myocardial infarction, diabetes, hypertension, arthritis, gout and cancer of the breast, stomach and lung than adults of other ethnic groups living in Hawaii.

In studies relating diet to heart disease, dietary intakes and blood levels of certain nutrients have been measured. Results indicated some similarities and differences in the two parameters between the Hawaiian and Part-Hawaiian groups. Similar findings in both populations were increased serum triglycerides and increased blood pressure but normal uric acid levels.

Serum cholesterol concentrations as a whole were not elevated but seemed to vary by age with the highest concentrations in the age groups 20-39 and 50-59 years. In the Hawaiian population, the hematocrits were elevated; there were no data for the Part-Hawaiian population. In terms of dietary intake, both groups had a high intake of calories and fat in the diet. The type of fat in the diet varied; Hawaiians had higher intakes of polyunsaturated fat (PUFA) and lower cholesterol intakes while the Part-Hawaiians had higher saturated fat and cholesterol intakes with lower consumption of PUFA. Part-Hawaiian males also had a higher alcohol consumption, decreased carbohydrate, fiber, sucrose, fructose and caffeine intakes.

The nutritional factors found to be contributing to the incidence of these chronic diseases were obesity and diet. Obesity in the Native Hawaiian has been documented by several studies (60, 61, 64, 67) which was shown by a thicker triceps skinfold thickness and a weight for height above the recommended standards. The diet was generally high in calories due to large intakes of food or on some occasions, alcohol. There was also a record of a sporadic or widely fluctuating caloric intake (feast or famine pattern) ranging from 1,000 kcal for one day and 4,000 kcal during weekends. A high percentage of calories from the diet was from fat (40%), and most was in the form of saturated fat. There was less consumption of fiber, sucrose and fructose in the diet compared with other ethnic groups (62, 63). Thus, we can see a change in the diet of the ancient Hawaiians from a simple and nutritious diet of fish, taro, breadfruit, yams and greens which provided most of the essential nutrients (2) with the possible exception of vitamin C, to a diet of

the modern Native Hawaiian which consists of high fat, high sugar, highly refined and highly processed foods which may have contributed to the incidence of these chronic diseases. The change in dietary pattern with urbanization and the consequent increase in chronic diseases such as CHD, diabetes and cancer seem to be a pattern which occurred in various countries of the Pacific Basin (105-112).

More recent surveys (27) have been done on the dietary intake patterns of people living in Hawaii but results were not reported according to ethnicity. Thus, findings based on these surveys hardly give a clue on the dietary patterns of the modern day Native Hawaiian and other ethnic groups. Thus, nutritional studies are needed to determine the present eating habits of Native Hawaiians and changes that may have occurred in the Native Hawaiian community.

V. RECOMMENDATIONS

A. Nutrition

1. Nutrition Education

There is a need to educate the Native Hawaiian population regarding the essentials of a good diet using the most culturally effective means for nutrition education. The target population, purpose of nutrition education and content of nutrition education should be:

a. Pregnant women

Before and during pregnancy, teenage and adult pregnant women should be helped to appreciate the importance of good nutrition and its relation to a positive pregnancy outcome. They should also be informed of the detrimental effects of alcohol, drugs, excess caffeine and other substances to the fetus.

b. Mothers

They should be shown how to feed their infants and children. Since they are the role models in the home, they should provide an example to their children on proper nutrition. Thus, common nutritional problems in infancy and childhood such as obesity, anemia and dental caries may be avoided.

c. Children

Children should be taught how to plan and select a good diet both at home and in school. In order to avoid obesity, they should limit their energy, fat and sugar intake and to increase physical activity. To lessen dental caries, high intake of sugars should be avoided. Nutrition should be taught in day care centers and should be a part of the curriculum in the elementary and high schools. Public school teachers need to be trained in nutrition. Also, nutrition resource personnel are needed for the implementation of the nutrition curriculum.

d. Adults

To avoid the incidence of chronic diseases early in life, the Native Hawaiian population should be helped to follow a sensible dietary guideline (113). This includes maintaining a desirable body weight, eating a variety of foods, avoiding excessive fat, saturated fat, cholesterol, sugar and salt intake. Alcohol should also be limited since this contributes to the caloric content of the diet. Fiber intake could be increased by consumption of more fruits and vegetables. Complex carbohydrates may be consumed more by intake of whole grain cereals, starches and breads.

2. Research

Several areas were identified in which data were severely

lacking so that there is an inadequate assessment of the nutritional status of the Native Hawaiian population. These areas include the nutritional status of pregnant and lactating women, infants, preschool children and adults. Because of this inadequacy, the elucidation of the relationship between diet and pregnancy outcomes or development of obesity and other chronic diseases throughout the life cycle had been severely hampered.

No careful studies have been done on the dietary intakes of pregnant and lactating women. The MIC data provided some clues for the changes that have occurred in their dietary patterns within a decade. More data need to be collected from the MIC Projects (Waimanalo, Nanakuli, Hilo), WCCHC, WIC, various health centers, hospitals and other facilities which serve the Native Hawaiian population. A prospective study needs to be done to investigate the dietary intakes of pregnant Native Hawaiian women and to relate this to their pregnancy outcomes and chronic conditions of mother and infant. Investigation of risk factors on pregnancy outcomes such as the intake of alcohol, drugs, caffeine, nicotine and other substances needs to be done.

Data on the dietary intakes of Native Hawaiian infants and preschool children are outdated, since they were collected in 1969. A survey of the infant feeding practices and dietary intakes of preschool children of Hawaiian ancestry needs to be undertaken and related to the incidence of obesity. Dietary data relating to CHD in the Native Hawaiian population are also outdated since they were conducted in the 1970s; thus new data need to be collected and related to the incidence of CHD and other related disorders such as cancer, diabetes, arthritis and gout.

Research also needs to be done on better ways to change Native Hawaiian behavior to promote a healthier lifestyle within a culturally appropriate framework.

3. Nutrition Surveillance

There is a need for a good system of nutrition data collection, retrieval, dissemination and surveillance. Data such as height, weight, hematocrit, hemoglobin and dietary intakes of persons attending the various health centers, hospitals and programs may be submitted to the state or CDC for continued Pediatric and Pregnancy Nutrition Surveillance. Reports generated by CDC will be sent back to these organizations for continued monitoring and evaluation. There is also the need for a continued nutrition surveillance not only in children but also in the adult population to determine nutritional needs and evaluate the effectiveness of nutrition education programs. Data on heights, weights, hemoglobin, hematocrit, serum cholesterol levels and dietary intakes would be useful. These data may be collected at the various sites which provide health care to the adult population and sent to CDC for tabulation and analysis. Although the CDC is not presently collecting data on the adult population, except in pregnant women, they may be persuaded to undertake this task because of its potential beneficial effects.

4. Promotion of Breast-Feeding

Since breast-feeding is beneficial both for the mother and the infant, this should be encouraged as the preferred method of infant feeding. The incidence of breast-feeding in the Native Hawaiian women has increased from 29% in 1969 to 81.5% in 1984. However, only 52.6% were exclusively breast-feeding at hospital discharge and

22% of women stop breast-feeding at 8 weeks due to mixed feeding. Therefore, there remains a need to encourage Native Hawaiian women to breast-feed exclusively and follow the 1990 objectives for Hawaii which states that the prevalence of exclusive breast-feeding should be increased to 75% at hospital discharge and 65% at 8 weeks (114). Thus, strategies needs to be developed to accomplish this. There is a need to validate whether the reasons cited for not choosing to breast-feed is apppllicable to the Native Hawaiian mothers. There is a need to educate health professionals in the hospital and community to encourage women to breast-feed. Pregnant women should be shown the advantages of breast-feeding and how to breast-feed even before delivery. It is also useful to establish support groups in the community to help these new mothers to breast-feed successfully.

5. Continued Funding of Nutrition Programs

Studies have reported the beneficial effects of nutrition programs such as MIC (37), WIC (103, 104, 115), Headstart, School Lunch, School Breakfast, Expanded Food and Nutrition Education Program (EFNEP) and Nutrition Education Training (NET) Programs (26) especially of vulnerable groups such as pregnant women, infants and children. There should be continued support and funding for these programs because they are being reduced under the present Federal Administration and especially since the Native Hawaiian population were shown to be the greatest users of this program and have increased their use of these programs.

6. Provision and Promotion of Native Hawaiian Cultural Food Resources

Sources of Native Hawaiian foods such as taro, sweet potato and yams have diminished with development and urbanization. Fishing grounds and rights have also been lost. Legislation is needed to

restore the basic food supply of the Native Hawaiians. Programs to promote economic feasibility for farming of taro and other Native Hawaiian foods in addition to cultivation of fish in the traditional manner should be developed and promoted. The use of traditional foods needs to be encouraged among the Native Hawaiian population.

B. DENTAL

Recommendations

These recommendations were formulated after readings from a number of sources including the SHPDA Task Force recommendations and those from the 1990 Governor's Task Force on Health Promotion and Disease Prevention (90). In addition, individual contacts with private dentists, dental clinic personnel, the Head Start Dental hygienist, the UH Dental Hygiene staff, the UH School of Public Health staff and Native Hawaiian Health professionals have all given information which led to these recommendations.

1. Fluoridation of Water Supply

Assistance is needed by Hawaii in its effort to fluoridate all publicly owned water systems immediately. Owners of private water systems should be offered incentives and/or assistance in fluoridating their water system as well. Alternative methods of fluoridation (i.e., self applied school fluoride programs such as rinses, sealants and supplements) should be provided to all children until they have access to fluoridated water.

2. Dental Education

Educational programs addressing oral hygiene, routine preventive dental care for caries and periodontal disease control should be escalated immediately and made available to all adults and families using various media, dental insurance providers, employers

and the professional providers and dental associations. Particular attention and preference should be given to those groups and individuals who exhibit higher than usual rates of poor oral hygiene, DMF, periodontal disease and other dental health problems as determined in survey studies.

Escalate immediately dental education and hygiene programs within public and private preschools, kindergarten and elementary schools beginning in areas determined in previous surveys to have unusually high rates of poor dental health. The public schools should have an adequate professional resource of dental health personnels available for consultation, i.e., hygienists, dentists and aides, to carry out this program.

To reduce hesitancy to dental visits and fear of dental procedures by patients, it is necessary to assist teachers and dental professionals in identifying and developing educational tools which discuss treatment modes and methods that are culturally sensitive, in appropriate languages and acceptable for all ethnic groups in Hawaii.

3. Research and Early Dental Treatment

Agencies such as the DOH Dental Health Division, Hawaii Dental Association, and the University of Hawaii's Department of Dental Hygiene and School of Public Health should work together to perform regular dental surveys of Hawaii's population. Special attention should be given to children and those previously identified as having a high rate of dental problems, to determine their oral hygiene, periodontal disease and treatment status.

Immediate and appropriate treatment should be provided close to the survey site, at no or low cost to those who are without dental

insurance or without adequate dental insurance.

4. Dental Protection in Sports

Provision of maximum protection against dental injuries for all youngsters involved in competitive sports by providing appropriate mouth and head guards in sports such as basketball, soccer and hockey.

REFERENCES

REFERENCES

List of Journal Abbreviations

1. World Rev Nutr Diet - World Review of Nutrition and Dietetics
2. Dental Cosmos - Dental Cosmopolitan
3. Am J Public Health - American Journal of Public Health
4. Am J Obstet Gynecol - American Journal of Obstetrics and Gynecology
5. Pub Health Rept - Public Health Reports
6. J Am Diet Assoc - Journal of the American Dietetic Association
7. Trop Geogr Med - Tropical and Geographical Medicine
8. Ann Allergy - Annals of Allergy
9. Am J Clin Nutr - American Journal of Clinical Nutrition
10. J Chron Dis - Journal of Chronic Diseases
11. JAMA - Journal of the American Medical Association
12. Brit Med J - British Medical Journal
13. J Nutr - Journal of Nutrition
14. Br J Cancer - British Journal of Cancer
15. J Agric Food Chem - Journal of Agricultural Food Chemistry
16. J Am Dental Association - Journal of the American Dental Association
17. J Dent Res - Journal of Dental Research
18. J Periodont Res - Journal of Periodontal Research
19. Ecol Food Nutr - Ecology of Food and Nutrition
20. Ann Human Biol - Annals of Human Biology

References

1. Bryan E Jr. Ancient Hawaiian Life. Reprint for Books About Hawaii, 1970.
2. Miller C. The Influence of Foods and Food Habits Upon the Stature and Teeth of the Ancient Hawaiians. In: Snow, CE. Early Hawaiians: An Initial Study of Skeletal Remains From Mokapu, Oahu. The Univ. Press of Kentucky, 1974.
3. Malo D. Hawaiian Antiquities. 2nd Edition. Honolulu: Bernice P. Bishop Museum, Honolulu, 1951.
4. Potgieter M. The Adequacy of Diets of 38 Honolulu Families on Relief. University of Hawaii: Hawaii Agricultural Experiment Station, Bulletin #94, June 1944.
5. Potgieter M, Nakatani K. Diet and Health in Rural Hawaii. University of Hawaii: Hawaii Agricultural Experiment Station, February 1954.
6. Lichton I, Bullard L, Sherrell B. A Conspectus of Research on Nutritional Status in Hawaii and Western Samoa - 1960-1980 With References to Diseases in Which Diet Has Been Implicated. World Rev Nutr Diet 1983; 41:40-75.
7. Center for Disease Control Nutrition Surveillance Data. Preliminary - WIC Program. Honolulu, Hawaii: January 1982-February 1984.
8. Lai M, Shimabukuro S, Kanda J, Toguchi A, Janeway-Fenton K, McCord C, Murray A. Hawaii: Nutrition Needs Assessment - Final Report. University of Hawaii, Honolulu, Hawaii: Curriculum Research and Development Group, May 1980.
9. Health Provider's Survey. Edie Sukanuma (Informant). Honolulu, Hawaii: Hawaii Mother's Milk Bank and MCH, School of Public Health, University of Hawaii, November 1984.
10. Chapell HG. Jaws and Teeth of Ancient Hawaiians. Bernice Bishop Museum, Bulletin 4, 1927.
11. Lai, LJJ. An Oral Examination of Early Hawaiians. In: Snow CE. Early Hawaiians. Appendix C. University Kentucky Press, 1974.
12. Jones M, Larsen NP, Pritchard GP. Taro and Sweet Potatoes Versus Grain Foods in Relation to Health and Dental Decay in Hawaii. Dental Cosmos, 1934.
13. Hawaii State Health Planning and Development Agency. Hawaii State Plan. Honolulu, Hawaii: State Department of Health. 3rd Ed., 1979.

14. Oyama N. Dental Survey Utilization Study: State of Hawaii. State Health Planning and Development Agency with the Cooperation of the Health Surveillance Program, October 1981. Research and Statistics Office, Hawaii State Department of Health, July 1982.
15. Food and Nutrition Board, National Research Council, National Academy of Sciences. Recommended Dietary Allowance. 9th Ed. Washington D.C., 1980.
16. Brennan J, Witz L. Stat 1 - A Statistical Toolbox. Sugar Mill Softwares Corporation, 1984.
17. Dixon, WJ, Massey FJ Jr. Introduction to Statistical Analysis. New York: McGraw Hill Company, 1969.
18. Maxwell AE. Analyzing Quantitative Data. New York: John Wiley and Sons, Inc., 1961.
19. Weight By Height and Age for Adults 18-74 Years: U.S., 1971-74. U.S. Department of Health, Education and Welfare, Public Health Service, Office of Research, Statistics and Technology, National Center for Health Statistics. Vital and Health Statistics, Data From the National Health Survey, Series II, Number 208, 1979.
20. National Center for Health Statistics: NCHS Growth Charts, 1976. Monthly Vital Statistics Report, Vol. 25 #3, Supp. (HRA) 76-1120. Rockville, Maryland: Health Resources Administration, June 1976.
21. Marlow D. Textbook of Pediatric Nursing. 5th Ed. Philadelphia: WB Saunders Company, 1977.
22. Christakis G. Nutritional Assessment in Health Programs. Am J Publ Hlt Supp 1973; 63:34.
23. Sauberlich HE, Dowdy RP, Skala JH. Laboratory Tests for the Assessment of Nutritional Status. Cleveland, Ohio: CRC press, 1974.
24. Profile of Waianae Coast Comprehensive Health Center Nutrition Caseload, Waianae, Hawaii: Waianae Coast Comprehensive Nutrition Program, August 1985.
25. Abel M. Racial Foods in Hawaii. Honolulu, Hawaii: Department of Health, 1968.
26. Dannemiller J, Maretzski A. Dietary Patterns in Hawaii: Methodology. Technical Report #1. Final Report 1985. Honolulu, Hawaii: Policy Research Incorporated and Department of Food Science and Human Nutrition, University of Hawaii.

27. Shimabukuro S, Maretzski A. The Hawaii Food Consumption Survey. 1978: Implications for Health and Nutrition Policy. Honolulu, Hawaii: University of Hawaii Technical Report No. 5, Final Report 1985.
28. Durrrough SAL. Food Habits and Attitudes of Young Adults 18 to 26 Years Old in Hawaii. Honolulu, Hawaii: University of Hawaii, Department of Food Science and Human Nutrition, August 1984. MS Project Report.
29. Yerushalmy J, Bierman J, Kemp D, Connor A, French F. Longitudinal Studies of Pregnancy on the Island of Kauai, Territory of Hawaii. Am J Obstet Gynecol 1956; 71:80.
30. French F, Bierman J. Probabilities of Fetal Mortality. Pub Health Rept 1962; 77:835.
31. Bierman J, Siegel E, French F, Simonian K. Analysis of the Outcome of All Pregnancies in a Community. Am J Obstet Gynecol 1965; 91:37.
32. French F, Howe L, Bierman J, Connor A, Kemp D. Community Wide Reporting in Kauai, Hawaii. Pub Health Rep 1958; 73:61.
33. Huenemann R, French F, Bierman J. Diets of Pregnant Women in Kauai. J Am Diet Assoc 1961; 39:569-577.
34. Burch T. Statistical Report (1970). Honolulu, Hawaii: Department of Health, State of Hawaii, 1972, p.46-49.
35. Stringfellow L, Wooton MJ, Hustace M, Burch T, Reyes B, Colby D. Adolescent Fertility in Hawaii: Implications for Planning. Hawaii Med J 1978; 37:105-113.
36. Statistical Report. 1984 Statistical Supplement. Honolulu, Hawaii: State of Hawaii Department of Health.
37. Schmidt D, Onzuka K, Drorbough J. Hilo Maternity and Infant Care Clinic - An Evaluative Study. Honolulu, Hawaii: Research and Statistics Office, Hawaii State Department of Health, R and S Report, October 1979.
38. Statistical Report. 1982 Statistical Supplement. Honolulu, Hawaii: State of Hawaii Department of Health.
39. Organizing Perinatal Services to Improve the Health of Mothers and Children in Hawaii. Honolulu, Hawaii: Regional Perinatal Planning Program and Maternal and Child Health Branch, Family Health Services Division, Department of Health, State of Hawaii, March 1984.
40. Dirige O, McNutt S, Hamatake C, Manayan C. A Study of the Nutritional Status of Pregnant Filipino Women in Hawaii. New Orleans: Am Diet Assoc: Meeting (Abstract), 1985.

41. Worthington-Roberts B, Vermeersch J, Williams SR. Nutrition During Pregnancy and Lactation. 3rd Ed. St. Louis: CV Mosby Company, 1985.
42. Hendershot G. Trends and Differences in Breast-Feeding in the United States, 1970-74. National Center for Health Statistics, Working Paper #5, June 1981.
43. Martinez G., Nalizienski JP. The Present Trends in Breast-Feeding. Pediatrics 1979; 6:686.
44. Wallace H, Gold EM, Oglesby A. Maternal and Child Health Practices-Problems, Resources and Methods of Delivery, New York: John Wiley and Sons, Inc., 1982, p.492.
45. Martinez G, Dodd D. 1981 Milk Feeding Patterns in the U.S. During the First 12 Months of Life. Pediatrics 1983; 71:166.
46. Brown M, Adelson S. Infant Feeding Practices Among Low and Middle Income Families in Honolulu. Trop Geogr Med 1969; 21:53-61.
47. Brown M, Ho C. Low Income Groups in Hawaii. Practices of Low Income Families in Feeding Infants and Small Children: With Particular Attention to Cultural Subgroups. In: Proceedings of a National Workshop. U.S. Department of Health, Education and Welfare, 1972.
48. Roth A, Worth RM, Lichton I. Use of Poi in the Prevention of Allergic Disease in Potentially Allergic Infants. Ann Allergy 1967; 25:501.
49. Hughes-Ho C, Brown M. Food Intake of Infants Attending Well Baby Clinics in Honolulu. J Am Diet Assoc 1970; 57#1:17.
50. Brown M, Smith D, Mertz J, Hill H, Adelson S. Diet and Nutrition of Preschool Children in Honolulu. J Am Diet Assoc 1970; 57:22-28.
51. Smith D, Brown M. Anthropometry in Preschool Children in Hawaii. Am J Clin Nutr 1970; 23#7:932-939.
52. Smith D, Brown M. Growth Measures of a Selected Group of Preschool Children in Honolulu. Hawaii Medical Journal 1970; 29#5:375-377.
53. Wenkam NS, Wolff RJ. A Half Century of Changing Food Habits Among Japanese in Hawaii. J Am Diet Assoc 1970; 57:29.
54. Nutrition Surveillance. Annual Summary 1981. Centers for Disease Control. U.S. Department of Health and Human Services-Public Health Service, December 1983.

55. Lai M, Shimabukuro S. Ethnic Differences in the Nutritional Quality of Diets of Children in Hawaii. Honolulu, Hawaii: Curriculum Research and Development Group, University of Hawaii, 1980.
56. Lichton I, Pattabi Raman S, McGandy R. Anthropometry of Hawaii School Children. Honolulu, Hawaii: College of Tropical Agriculture and Human Resources, University of Hawaii, Research Series 036, November 1984.
57. Bennett C, Tokuyama G, McBride T. Cardiovascular Renal Mortality in Hawaii. Am J Pub Hlth 1962; 52#9:1418-1431.
58. Moellering R, Bassett D. Myocardial Infarction in Hawaiian and Japanese Males on Oahu - a Review of 505 Cases Occurring Between 1955 and 1964. J Chron Dis 1967; 20:89-101.
59. Lin TK, Kim JHC, Dung WMH, Miyawaki EH, Bennett JG. Myocardial Infarction in Kaiser Hospital, Honolulu (1959-1967). A Long Term Analysis. Hawaii Medical Journal. 1972; 31#4:257.
60. Bassett D, Rosenblatt G, Moellering R, Hartwell A. Cardiovascular Disease, Diabetes Mellitus, and Anthropometric Evaluation of Polynesian Males on the Island of Niihau, 1963. Circulation 1966; XXXIV:1088-1097.
61. Bassett D, Moellering R, Rosenblatt G, Greenberg D, Stokes J. Coronary Heart Disease in Hawaii. Serum Lipids, and Cardiovascular, Anthropometric and Related Findings in Japanese and Hawaiian Men. J Chron Dis 1969; 21:565-283.
62. Bassett D, Abel M, Moellering R, Rosenblatt G, Stokes J. Coronary Heart Disease in Hawaii: Dietary Intake, Depot Fat, "Stress", Smoking and Energy Balance in Hawaiian and Japanese Men. Am J Clin Nutr 1969; 22#11:1483-1503.
63. Bassett D, Abel M, Moellering R, Rosenblatt G, Stokes J. Dietary Intake, Smoking History, Energy Balance, and "Stress" in Relation to Age, and to Coronary Heart Disease Risk in Hawaiian and Japanese Men in Hawaii. Am J Clin Nutr 1969; 22:1504-1520.
64. Healey L, Caner JEZ, Bassett D, Decker J. Serum Uric Acid and Obesity in Hawaiians. JAMA April 25, 1966; 196#4:152-153.
65. Prior IAM, Rose BS, Davidson F. Metabolic Maladies in New Zealand Maoris. Brit Med J April 25, 1964; 1:1065-1069.
66. Adamson L. Serum Cholesterol Concentrations of Various Ethnic Groups in Hawaii. J Nutr 1960; 71:27-36.
67. Morioka H, Brown M. Incidence of Obesity and Overweight Among Honolulu Police and Firemen. Pub Hlth Rept May 1970; 85#5:433-439.

68. Young F, Lichton IJ, Hamilton RM, Durrough SAL, Alford E. Body Weight, Blood Pressure and Electrolyte Excretion of Young Adults From Six Ethnic Groups in Hawaii. Am J Clin Nutr. To be published.
69. Curb JD. The Molokai Heart Study. The American Heart Association/Chapter Grant in Aid Award Application, School of Public Health, University of Hawaii, 1983.
70. Sloan N. Ethnic Distribution of Diabetes Mellitus in Hawaii. JAMA 1963; 183#6:123-128.
71. Varney J, Sato M. Diabetes in Hawaii: Arthritis/Rheumatism and Gout in Hawaii: Some Statistical Analysis. Hawaii Medical Journal. 1979; 38:197-201.
72. Hankin J. Diet and Cancer. Community Health Studies. 1981; V:126-132.
73. Kolonel LN, Hankin JH, Lee J, Chu SY, Nomura AMY, Ward Hinds M. Nutrient Intakes in Relation to Cancer Incidence in Hawaii. Br J Cancer 1981; 44:332.
74. Kolonel L, Hankin J, Nomura A, Ward Hinds M. Studies of Nutrients and Their Relationship to Cancer in the Multiethnic Population in Hawaii. Honolulu: Unpublished Communication. Cancer Center of Hawaii, 1985.
75. Ichinotsubo D, Mower HF. Mutagens in Hawaiian Dried/Salted Fish. J Agric Food Chem 1982; 30:939-39.
76. Alfano MC. Dental Caries: the Nature of the Problem. Cereal Foods World. 26; 1, p.5, January 1981.
77. Jenkins N. Diet and Dental Caries. Food and Nutrition. November/December 1984; 56:5.
78. Schachtele CF. Changing Perspectives on the Role of Diet in Dental Caries Formation. Nutrition News December 1982; 45:4, p.1.
79. Worthington-Roberts BS. Contemporary Developments in Nutrition. St. Louis: C.V. Mosby, Co. 1981.
80. Center for Disease Control. Perspectives in Disease Prevention and Health Promotion: Dental Caries and Community Water Fluoridation Trends - United States. MMWR, Volume 34:6, February 15, 1985.
81. City and County of Honolulu Board of Water Supply. Telephone Communication. October 1985.
82. Richmond VL. Thirty Years of Fluoridation: A Review. Am J Clin Nutr 1985; 41:129-138.

83. Jelliffe EF, Jelliffe DB. Children in Ancient Polynesian Hawaii. Clinical Pediatrics October 1964; Volume 3: No.10.
84. Hardy ESC, Pukui M. The Polynesian Family System of Kau. Charles E. Tuttle Co., 1972.
85. Pukui MK. Hawaiian Folkways of Posture and Body Molding. In: Snow, C.E.: Early Hawaiians. Appendix D. University Kentucky Press, 1974.
86. Kau MCW, Robinson JR, Bennett CG. Dental Caries Among Hawaii's School Children. J Am Dental Association November 1961; Volume 63, p.653.
87. Chung CS, Hankin JH, Miyamoto W, Kau MCW. Dental Plaque and Dietary Intake in School Children in Hawaii. J Dent Res January 1977; 56:1, p.11.
88. Chung CS, Rurick DW, Niswander JD, Bilbin SE, Kau MCW. Genetic and Epidemiologic Studies of Oral Characteristics in Hawaii's School Children: I Caries and Peridontal Disease. J Dent Res December 1970; 49:6, p.1374.
89. Chung CS, Kau MCW, Chung SSC, Schendel SA. A Genetic and Epidemiological Study of Peridontal Disease Intrusion. 1. Racial and Other Epidemiologic Factors. J Periodont Res 1977; 12:, p.148-159.
90. Hankin JH, Chung CS, Kau MCW. Genetic and Epidemiologic Studies of Oral Characteristics in Hawaii's School Children: Dietary Patterns and Caries Prevalence. J Dent Res October 1973; 52:5, p.1079-1086.
91. Fluoridation and Dental Health Study Group. Honolulu, Hawaii: Governor's Conference on the 1990 Health Objectives, Honolulu, 1985.
92. Ho'ola Niho; A Comprehensive Approach for Improving Oral Health for Minority Children With Specific Implications for Native Hawaiian Children. ALU LIKE Inc., Honolulu, Hawaii, January 1985.
93. Native Hawaiians Study Commission. Report on the Culture, Needs and Concerns of Native Hawaiians. Volume I, June 1983.
94. Weight and Height of Adults, 18-74 Years of Age: U.S., 1971-74. U.S. Department of Health, Education and Welfare. Public Health Service, Office of Health Research, Statistics and Technology. National Center for Health Statistics. Vital and Health Statistics, Data from the National Health Survey, Series 11 #211, 1979.

95. Pitkin R, Apellacy W. Physiologic Adjustments in General. In: National Research Council, Committee on Nutrition of the Mother and Preschool Child, eds. Laboratory Indices of Nutritional Status of Pregnancy. Washington D.C.: National Academy of Sciences, 1978.
96. Statistical Report. 1984. Honolulu, Hawaii: Department of Health, State of Hawaii.
97. Placek PJ, Taffel A., Moien M. Cesarean Section Delivery Rates: United States, 1981. Am J Publ Hlt 1983; 73:861.
98. E Ola Mau. The Native Hawaiian Health Needs Study. Medical Task Force Report. Honolulu, Hawaii: The Native Hawaiian Health Research Consortium, ALU LIKE, Inc., December 1985.
99. Cassidy, C. Subcultural Prenatal Diets of Americans. In: Alternative Dietary Practices and Nutritional Abuses in Pregnancy. Proceedings of a Workshop. Committee on Nutrition of the Mother and Preschool Child. Food and Nutrition Board, National Research Council. Washington D.C.: National Academy Press, 1982.
100. Hytten FE, Thomson AM. Maternal Physiological Adjustments. In: Committee on Maternal Nutrition/Food and Nutrition Board, National Research Council, eds. Maternal Nutrition and the Course of Pregnancy. Washington D.C.: National Academy of Science, 1970, p.57.
101. Consumer and Food Economics Research Division, Agricultural Research Service. Dietary Levels of Households in the United States, Spring 1965. U.S. Dept. Agr. Household Food Consumption Survey 1965-1966, Rept. No.6, Washington D.C., U.S. Government Printing Office, 1969.
102. Frequency of Reproductive Dysfunction in Hawaii by Race and Judicial District 1968-1982. R & S Report. Research and Statistics Office, Hawaii State Department of Health, December 1984, p.2-3.
103. Heimendinger J, Laird N, Austin JE, Timmer P, Gershaff S. The Effects of the WIC Program on the Growth of Infants. Am J Clin Nutr 1984; 40:1250-1257.
104. Miller V, Swaney S, Deinard A. Impact of the WIC Program on the Iron Status of Infants. Pediatrics 1985; 75#1:100-104
105. Hankin J, Dickinson L. Urbanization, Diet and Potential Health Effects in Palau. Am J Clin Nutr 1972; 25:348-353.
106. Hankin J, Reed D, Labarthe D, Nichaman M, Stallones R. Dietary and Disease Patterns Among Micronesians. Am J Clin Nutr 1970; 23:346-357.

107. Thaman RR. Food for Urbanizing Polynesian People. University of the South Pacific, Suva, Fiji. Unpublished Paper.
108. Coyne T. The Effect of Urbanization and Western Diet on the Health of the Pacific Island Populations. South Pacific Commission, December 1981.
109. Lambert J. The Effect of Urbanization and Western Foods on Infant and Maternal Nutrition in the South Pacific. Food and Nutrition Bulletin 1982; 4#3:11-13.
110. Bindon J. An Evaluation of the Diet of Three Groups of Samoan Adults: Modernization and Dietary Adequacy. Ecol Food Nutr 1984; 14:105-115.
111. Bindon JR. Modernization, Migration and Obesity Among Samoan Adults. Ann Human Biol 1985; 12:67-76.
112. Coyne T. The Effect of Urbanization and Western Diet on the Health of Pacific Island Populations. In: Bodcock J, Taylor R, eds. Technical Paper #186, South Pacific Commission, Naumen, New Caledonia, December 1984.
113. Dietary Guidelines for Americans. U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1985.
114. Nutrition - Hawaii Objectives for 1990. Honolulu, Hawaii: Nutrition Study Group for the Governor's Conference on Health Promotion and Disease Prevention. Objectives for 1990 and Beyond, December 1985.
115. Dirige O, Hughes C. Demographic, Medical and Nutritional Characteristics of Native Hawaiian Women in the MIC Project. In: Native Hawaiian Health Research Consortium, ALU LIKE, Inc. E Ola Mau - Nutrition/Dental Task Force. Honolulu, Hawaii, 1986.

TABLES AND FIGURES

Table 1

Types of Subjects, Year of Patient Visit and
Number of Records Abstracted from the MIC Project

SUBJECT	YEAR OF PATIENT VISIT *									
	1970	1971	1972	1973	YEAR TOTAL	1980	1981	1982	YEAR TOTAL	OVERALL TOTAL
Pregnant Women	33	15	22	30	100	31	31	39	101	201
Infants (0-1 Year)	-	-	25	25	50	-	22	28	50	100
Preschool (1-5 Years)	-	-	38	11	49	-	-	49	49	98
Total	33	15	85	66	199	31	53	116	200	399

* Only one year in each decade was selected but if the number of records needed were not obtained in one year, records were obtained in the preceding or subsequent year close to it.

Reference: Dirige, O. and Hughes-Ho, C. A study of the nutritional status of pregnant Native Hawaiian women, infants and children at the MIC Project, Waimanalo, Hawaii, 1985.

Table 2
Number and Percentage of Family Diets Deficient* in
Each of the Eight Dietary Essentials

	CALORIES	PROTEIN	CALCIUM	PHOSPHORUS	IRON	VITAMINS		
						A	B	C
Number of family diets deficient in the various essentials								
Hawaiian		22	47	31	20	42	39	26
Oahu Japanese		6	36	22	6	33	38	11
Kona Japanese	11	7	24	16	4	18	24	11
Chinese	3	3	5	4	3	2	4	2
Percentage of family diets deficient in the various essentials								
Hawaiian	46	46	98	65	42	88	81	54
Oahu Japanese	41	15	92	56	15	85	97	28
Kona Japanese	44	28	96	64	16	72	96	44
Chinese	60	60	100	80	60	40	80	40

* Deficient means failure to meet the recommended allowances (28).

Table 3
Number of Families Whose Diets Failed to Meet the
Recommended Standards

NUMBER OF DIETARY ESSENTIALS INADEQUATE →	0	1	2	3	4	5	6	7	8	AV.
Hawaiian	0	2	6	8	5	2	5	9	11	5.2
Oahu Japanese	0	3	4	7	7	8	4	4	2	4.1
Kona Japanese	1	0	1	5	6	3	4	5	0	4.1
Chinese	0	1	0	1	0	0	1	0	2	5.2
Totals	1	6	11	21	18	13	14	18	15	

Reference: Potgeiter, M. and K. Nakatani. Diet and Health in Rural Hawaii. Hawaii Agricultural Experiment Station, University of Hawaii, 1954.

FIGURE 1

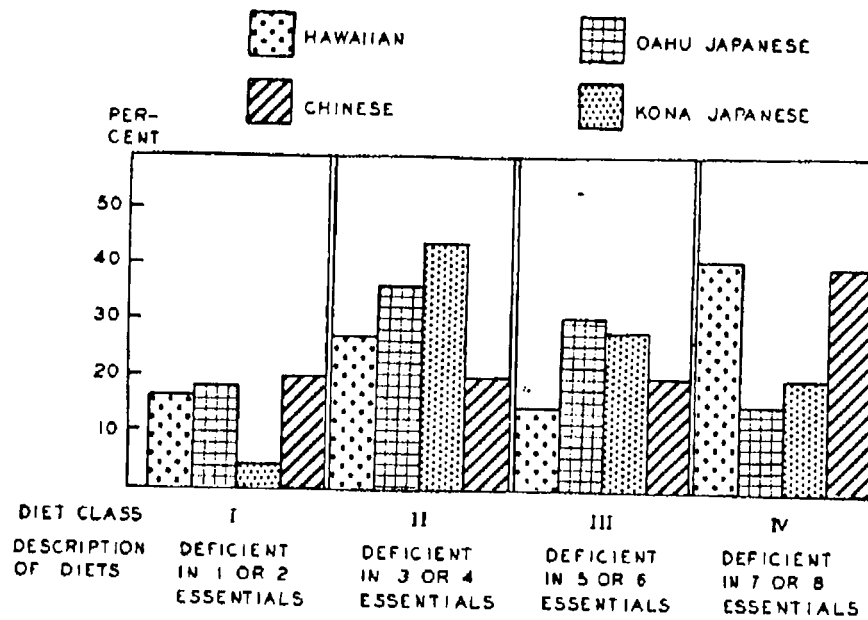


Figure 1. Percentage of family diets in each of four dietary classes.

Reference: Potgeiter, M. and K. Nakatani. Diet and Health in Rural Hawaii. Hawaii Agricultural Experiment Station, University of Hawaii, 1954.

TABLE 4.—Total Live Births By Age And Race Of Mother 19 Years And Under, 1968-1972.

AGE OF MOTHERS IN YEARS	ALL RACES		RACE OF MOTHER							
	NO.	PERCENT	CAUCA- SIAN	HAWN PART HAWN	CHI- NESE	FILI- PINO	JAPA- NESE	NEGRO	SAMOAN	OTHERS UNKNOWN
All ages 10-19	10,170		3,316	3,439	186	1,680	931	109	232	205
		100.0	32.9	34.0	1.8	16.5	9.4	1.1	2.3	2.0
11	1	—	0	1	0	0	0	0	0	0
12	4	0	0	2	0	1	0	0	1	0
13	17	0.2	2	10	0	5	2	0	0	0
14	104	1.0	21	45	0	22	7	2	5	2
15	324	3.2	73	146	6	65	21	2	7	4
16	893	8.8	249	365	13	167	57	5	20	17
17	1,668	16.4	489	598	20	310	160	8	46	36
18	2,892	28.4	940	966	57	475	289	42	63	60
19	4,267	42.0	1,572	1,326	90	637	415	50	90	86

TABLE 5 —Live Births By Race, Age of Mother 10-19 And Prematurity, 1968-1972.

RACE	TOTAL NO BIRTHS	TOTAL	AGE OF MOTHER				
			10-14		15-19		
			PREMATURE ^a		PREMATURE		
			NO	PERCENT ^b	TOTAL	NO	PERCENT
All Races	78,240	126	26	20.6	10,044	1103	11.0
Caucasian	28,500	23	3	13.0	3,323	274	8.2
Chinese	2,732	—	—	—	186	25	13.4
Filipino	12,229	26	6	23.1	1,654	270	16.3
Hawaiian	16,804	58	12	20.7	3,401	367	10.8
Japanese	13,855	9	3	33.3	942	115	12.2
Negro	783	2	—	—	107	15	14.0
Samoan	1,567	6	1	16.7	226	18	8.0
Others	1,753	2	1	50.0	203	21	10.5
Unknown	17	—	—	—	2	—	—

a. less than 2500 gms

b. percent of total

Reference: Stringfellow, L., M.J. Wooton, M. Hustace, T. Burch, B. Reyes and D. Colby. Adolescent Fertility in Hawaii: Implications for Planning. Hawaii Medical Journal. 1978:37:105.

Table 6 Number and percent of live births by age in M&ICP and Non-M&ICP population.*

<u>AGE</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
<15	7	1.1	4	0.1
15 - 19	254	40.6	542	13.6
20 - 24	247	39.6	1382	34.6
25 - 29	74	11.9	1189	29.8
30 - 34	31	5.0	587	14.7
35 - 39	10	1.6	229	5.7
≥ 40	<u>1</u>	<u>0.2</u>	<u>59</u>	<u>1.5</u>
TOTAL	624	100.0	3992	100.0

*P<.001

Table 7 Number and percent of live births by ethnic group of Mother in the M&ICP and the Non-M&ICP population.*

<u>ETHNIC GROUP</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
Caucasian	87	13.9	843	21.1
Haw'n./Part-Haw'n.	332	53.2	1130	28.3
Japanese	49	7.9	1090	27.3
Filipino	98	15.7	645	16.2
Chinese	5	0.8	63	1.6
Other	<u>53</u>	<u>8.5</u>	<u>221</u>	<u>5.5</u>
TOTAL	624	100.0	3992	100.0

*P<.001

Reference: Schmidt, D., K. Onzuka and J. Drorbough. Hilo Maternity and Infant Care Clinic - An evaluative study. R and S Report. Research and Statistics Office, Hawaii State Department of Health, October 1979.

Table 8 Number and percent of live births by education of Mother in the M&ICP and Non-M&ICP population.*

<u>EDUCATION</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
≤ 8	22	3.5	132	3.3
9 - 11	233	37.3	555	13.9
12	298	47.9	2120	53.1
13 - 15	62	9.9	705	17.7
≥ 16	7	1.1	479	12.0
Unknown	<u>2</u>	<u>0.3</u>	<u>1</u>	<u>0.0</u>
TOTAL	624	100.0	3992	100.0

*P<.001

Table 9 Number and percent of live births by legitimacy at delivery for the M&ICP and Non-M&ICP population.*

<u>LEGITIMACY</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
Legitimate	444	71.2	3649	91.4
Illegitimate	176	28.2	313	7.8
Other	<u>4</u>	<u>0.6</u>	<u>30</u>	<u>0.8</u>
TOTAL	624	100.0	3992	100.0

*P<.001

Reference: Schmidt, D., K. Onzuka and J. Drorbough. Hilo Maternity and Infant Care Clinic - An evaluative study, October 1979.

Table 10 Number and percent of live births by birth weight in the M&ICP and the Non-M&ICP population.*

<u>BIRTH WEIGHT</u> <u>(grams)</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
<1500	9	1.4	48	1.2
1500-2500	49	7.9	327	8.2
2501-4500	560	89.7	3584	89.8
> 4500	<u>6</u>	<u>1.0</u>	<u>33</u>	<u>0.8</u>
TOTAL	624	100.0	3992	100.0

*P>.10

Table 11 Number and percent of live births by weeks of gestation in the M&ICP and the Non-M&ICP population.*

<u>GESTATION</u> <u>(weeks)</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
	<u>NUMBER</u>	<u>PERCENT</u>	<u>NUMBER</u>	<u>PERCENT</u>
≤ 33	36	5.8	154	3.9
34 - 37	68	10.9	462	11.6
38 - 42	438	70.2	2948	73.8
≥ 43	78	12.5	352	8.8
Unknown	<u>4</u>	<u>0.6</u>	<u>76</u>	<u>1.9</u>
TOTAL	624	100.0	3992	100.0

*P<.01

Reference: Schmidt, D., K. Onzuka and J. Drorbough. Hilo Maternity and Infant Care Clinic - An evaluative study, October 1979.

Table 12 Frequency of Small Babies and Babies ≥ 43 Weeks Gestation
in the M&ICP and Non-M&ICP Pregnancies by High Risk Factors
in the Hawaiian/Part-Hawaiian Ethnic Group.*

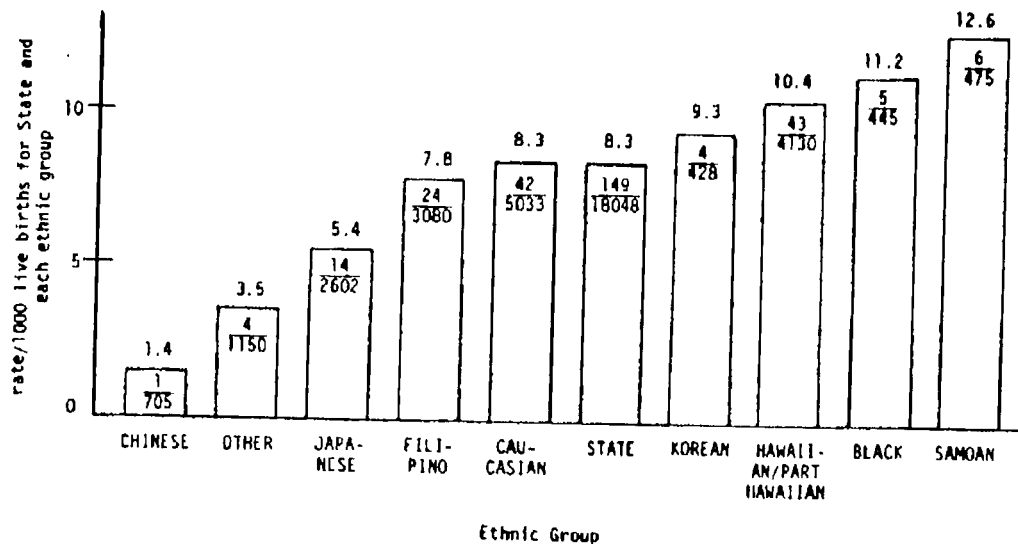
<u>CHARACTERISTIC</u>	<u>PREGNANCY OUTCOMES</u>	<u>M&ICP</u>		<u>Non-M&ICP</u>	
		<u>NUMBER OF PREGNANCIES</u>	<u>PERCENT</u>	<u>NUMBER OF PREGNANCIES</u>	<u>PERCENT</u>
Age (<20 years)	< 2501 gms.	145	11.9	235	16.6
	≤ 33 wks.		5.6		8.5
	≥ 43 wks.		16.1		11.9
Education (<12 years)	< 2501 gms.	160	11.9	287	12.2
	≤ 33 wks.		6.3		7.3
	≥ 43 wks.		14.4		11.5
Illegitimacy	< 2501 gms.	115	10.5	171	14.0
	≤ 33 wks.		7.8		10.5
	≥ 43 wks.		13.0		11.9

*P>.10 for all comparisons

Reference: Schmidt, D. et al. October 1979.

- Infants born to Korean, Hawaiian/Part Hawaiian, Black and Samoan mothers had a higher neonatal mortality rate (infant deaths birth to 28 days of life per 1000 live births) than the State rate (all ethnic groups).

Figure 2
Ranking of Neonatal Mortality Rates By
Ethnic Group of Mother
Hawaii, FY 1981

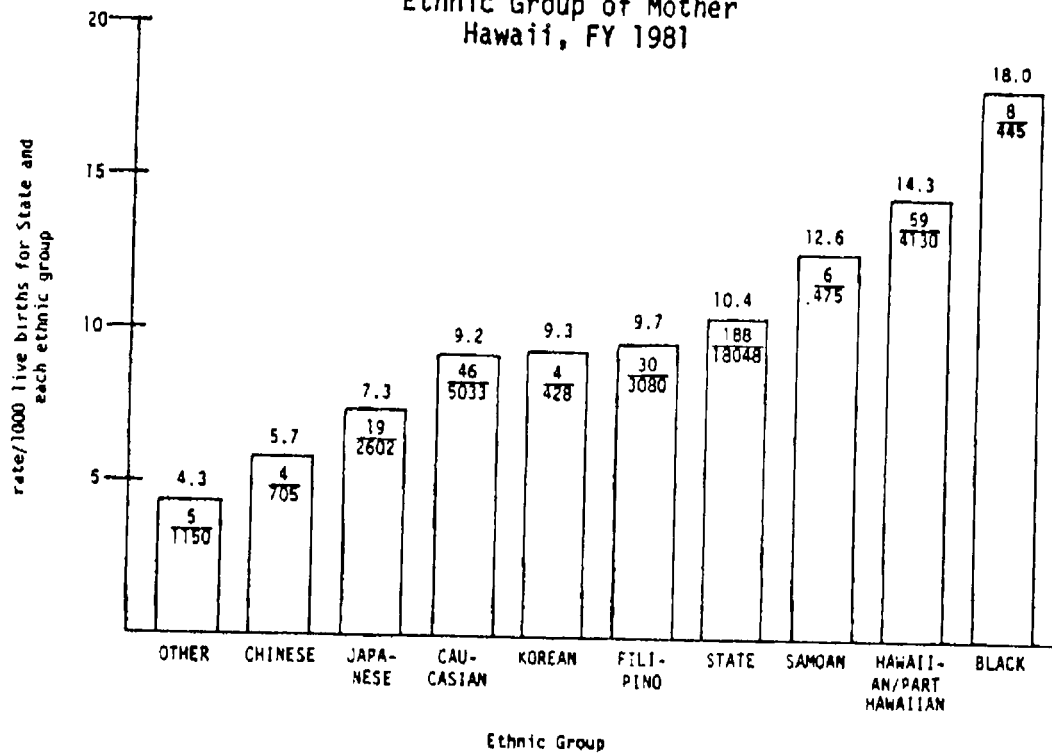


(NOTE: Fractions in figures show number of events over number of births.)

Reference: Organizing Perinatal Services to Improve the Health of Mothers and Children in Hawaii. Regional Perinatal Planning Program and Maternal and Child Health Branch, Family Health Services Division, Department of Health, State of Hawaii, March 1984.

- Infants born to Samoan, Hawaiian/Part Hawaiian and Black mothers had a higher infant mortality rate (infant deaths birth to 1 year of age per 1000 live births) than the State rate (all ethnic groups).

Figure 3
Ranking of Infant Mortality Rates By
Ethnic Group of Mother
Hawaii, FY 1981



- Hawaiian/Part Hawaiian, Black and Filipino mothers had a higher percentage of low birth weight infants (birth weight 5.5 pounds or less) than the State percent (all ethnic groups).

Figure 4
Ranking of Percent of Low Birth Weight (LBW) Infants
Among Single Live Births By Ethnic Group of Mother
Hawaii, FY 1981

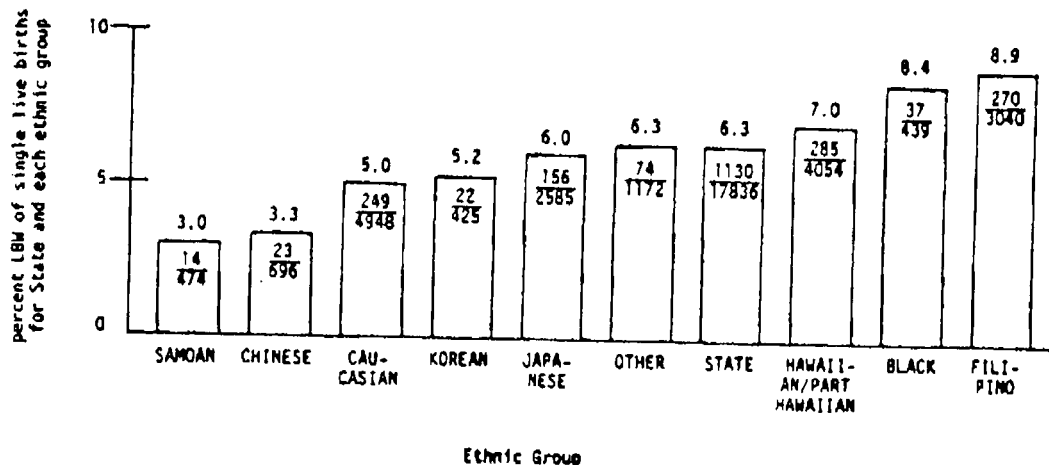


TABLE 13

ETHNICITY OF HAWAII MOTHER'S MILK BANK SURVEY RESPONDENTS

ETHNICITY	PERCENT OF RESPONDENTS	LIVE BIRTHS BY ETHNICITY OF MOTHER	
		STATE	OAHU
Caucasian	38.0	32.5	32.8
Japanese	13.2	13.3	13.5
Hawaiian/ Part Hawaiian	20.3	22.1	19.5
Filipino	10.2	16.0	15.5
Mixed*	7.7	-	-
Black	1.8	3.2	4.0
Pacific Islander	1.4	2.7	3.4
Chinese	3.7	2.7	3.4
Other	3.4	6.3	6.7

* The Department of Health does not include a "mixed" category for race of mother

Reference: Hawaii Mother's Milk Bank, Maternal and Child Health, School of Public Health, University of Hawaii, November 1984 (E. Sukanuma, informant).

TABLE 14

PERCENTAGE OF WOMEN BY ETHNIC GROUP AND
FORM OF FEEDING AT HOSPITAL DISCHARGE - HAWAII MOTHER'S MILK BANK SURVEY

	BOTTLE ONLY	BREAST ONLY	BREAST & BOTTLE	TOTAL RESPONDENTS
Caucasian	18.3%	70.4%	11.3%	38%
Japanese	12.2%	55.4%	32.4%	13.2%
Hawaiian/ Part Hawaiian	18.4%	52.6%	28.9%	20.3%
Filipino	26.3%	33.3%	40.4%	10.2%
Mixed	23.3%	39.5%	37.2%	7.7%
Black	50.0%	40.0%	10.0%	1.8%
Pacific Islander	-	50.0%	50.0%	1.4%
Chinese	9.5%	71.4%	19.0%	3.7%
Other	31.6%	63.2%	5.3%	3.4%
Total				100%

Reference: Hawaii Mother's Milk Bank, Maternal and Child Health, School of Public Health, University of Hawaii, November 1984 (E. Suganuma, informant).

Table 15. Nutrient Intakes of Hawaiian and Japanese Children, 2 and 3 Years of Age

	Hawaiian				Japanese	
	Low Income N=76		Middle Income N=42		Middle Income N=60	
	Mean	S.D. ¹	Mean	S.D.	Mean	S.D.
Energy (kcal)	1,343	481	1,516 ²	674	1,217 ²	393
Protein (gm)	50.4	22.2	55	20.2	46.2	17.9
Calcium (mg)	615	390	742	398	733	365
Iron (mg)	7.3	4.2	7.5 ³	3.5	5.9 ³	3.9
Vitamin A (I.U.)	2,730	2,990	3,290	2,320	2,960	2,830
Thiamin (mg)	0.64	0.34	0.73	0.31	0.61	0.29
Riboflavin (mg)	1.18	0.63	1.4	0.63	1.27	0.58
Niacin (mg)	8.1	4.6	8.9 ²	4.3	6.9 ³	3.5
Ascorbic Acid (mg)	39	44	59	77	59 ²	52

¹ Significant deviation

² Significant at 2% level

³ Significant at 5% level

Reference: Brown, M. and C. Ho. New Income Groups in Hawaii. Practices of Low Income Families in Feeding Infants and Small Children: With Particular Attention to Cultural Subgroups. Proceedings of a National Workshop. U.S. Department of Health, Education and Welfare, 1972.

TABLE 16 Ethnic, sex, and age distribution of sample.

RACIAL GROUP ^a	BOYS Age (Months)				GIRLS Age (Months)			
	24-29	30-35	36-41	42-48	24-29	30-35	36-41	42-48
Part-Hawaiian	10	13	17	17	8	16	19	18
Japanese	5	8	5	14	7	8	8	6
Caucasian	3	2	4	1	0	1	3	2
"Other"	12	16	9	9	4	12	11	13
TOTAL	30	39	35	41	19	37	41	39

^a Determined from interview responses to parental ethnic backgrounds.

TABLE 17 Means of anthropometric measurements by ethnic group.

	JAPANESE		PART-HAWAIIAN	
	No. Cases = 61 ^a		No. Cases = 118 ^a	
	Means	S.D.	Means	S.D.
Age (months)	36.59	7.28	37.30	6.51
Weight (lb)	31.09	5.02	32.82	4.98
Standing height (in)	36.29*	2.17	37.23*	2.35
Total recumbent length (in)	37.01*	2.26	37.75*	2.35
Crown-buttocks recumbent length (in)	22.24	1.14	22.57	1.24
Mid-upper arm circumference (cm)	16.51	1.48	16.89	1.38

^a In height category, number cases = N-1.

^b In height category, number cases = N-3; in total and crown-buttocks recumbent lengths, number cases = N-1.

* Significant at 5% level.

Reference: Smith, D. and M. Brown. Growth Measures of a Selected Group of Preschool Children in Honolulu. Hawaii Medical Journal. 1970:29#5:375.

FIGURE 5
 AGE DISTRIBUTION
 *HAWAII ALL WIC VISIT DATA - 1/82-2/84

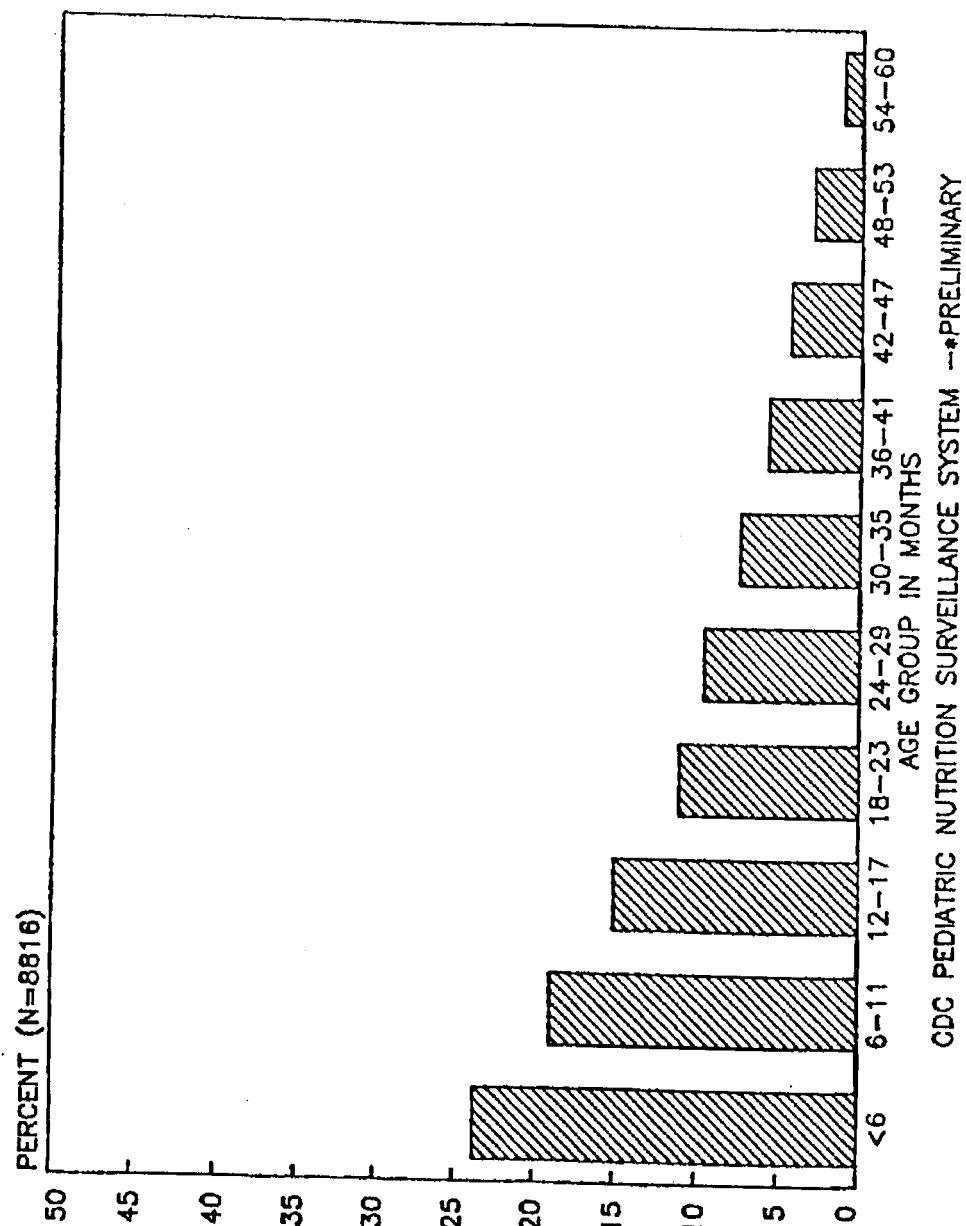


FIGURE 6
 ETHNIC DISTRIBUTION
 *HAWAII ALL WIC VISIT DATA - 1/82-2/84

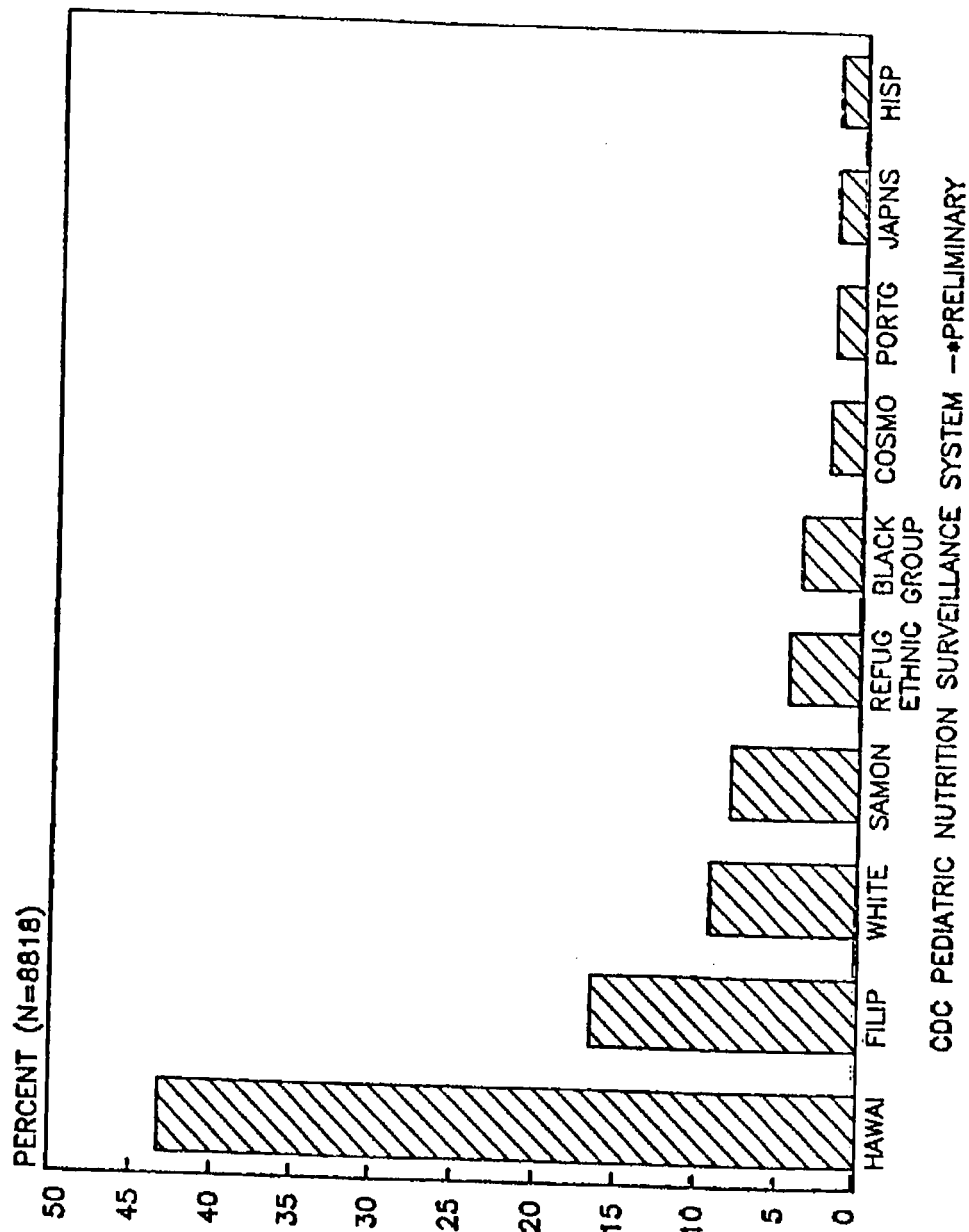


FIGURE 7
 PREVALENCE OF ANTHROPOMETRY RISK BY ETHNICITY
 *HAWAII INITIAL WIC VISIT DATA - 1/82-2/84

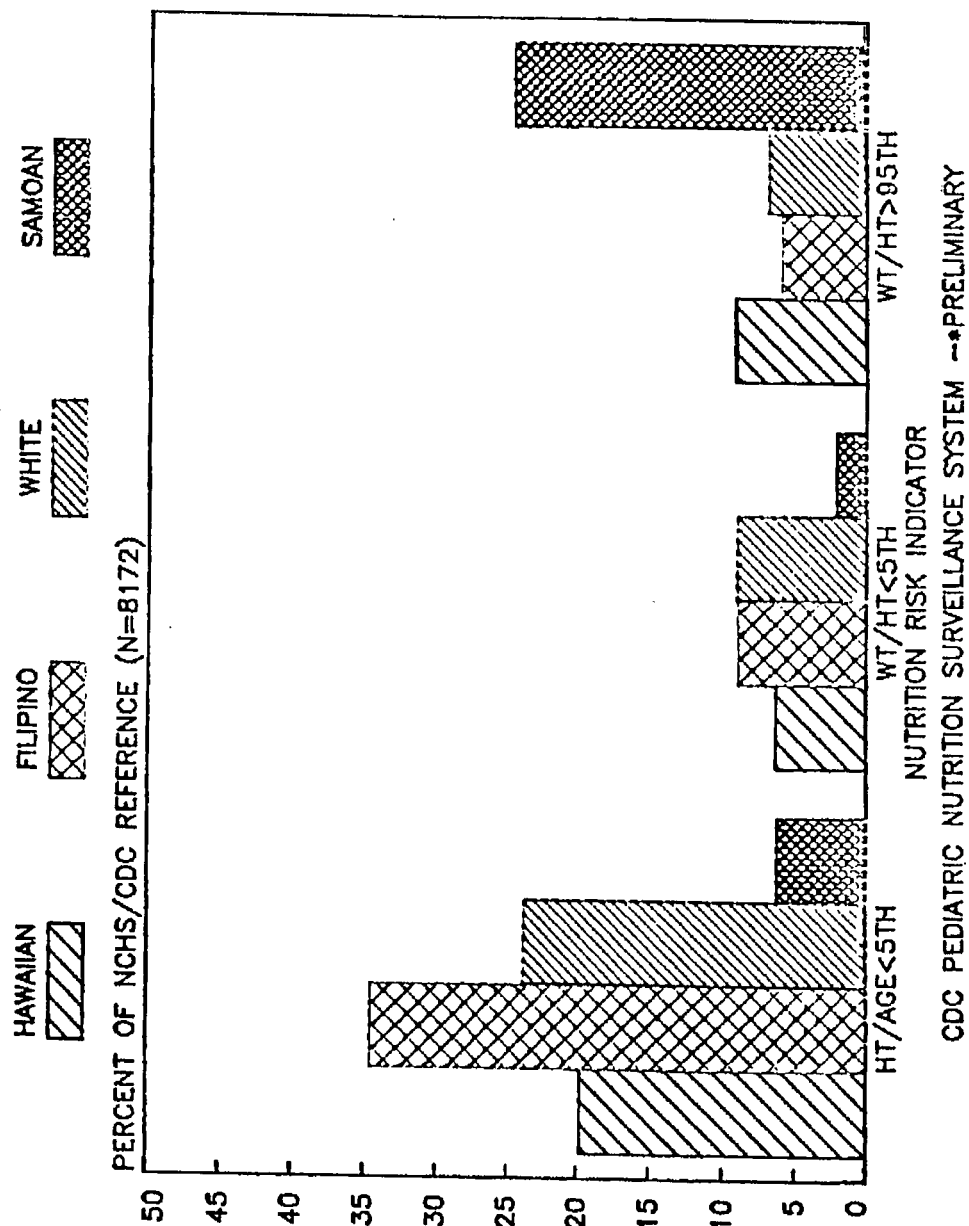


FIGURE 8

PREVALENCE OF LOW HEIGHT/AGE - HAWAIIAN *HAWAII ALL WIC VISIT DATA - 1/82-2/84

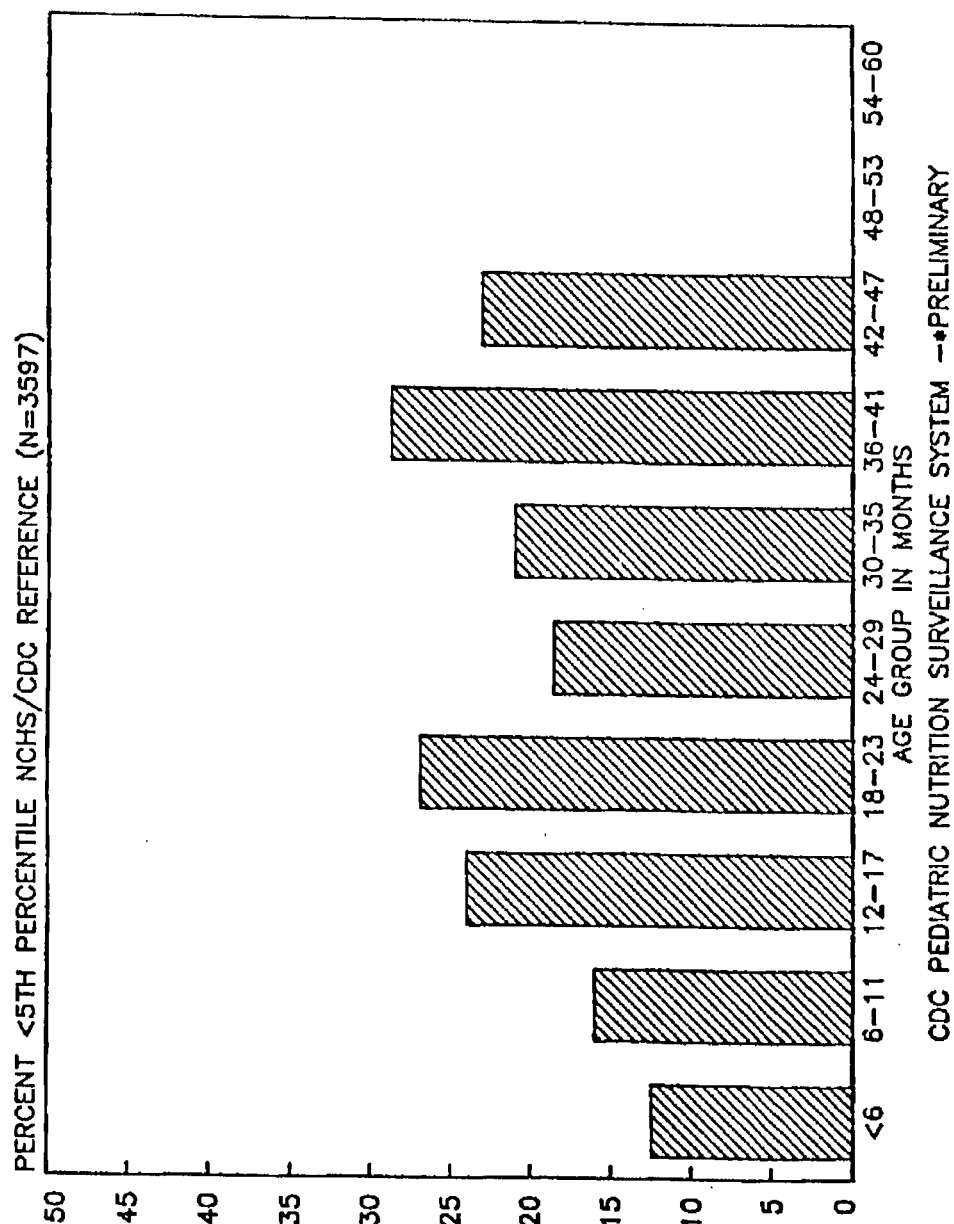


FIGURE 9

PREVALENCE OF LOW WEIGHT/HEIGHT - HAWAIIAN *HAWAII ALL WIC VISIT DATA - 1/82-2/84

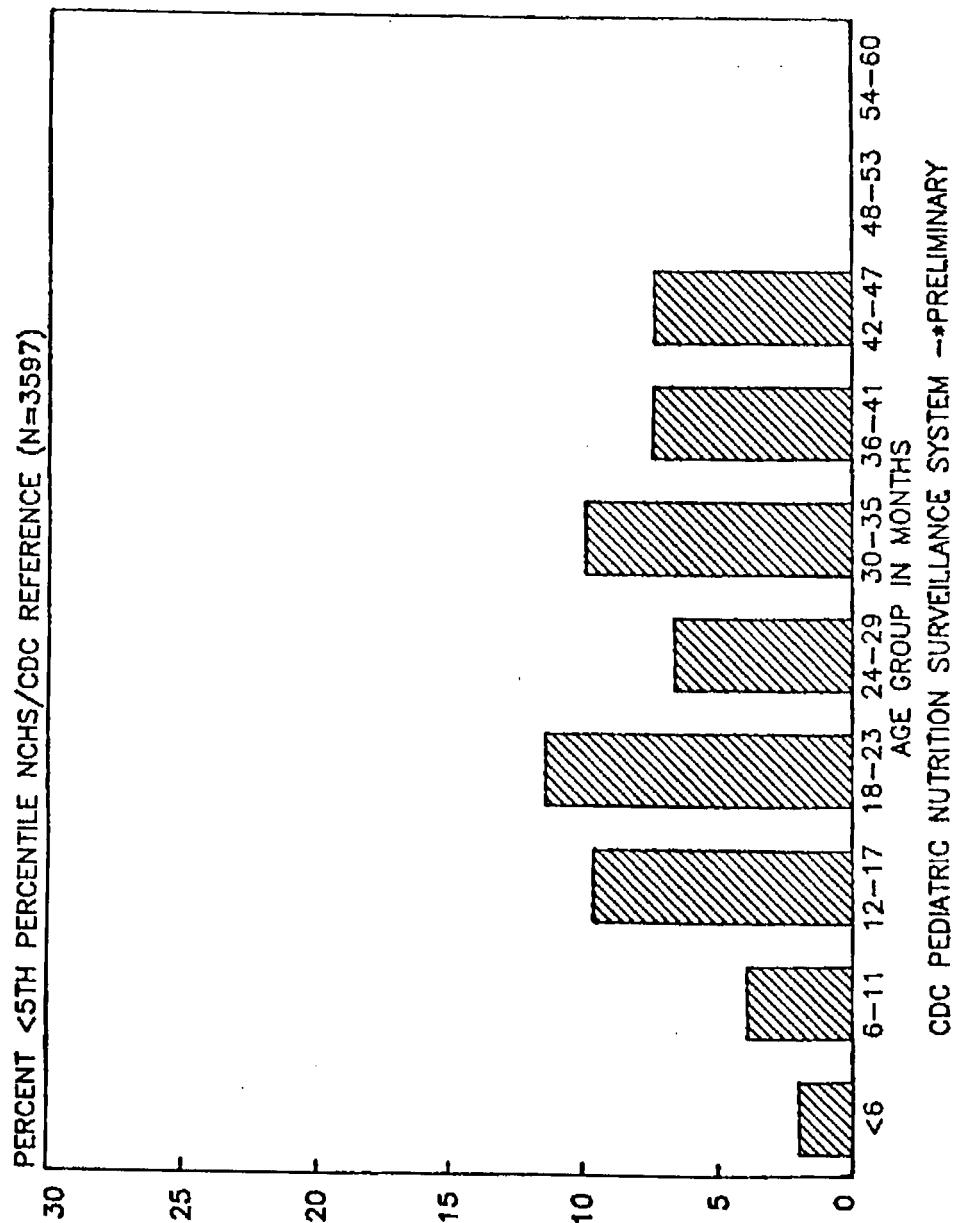


Table 18 Ethnic Distribution of Diet Recall Sample

<u>Ethnicity</u>	<u>Elementary</u>	<u>Junior High</u>	<u>Senior High</u>	<u>State*</u>
Caucasian	20%	13%	14%	26%
Japanese	18%	22%	18%	25%
Hawaiian	26%	22%	22%	20%
Filipino	20%	24%	23%	10%
Chinese	3%	3%	3%	4%
Samoan	3%	1%	4%	1%
Korean	2%	1%	2%	1%
Black	0%	0%	1%	1%
Other	8%	14%	12%	11%

* From the Department of Planning and Economic Development, The State of Hawaii Data Book, 1979.

Reference: Lai, M. and S. Shimabukuro. Ethnic Differences in the Nutritional Quality of Diets of Children in Hawaii. CRDG, University of Hawaii, 1980.

Table 19
Elementary: Mean Intake by Ethnicity

RNA/Standards	Ethnicity	Hawaiian	Chinese	Japanese	Korean	Filipino	Caucasian	Samoan	Other
	N	86	10	60	6	65	67	9	27
34	Protein (g)	86	85	84	65	78	77	95	85
	Fat (g)	93	80	84	73	76	87	86	89
	Carbohydrate (g)	269	200	232	204	242	266	234	264
800	Calcium (mg)	852	882	895	839	685	1079	846	903
500	Phosphorus (mg)	1274	1177	1213	1039	1105	1492	1279	1356
10	Iron (mg)	11.95	10.3	10.2	9.4	10.6	11.3	12.2	12.1
600-1800	Sodium (mg)	2416	2031	2478	1829	1684	2286	2326	2530
1000-3000	Potassium (mg)	2124	2016	2838	1787	2093	2951	2810	2299
700	Vitamin A (R.E.)	1289	717	759	609	700	1078	625	688
1.2	Thiamin (B ₁) (mg)	1.1	0.9	0.9	0.8	1.0	1.2	1.1	1.3
1.4	Riboflavin (B ₂) (mg)	1.96	1.8	1.7	1.6	1.6	1.99	2.1	1.9
16	Niacin (mg)	16.9	15.0	15.6	10.9	16.7	15.8	16.9	16.2
.45	Vitamin C (mg)	79	94	86	37	109	123	107	87
	Total Gram Amount	1784	1525	1618	1416	1632	1760	1715	1784
2400	Total Calories	2220	1804	1980	1679	1926	2098	2078	2177
	Total Sugar (g)	51.0	17.4	36.2	46.1	44.1	44.2	21.6	44.0
	Candy Sugar	10.9	1.8	6.7	13.9	8.2	15.1	7.8	10.6
	Soda Sugar	31.1	12.6	20.4	28.2	30.5	19.3	13.2	25.8
	Other Sugar	9.0	3.1	9.0	3.95	5.4	9.9	0.6	7.6

Reference: Lai, M. and S. Shimabukuro. Ethnic differences in the nutritional quality of diets of children in Hawaii. CRDG, University of Hawaii, 1980.

Table 20

Percent of Calories from Protein, Carbohydrate, and Fat: Elementary

	<u>Hawaiian</u>	<u>Chinese</u>	<u>Japanese</u>	<u>Korean</u>	<u>Filipino</u>	<u>Caucasian</u>	<u>Samoa</u>	<u>Other</u>
Total Calories	2220	1804	1980	1679	1926	2098	2078	2177
Protein	15%	18%	16%	15%	16%	14%	18%	15%
Fat	37%	39%	37%	38%	34%	36%	37%	36%
Carbohydrate	48%	43%	46%	47%	50%	50%	45%	48%

Reference: Lai, M. and S. Shimabukuro, 1980.

Table 21

Jr. High: Mean Intake by Ethnicity

RDA/Standards	Ethnicity	Hawaiian	Chinese	Japanese	Korean	Filipino	Chamorro	Samoa	Other
	N	62	8	63	4	67	37	2	38
45-46	Protein (g)	97	96	89	89	83	90	101	90
	Fat (g)	110	90	99	108	88	95	132	94
	Carbohydrate (g)	329	255	275	230	268	295	292	273
1200	Calcium (mg)	982	685	855	1202	709	1222	585	818
1200	Phosphorus (mg)	1521	1194	1419	4098	1118	1594	1434	1374
18	Iron (mg)	13.5	12.1	11.99	10.97	10.6	11.7	12.9	11.8
900-2700	Sodium (mg)	2650	2892	2399	4154	2305	3001	5098	2349
1525-4575	Potassium (mg)	3197	1839	2591	2474	2530	2940	2068	4264
800-1000	Vitamin A (R.E.)	820	837	686	1466	616	1142	216	711
1.1-1.4	Thiamin (B ₁) (mg)	1.2	0.9	1.0	0.99	0.98	1.1	0.8	1.2
1.3-1.6	Riboflavin (B ₂) (mg)	2.0	1.5	1.8	1.7	1.6	2.1	1.7	1.8
15-18	Niacin (mg)	18.6	16.4	16.98	15.6	15.8	15.3	20.6	18.3
50	Vitamin C (mg)	98	137	97	80	75	105	9	125
2200-2700	Total Gram Amount	2207	1958	1928	1826	1724	2100	1833	1841
	Total Calories	2650	2229	2312	2241	2173	2330	2773	2270
	Total Sugar (g)	74.4	46.2	57.2	12.4	55.6	69.3	70.95	42.8
	Candy Sugar	15.0	2.3	12.8	0.0	10.96	22.0	17.1	11.3
	Soda Sugar	49.8	38.4	39.3	11.2	38.4	32.4	51.9	24.2
	Other Sugar	9.5	5.5	5.1	1.2	6.2	14.8	1.95	7.3

Reference: Lai, M. and S. Shimabukuro, 1980.

Table 22

Percent of Calories from Protein, Carbohydrate, and Fat: Junior High

	Hawaiian	Chinese	Japanese	Filipino	Caucasian	Other
Total Calories	2650	2229	2312	2173	2330	2270
Protein	14%	17%	15%	15%	15%	15%
Fat	37%	36%	38%	36%	35%	37%
Carbohydrate	49%	46%	47%	49%	50%	48%

Reference: Lai, M. and S. Shimabukuro, 1980.

Table 23

Sr. High: Mean Intake by Ethnicity

RDA/Standards	Ethnicity	Hawaiian	Chinese	Japanese	Korean	Filipino	Caucasian	Samoan	Other	Black
N		61	9	51	5	65	40	12	34	2
46-56	Protein (g)	108	112	88	108	98	100	114	86	81
	Fat (g)	115	123	93	106	106	118	124	101	97
	Carbohydrate (g)	355	384	282	329	305	309	349	293	279
1200	Calcium (mg)	969	1134	909	1380	907	1336	863	879	576
1200	Phosphorus (mg)	1516	1673	1348	2095	1401	2218	1794	1328	1054
1R	Iron (mg)	13.95	14.2	10.2	12.0	12.9	13.3	17.0	12.3	13.0
900-2700	Sodium (mg)	2700	3041	2358	3051	3115	2981	3792	3143	3024
1525-4575	Potassium (mg)	2886	4082	3633	3880	2750	3944	2582	2869	2274
800-1000	Vitamin A (R.E.)	1199	1120	622	736	969	1413	757	891	511
1.1-1.4	Thiamin (B ₁) (mg)	1.3	1.6	1.0	1.4	1.3	1.3	1.3	1.1	1.1
1.3-1.7	Riboflavin (B ₂) (mg)	2.2	2.4	1.8	2.9	2.0	2.7	2.2	1.8	1.3
14-18	Niacin (mg)	20.5	24.2	16.1	28.9	18.8	21.3	24.6	17.1	21.2
60	Vitamin C (mg)	155	270	117	142	149	135	82	124	230
	Total Gram Amount	2560	2717	2091	3662	2339	2554	2747	2098	1700
2100-2400	Total Calories	2882	3049	2278	2702	2536	2828	3046	2415	2275
	Total Sugar (g)	62.6	64.3	60.2	47.4	77.1	53.7	61.2	55.6	19.1
	Candy Sugar	13.6	18.2	11.8	0.8	15.6	11.6	6.6	8.6	0.0
	Soda Sugar	43.2	37.4	53.4	36.3	55.5	32.7	48.0	42.7	15.0
	Other Sugar	5.8	8.6	4.1	10.3	6.1	9.4	6.6	4.3	4.1

Reference: Lai, M. and S. Shimabukuro, 1980.

Table 24

Percent of Calories from Protein, Carbohydrate, and Fat: Senior High

	Hawaiian	Chinese	Japanese	Korean	Filipino	Caucasian	Samoan	Other
Total Calories	2882	3049	2278	2702	2536	2828	3046	2415
Protein	15%	14%	15%	16%	15%	15%	15%	14%
Fat	36%	36%	36%	35%	37%	37%	37%	38%
Carbohydrates	49%	50%	49%	49%	48%	43%	46%	48%

Reference: Lai, M. and S. Shimabukuro, 1980.

TABLE 25

Distribution of the population of Hawaii, the public school population, and the survey sample by race

Racial classification*	Hawaii population†		Public school population‡		Survey sample	
	No.	%	No.	%	No.	%
Caucasian	318,770	33.04	38,269	24.39	3,800	26.82
Japanese	239,748	24.85	30,332	19.33	3,648	25.75
Filipino	133,940	13.88	29,552	18.84	1,742	12.30
Hawaiian and part-Hawaiian	115,500	11.97	31,793	20.26	1,585	11.19
Chinese	56,285	5.83	5,995	3.82	1,997	14.10
Korean	17,962	1.86	2,856	1.82	716	5.05
Samoan	14,073	1.46	4,904	3.12	678	4.79
Others	68,413 §	7.09	13,179	8.40		
Total	964,691		156,880		14,166	

*By self-identification or race of mother.

†Source: U.S. Bureau of the Census, Census of Population and Housing, 1980 Summary Tape File 1A, Hawaii (1981).

‡Source: Hawaii Department of Education, Office of Civil Rights Report ID: EDE13X-A, September 12, 1980.

§ Includes 17,364 Blacks, 2,655 American Indians, 68 Eskimos, 45 Aleuts, 604 Asian Indians, 3,463 Vietnamese, 1,677 Guamanians, and 42,537 unclassified others.

|| Includes 2,059 Blacks, 351 American Indians or Alaskans, 3,160 Hispanics, and 7,609 unclassified Asians or Pacific Islanders.

Reference: Lichton, I., S. Pattabi Raman and R. McGandy. Anthropometry of Hawaii School Children, Research Series 036, University of Hawaii, 1984.

TABLE 26
Average height of Hawaii school children by age and race, cm

Age years	Caucasian			Japanese			Filipino			Hawaiian and part-Hawaiian			Chinese			Korean			Samoan		
	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM
Girls																					
5	43	109.4	1.28	40	107.6	0.76	20	108.6	1.97	25	108.9	0.97	38	108.2	0.80	11	108.2	1.25	13	112.5	1.26
6	128	115.9	0.59	138	113.0	0.45	65	112.0	0.70	66	114.9	0.68	63	113.3	0.68	16	111.9	1.48	43	119.2	0.69
7	168	120.6	0.45	158	118.6	0.46	80	117.4	0.69	78	120.8	0.58	93	120.0	0.59	43	119.8	0.87	54	124.6	0.84
8	130	127.0	0.44	159	122.9	0.46	92	122.3	0.73	81	126.6	0.69	85	125.0	0.58	29	123.6	0.99	48	131.3	0.69
9	148	131.7	0.51	137	129.6	0.48	85	129.8	0.79	71	132.6	0.78	82	130.2	0.67	47	130.5	0.79	43	137.1	1.09
10	162	139.2	0.55	163	135.5	0.50	92	136.2	0.73	94	140.5	0.83	86	135.6	0.83	35	134.0	1.10	39	143.9	0.78
11	178	144.6	0.52	168	142.4	0.61	98	142.1	0.68	72	146.2	0.90	91	143.1	0.65	41	143.4	1.15	33	149.0	1.17
12	245	151.8	0.45	233	147.9	0.43	87	148.8	0.68	71	153.5	0.89	117	151.0	0.67	44	150.4	1.00	28	158.2	1.64
13	260	156.6	0.46	246	152.5	0.39	120	151.2	0.53	96	157.2	0.67	109	154.3	0.61	44	153.5	0.96	23	162.3	1.18
14	272	158.7	0.37	208	154.3	0.40	100	153.0	0.55	86	159.0	0.61	130	157.8	0.49	36	155.6	1.14	24	162.0	1.27
15	169	162.3	0.44	124	155.1	0.50	52	155.1	0.86	43	160.8	0.89	66	159.8	0.71	18	158.4	1.13	10	160.2	1.56
Boys																					
5	37	110.1	0.80	69	108.6	0.55	26	107.7	0.80	21	111.0	0.84	34	108.9	1.00	9	112.0	1.49	21	112.5	0.96
6	113	116.1	0.58	154	112.3	0.51	77	112.1	0.81	75	116.3	0.88	74	114.0	0.82	19	115.2	1.22	41	118.3	0.70
7	131	121.6	0.47	167	118.4	0.42	67	117.0	0.69	68	120.7	0.68	63	119.5	0.68	28	120.4	1.03	45	125.2	0.85
8	133	128.0	0.55	183	124.0	0.38	97	123.0	0.64	72	125.5	0.69	94	124.8	0.60	32	125.4	1.15	45	131.0	0.91
9	172	133.1	0.49	169	129.4	0.54	101	129.4	0.54	74	133.1	0.76	86	130.4	0.62	36	131.6	0.80	34	137.5	1.14
10	170	137.9	0.48	187	135.1	0.51	86	134.1	0.76	88	137.4	0.71	94	135.5	0.70	53	133.3	0.91	41	142.2	1.06
11	179	143.8	0.54	168	140.6	0.50	75	138.3	0.82	86	144.0	0.87	104	141.9	0.73	36	141.1	1.16	27	148.4	1.23
12	212	149.8	0.56	212	146.8	0.51	79	146.2	0.89	76	147.6	0.94	113	145.4	0.76	40	147.9	1.31	21	153.0	1.60
13	261	156.4	0.54	231	154.2	0.62	96	152.4	0.95	98	159.8	0.83	145	155.9	0.75	48	156.4	1.14	22	161.8	1.96
14	266	163.4	0.53	211	160.5	0.54	96	160.1	0.80	95	165.0	0.90	120	161.9	0.76	39	160.6	1.23	75	166.6	1.32
15	189	169.8	0.59	120	165.7	0.60	44	162.9	1.22	44	166.8	1.35	100	167.8	0.68	8	163.6	1.89	6	175.8	2.09

#Number of children.

†Mean.

‡Standard error of the mean.

Reference: Lichton, I., et al., Anthropometry of Hawaii School Children, 1984, p. 9.

TABLE 27 Hawaii percentiles--stature, cm, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE									
				5th	10th	25th	50th	75th	90th	95th			
<u>Hawaiian and part-Hawaiian females</u>													
5.5	27	112.0	5.3	101.9	105.2	108.8	111.3	115.6	120.3	122.1			
6.0	37	114.0	5.8	104.5	106.3	109.4	113.4	118.2	122.8	125.8			
6.5	33	117.8	5.3	108.4	110.3	114.2	117.1	121.9	125.4	127.6			
7.0	42	120.8	4.4	112.8	116.2	117.4	120.2	124.4	126.6	128.2			
7.5	37	122.7	5.8	113.3	115.2	117.9	122.9	127.6	130.8	131.0			
8.0	45	126.3	5.7	116.0	118.9	121.8	126.6	130.8	133.3	134.1			
8.5	34	131.4	5.6	121.9	125.0	128.0	130.4	135.9	139.0	141.2			
9.0	31	131.7	6.4	119.4	121.0	127.2	132.4	136.0	139.7	141.6			
9.5	52	135.0	7.6	121.4	124.3	130.1	135.4	139.5	143.4	150.3			
10.0	49	140.7	6.5	129.5	131.5	137.2	139.9	144.8	150.4	151.6			
10.5	34	144.8	9.5	128.5	130.4	138.3	143.0	152.2	159.8	160.4			
11.0	42	146.5	7.5	133.6	136.4	140.9	145.2	152.8	156.6	158.7			
11.5	31	148.8	6.5	138.2	139.1	143.0	149.7	153.7	157.6	159.1			
12.0	33	154.0	8.4	137.8	140.8	146.0	155.7	160.0	162.3	167.3			
12.5	55	156.0	6.5	145.1	146.1	152.1	155.3	161.5	164.8	166.5			
13.0	33	156.5	7.1	145.2	146.7	150.8	157.1	162.8	166.4	169.0			
13.5	59	159.0	6.4	148.7	151.0	153.8	157.9	164.1	167.2	168.9			
14.0	47	159.0	5.0	149.9	153.5	154.8	158.8	162.5	164.6	167.8			
14.5	24	159.4	4.9	148.7	153.2	156.6	160.4	162.7	165.3	168.2			
15.0	26	160.3	5.6	150.0	151.6	157.6	159.6	163.1	168.6	171.3			

Reference: Lichton, I., et al., Anthropometry of Hawaii School Children, 1984, p. 24.

TABLE 28 Hawaii percentiles--stature, cm, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
<u>Hawaiian and part-Hawaiian males</u>										
5.5	28	112.6	5.0	102.4	104.1	109.3	113.4	117.0	117.6	120.1
6.0	42	116.5	8.8	106.6	109.2	112.1	116.4	118.4	120.6	127.7
6.5	31	118.3	4.0	109.9	111.6	117.0	119.1	120.6	124.0	125.1
7.0	32	120.3	5.6	108.4	111.1	117.5	120.6	125.0	127.4	129.1
7.5	39	123.4	5.4	111.6	117.5	119.6	124.9	127.7	130.2	131.5
8.0	41	126.2	6.3	115.9	119.6	121.6	126.1	129.4	132.9	136.8
8.5	29	128.4	5.6	118.8	120.4	124.3	128.3	132.0	136.2	138.6
9.0	41	132.6	6.2	122.3	124.5	128.8	132.2	135.4	143.6	146.0
9.5	46	135.2	6.6	122.5	126.8	130.9	134.6	141.4	143.6	146.4
10.0	30	138.5	6.8	125.7	128.6	133.2	139.5	143.3	147.3	151.1
10.5	45	139.0	5.8	129.0	129.7	136.0	139.0	142.9	146.1	147.8
11.0	53	144.2	7.3	132.4	135.4	140.4	144.3	148.2	153.2	156.5
11.5	33	145.4	9.9	125.6	132.3	139.6	146.9	152.4	155.7	161.6
12.0	35	147.8	6.7	135.2	138.2	142.9	149.0	153.5	157.0	158.8
12.5	50	154.0	8.6	140.3	141.3	147.5	154.4	159.8	165.3	168.4
13.0	44	158.6	7.7	142.4	149.5	153.5	158.9	163.3	168.6	174.0
13.5	54	163.0	8.1	150.7	153.9	156.2	162.2	167.1	174.7	179.1
14.0	42	164.6	8.6	149.6	152.7	159.7	165.1	170.0	176.2	179.7
14.5	42	166.7	10.0	150.5	153.3	157.8	166.6	175.8	178.6	183.2
15.0	30	167.3	8.3	151.3	155.8	162.0	168.1	172.3	177.8	184.2

Reference: Lichton, I., et al, 1984, p. 31.

TABLE 29

Average weight of Hawaii school children by age and race, kg

Age years	Caucasian			Japanese			Filipino			Hawaiian and part-Hawaiian			Chinese			Korean			Samoan		
	n*	$\bar{x}$ †	SEM‡	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM	n	$\bar{x}$	SEM
Girls																					
5	43	19.0	0.66	40	18.2	0.40	20	17.5	0.44	25	18.6	0.53	38	18.2	0.47	11	17.8	0.59	13	21.2	0.65
6	128	21.4	0.32	138	20.6	0.33	65	19.6	0.42	66	22.0	0.56	63	19.1	0.38	16	19.5	0.62	43	25.4	0.72
7	168	23.8	0.38	158	23.6	0.46	80	22.3	0.46	78	24.5	0.59	93	22.6	0.47	43	22.7	0.64	54	27.1	0.66
8	138	27.5	0.54	159	25.1	0.42	92	23.9	0.50	81	28.1	0.63	85	25.7	0.53	29	24.0	0.83	48	32.0	0.92
9	148	30.6	0.55	137	28.8	0.46	85	29.2	1.09	71	31.3	0.72	82	28.7	0.78	47	29.2	0.83	43	37.4	1.35
10	162	35.3	0.69	163	32.8	0.57	92	33.4	0.95	94	39.2	1.17	86	31.7	0.79	35	30.2	0.95	39	42.0	1.48
11	178	38.3	0.66	168	37.3	0.72	98	37.5	0.99	72	40.8	1.29	91	35.9	0.79	41	36.1	1.05	33	43.4	1.37
12	245	44.5	0.65	233	40.3	0.53	87	43.0	1.02	71	49.4	1.40	117	41.8	0.83	44	42.3	1.14	28	54.4	2.35
13	260	49.2	0.63	246	45.6	0.54	120	45.1	1.03	96	51.9	1.00	109	45.8	0.87	44	45.5	1.23	23	62.5	2.86
14	272	51.0	0.50	208	47.9	0.56	100	47.2	1.00	86	53.3	1.06	130	48.7	0.76	36	47.6	1.22	24	67.6	4.13
15	169	55.3	0.75	124	50.4	0.76	52	49.4	1.02	43	59.9	1.73	66	54.2	1.29	18	50.2	1.12	10	58.8	1.72
Boys																					
5	37	19.0	0.41	69	18.3	0.28	26	17.8	0.38	21	20.5	0.66	34	18.6	0.90	9	20.6	1.11	21	21.5	0.81
6	113	21.6	0.40	154	20.8	0.36	77	20.4	0.58	75	21.8	0.38	74	20.1	0.40	19	21.5	0.76	41	25.3	0.73
7	131	23.7	0.34	167	23.0	0.34	67	22.5	0.61	68	24.8	0.57	63	22.8	0.45	28	24.4	0.98	45	27.6	0.86
8	133	27.5	0.50	183	26.3	0.41	97	26.0	0.62	72	28.4	0.77	94	25.8	0.62	32	27.3	1.19	45	31.8	1.23
9	172	30.7	0.50	169	29.7	0.51	101	30.1	0.73	74	32.8	1.03	86	28.9	0.64	36	30.7	0.82	34	37.0	1.31
10	170	33.9	0.51	187	33.6	0.61	86	33.6	1.11	88	35.0	1.13	94	33.8	1.01	53	31.2	0.95	41	41.2	1.60
11	179	39.1	0.78	168	38.3	0.68	75	35.7	1.07	86	41.6	1.22	104	37.2	0.94	36	37.4	1.37	27	44.5	1.83
12	212	43.1	0.72	212	41.5	0.65	79	41.5	1.14	76	45.9	1.59	113	39.1	1.10	40	42.7	1.72	21	49.7	2.41
13	261	48.1	0.65	231	47.6	0.76	96	45.0	1.21	98	56.8	1.44	145	48.6	1.09	48	49.4	1.55	22	58.4	2.55
14	266	53.9	0.67	211	53.3	0.89	96	52.9	1.27	95	57.7	1.54	120	51.9	1.04	39	50.7	1.27	15	58.3	2.06
15	189	60.1	0.85	120	60.0	1.06	44	56.5	2.51	44	61.3	2.03	100	62.2	1.35	8	65.0	5.97	6	81.0	7.21

*Number of children.

† Mean.

‡ Standard error of the mean.

Reference: Lichton, I., et al., 1984, p. 10.

TABLE 30 Hawaii percentiles--weight, kg, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
Hawaiian and part-Hawaiian females										
5.5	27	20.21	1.82	17.16	17.69	18.82	20.07	21.32	22.90	23.51
6.0	37	21.59	4.79	15.87	16.28	17.91	20.98	23.81	29.94	31.51
6.5	33	23.36	4.35	17.88	18.89	20.35	22.56	25.79	28.28	35.20
7.0	42	24.68	5.26	18.62	20.16	21.43	23.30	25.62	30.62	38.51
7.5	37	25.93	5.91	18.64	19.24	20.69	24.60	30.88	35.58	37.15
8.0	45	27.45	5.19	20.22	20.91	22.96	26.87	31.24	35.31	37.04
8.5	34	31.11	6.84	22.22	23.98	27.04	29.31	35.24	40.70	45.07
9.0	31	30.85	5.66	22.49	23.04	27.55	30.50	34.35	36.69	45.26
9.5	52	33.65	8.16	21.33	24.77	28.17	31.01	39.20	45.71	49.66
10.0	49	39.00	8.97	25.40	26.30	32.88	37.19	45.75	54.19	56.12
10.5	34	41.90	14.56	23.71	26.81	31.80	36.96	47.39	66.95	73.98
11.0	42	41.60	11.08	27.33	28.46	32.77	40.48	47.65	56.63	62.80
11.5	31	44.20	12.29	30.04	30.54	36.96	42.52	51.36	57.50	74.92
12.0	33	50.22	11.80	28.58	33.31	40.78	52.15	58.50	66.28	69.69
12.5	55	50.08	10.67	36.94	38.18	41.95	48.87	54.76	65.17	75.36
13.0	33	49.79	8.47	33.99	34.83	46.60	50.23	55.60	61.99	63.16
13.5	59	55.68	11.12	37.64	45.01	49.32	53.42	59.86	73.42	80.27
14.0	47	52.65	7.91	41.70	42.65	46.26	50.98	58.84	64.45	67.67
14.5	24	53.93	7.81	42.32	44.78	48.73	52.89	57.48	66.33	73.78
15.0	26	59.19	10.19	45.54	47.83	52.12	56.63	64.28	71.59	85.99

Reference: Lichton, I., et al., 1984, p. 38.

TABLE 31 Hawaii percentiles--weight, kg, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
<u>Hawaiian and part-Hawaiian males</u>										
5.5	28	20.82	3.05	15.07	16.17	18.93	20.29	23.07	24.43	27.19
6.0	42	21.84	3.28	17.76	18.50	19.98	20.92	23.04	26.85	27.63
6.5	31	23.45	3.10	18.53	19.43	21.88	22.90	25.28	27.73	30.04
7.0	32	24.33	4.58	18.59	19.18	22.14	22.96	26.64	29.55	35.49
7.5	39	26.55	5.87	18.14	20.98	22.68	25.03	29.36	34.81	40.25
8.0	41	27.79	5.07	20.57	22.38	24.66	27.66	30.44	33.33	34.80
8.5	29	30.34	8.87	21.60	22.56	24.21	27.55	32.77	45.24	54.08
9.0	41	33.35	9.81	24.41	25.15	27.15	30.50	36.68	42.56	65.80
9.5	46	33.28	6.89	24.00	25.01	28.51	30.90	38.26	42.55	45.91
10.0	30	37.63	15.12	24.39	26.55	30.41	34.58	38.75	50.78	80.84
10.5	45	34.84	6.78	25.72	27.14	29.76	33.45	38.15	45.67	47.20
11.0	53	41.56	10.73	27.40	30.71	33.84	39.00	47.00	57.62	63.66
11.5	33	42.95	12.55	25.88	28.29	35.66	40.14	48.87	59.68	74.27
12.0	35	47.59	14.41	31.72	34.62	38.89	42.86	53.06	70.70	82.56
12.5	50	52.09	14.76	32.32	34.46	40.93	50.04	61.36	67.56	85.33
13.0	44	54.43	11.42	36.99	39.85	47.28	53.06	60.67	72.38	79.96
13.5	54	59.72	14.88	42.16	44.35	48.32	55.61	66.42	82.28	91.33
14.0	42	54.58	9.93	37.66	39.13	48.18	56.06	59.80	65.23	72.68
14.5	42	60.66	18.85	39.52	43.87	49.92	57.88	65.46	72.90	103.01
15.0	30	62.78	14.46	39.63	45.11	52.92	58.82	73.42	85.93	93.48

Reference: Lichton, I., et al., 1984, p. 45.

TABLE 32 Hawaii percentiles--weight-for-length index, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
Hawaiian and part-Hawaiian females										
5.5	27	1.000	0.068	0.900	0.929	0.945	0.991	1.033	1.120	1.140
6.0	37	1.016	0.178	0.790	0.822	0.894	0.987	1.115	1.275	1.363
6.5	33	1.027	0.171	0.819	0.876	0.917	1.030	1.080	1.170	1.521
7.0	42	1.051	0.194	0.857	0.877	0.934	1.009	1.087	1.264	1.582
7.5	37	1.049	0.201	0.798	0.839	0.871	0.988	1.210	1.403	1.434
8.0	45	1.020	0.162	0.793	0.820	0.871	1.011	1.133	1.264	1.329
8.5	34	1.050	0.208	0.788	0.835	0.923	0.994	1.188	1.289	1.508
9.0	31	1.015	0.173	0.812	0.820	0.919	0.998	1.076	1.201	1.480
9.5	52	1.081	0.223	0.760	0.840	0.924	1.020	1.245	1.366	1.566
10.0	49	1.038	0.217	0.728	0.754	0.879	1.012	1.190	1.347	1.481
10.5	34	1.103	0.318	0.711	0.761	0.858	0.995	1.237	1.615	1.803
11.0	42	1.011	0.237	0.729	0.742	0.842	0.989	1.128	1.328	1.440
11.5	31	1.040	0.260	0.750	0.761	0.874	0.994	1.148	1.295	1.730
12.0	33	0.967	0.196	0.606	0.705	0.796	0.986	1.110	1.238	1.302
12.5	55	1.016	0.192	0.754	0.796	0.870	0.999	1.112	1.310	1.438
13.0	33	0.993	0.157	0.712	0.733	0.907	0.995	1.077	1.228	1.276
13.5	59	1.032	0.183	0.748	0.852	0.920	0.983	1.119	1.322	1.432
14.0	47	1.031	0.146	0.845	0.857	0.922	1.000	1.170	1.276	1.279
14.5	24	1.025	0.140	0.797	0.853	0.947	1.011	1.095	1.262	1.375
15.0	26	1.039	0.167	0.808	0.848	0.922	1.016	1.120	1.217	1.496

Reference: Lichton, I., et al., 1984, p. 52.

TABLE 33 Hawaii percentiles--weight-for-length index, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE							
				5th	10th	25th	50th	75th	90th	95th	
Hawaiian and part-Hawaiian males											
5.5	28	1.031	0.121	0.823	0.868	0.961	1.005	1.106	1.182	1.303	
6.0	42	1.043	0.136	0.846	0.911	0.973	1.028	1.090	1.210	1.315	
6.5	31	1.028	0.115	0.856	0.896	0.953	1.006	1.099	1.186	1.263	
7.0	32	1.059	0.167	0.882	0.901	0.953	1.002	1.134	1.272	1.453	
7.5	39	1.068	0.203	0.811	0.886	0.922	1.011	1.171	1.324	1.568	
8.0	41	1.001	0.157	0.803	0.841	0.904	0.987	1.088	1.156	1.207	
8.5	29	1.095	0.294	0.827	0.851	0.907	0.989	1.165	1.655	1.904	
9.0	41	1.083	0.280	0.818	0.867	0.911	1.016	1.164	1.319	2.016	
9.5	46	1.067	0.182	0.830	0.864	0.954	1.014	1.176	1.300	1.401	
10.0	30	1.085	0.381	0.774	0.803	0.886	0.994	1.106	1.453	2.170	
10.5	45	1.038	0.171	0.833	0.858	0.917	0.992	1.105	1.340	1.378	
11.0	53	1.059	0.237	0.750	0.808	0.888	0.984	1.168	1.383	1.568	
11.5	33	1.071	0.258	0.737	0.763	0.905	1.024	1.168	1.486	1.711	
12.0	35	1.112	0.297	0.801	0.829	0.912	1.005	1.244	1.600	1.808	
12.5	50	1.034	0.248	0.710	0.752	0.854	0.982	1.191	1.366	1.572	
13.0	44	1.024	0.189	0.759	0.781	0.896	0.995	1.139	1.307	1.463	
13.5	54	1.064	0.233	0.779	0.797	0.902	0.990	1.180	1.382	1.594	
14.0	42	0.972	0.145	0.714	0.752	0.875	0.980	1.054	1.168	1.225	
14.5	42	1.037	0.262	0.743	0.805	0.893	1.016	1.092	1.231	1.629	
15.0	30	1.067	0.220	0.740	0.817	0.942	0.994	1.196	1.434	1.556	

Reference: Lichten, I., et al., 1984, p. 59.

TABLE 34

Triceps skinfold thicknesses of Hawaii and mainland school children, mm, 50th percentiles

Age years	Caucasian n	Japanese n	: Filipino		Hawaiian and part-Hawaiian		Chinese		Korean		Samoan		Mainland Caucasian			
			n	mm	n	mm	n	mm	n	mm	n	mm	n	mm		
Girls																
5.0	21	8.4	19	9.9	11	8.1	9	7.7	19	9.6	3	8.5	4	12.0	233	10
5.5	48	9.4	49	10.6	24	8.0	27	9.6	33	9.4	12	9.8	17	9.7		
6.0	57	9.7	65	10.6	32	8.7	37	9.3	35	9.1	6	11.1	23	9.8	259	10
6.5	78	9.6	83	11.2	34	9.0	33	10.8	35	8.9	21	9.5	24	10.2		
7.0	96	9.8	77	11.0	35	10.3	42	9.9	49	9.8	22	11.2	30	9.8	273	10
7.5	67	10.4	85	10.7	57	10.0	37	10.9	52	10.0	15	9.6	20	10.0		
8.0	66	11.2	72	11.5	42	9.2	45	10.7	37	10.3	14	9.6	26	11.0	270	10
8.5	77	10.7	81	10.8	45	9.7	34	11.5	36	10.8	20	10.2	22	11.6		
9.0	67	11.5	60	11.4	42	10.2	31	11.8	53	10.4	23	12.0	20	12.6	284	11
9.5	82	11.8	79	12.0	45	10.9	52	11.6	37	10.8	18	11.0	23	13.4		
10.0	81	13.2	77	13.2	45	10.4	49	14.5	37	9.9	23	12.9	26	12.8	276	12
10.5	83	12.5	91	11.9	43	11.0	34	12.2	46	12.0	18	12.0	11	10.6		
11.0	97	13.4	87	13.0	55	11.6	42	12.0	50	11.2	14	10.5	18	13.0		
11.5	104	12.4	82	12.3	41	10.8	31	11.3	43	11.7	23	12.5	16	13.6		
12.0	116	12.8	121	11.5	44	12.8	33	14.2	61	11.5	23	12.5	8	13.3	267	13
12.5	136	12.8	133	12.5	59	11.0	55	12.3	63	12.0	26	12.0	20	13.6		
13.0	180	14.1	124	13.0	59	12.2	33	13.2	65	13.7	16	13.4	9	17.0		
13.5	124	13.6	109	14.6	54	12.6	59	15.6	41	12.8	26	14.4	16	13.4	229	14
14.0	131	14.2	111	14.5	55	12.8	47	14.0	73	14.0	18	15.6	12	20.4	184	15
14.5	130	14.4	102	15.6	28	13.6	24	14.8	54	14.4	14	14.6	10	14.2		
15.0	92	16.0	65	15.8	35	13.8	26	15.8	38	15.0	7	14.2	3	24.0	197	16

Reference: Lichton, I., et al., 1984, p. 12.

Table 34. continued

Age years	Caucasian n	+	Japanese		Filipino		Hawaiian and part-Hawaiian		Chinese		Korean		Samoan		Mainland Caucasian ^a	
			n	mm	n	mm	n	mm	n	mm	n	mm	n	mm	n	mm
Boys																
5.0	20	8.2	37	8.4	12	8.4	9	8.2	19	9.3	5	10.4	11	8.9	262	8
5.5	44	8.2	68	9.0	35	8.0	28	8.9	37	8.2	9	9.2	19	9.4		
6.0	55	8.5	74	9.1	41	8.0	42	8.0	34	8.4	9	7.9	23	8.3	264	8
6.5	72	7.8	92	8.8	27	7.6	31	9.0	35	8.5	12	8.3	20	9.0		
7.0	58	7.8	78	8.9	37	7.6	32	8.4	32	7.8	16	10.3	23	8.2	309	8
7.5	69	8.2	78	8.8	43	8.5	39	8.0	42	9.6	15	10.1	18	9.4		
8.0	63	8.3	106	9.3	61	8.2	41	8.8	45	8.5	13	10.4	27	8.6	301	8
8.5	84	8.2	73	9.8	41	8.5	29	8.1	41	8.8	16	9.6	19	9.9		
9.0	82	8.2	83	10.4	53	9.3	41	9.6	43	8.7	22	10.7	19	10.0	287	9
9.5	80	9.1	98	10.6	44	9.5	46	9.3	48	9.8	15	8.1	14	10.4		
10.0	97	10.4	86	10.4	39	10.6	30	9.3	41	8.6	28	9.6	20	11.2	315	10
10.5	77	9.2	95	11.6	37	10.0	45	9.4	54	10.4	23	11.1	22	11.4		
11.0	93	10.0	82	12.4	48	10.8	53	10.7	51	9.9	21	11.8	11	16.5	294	10
11.5	83	10.4	92	12.2	29	9.6	33	10.4	56	9.7	18	12.0	12	8.7		
12.0	106	10.8	101	11.0	32	9.5	35	10.9	49	9.8	22	10.7	10	10.6	294	11
12.5	133	10.2	130	10.8	47	10.0	50	13.0	73	9.8	22	10.7	16	11.5		
13.0	132	10.0	103	9.9	51	8.0	44	11.4	73	9.9	23	8.6	8	11.2	266	10
13.5	120	9.7	123	9.7	53	8.6	54	10.1	66	9.0	27	9.4	11	10.0		
14.0	140	9.4	114	9.2	45	8.2	42	9.2	59	9.0	13	8.3	6	8.4	207	10
14.5	127	9.1	81	9.2	36	8.3	42	8.9	65	8.6	13	7.1	5	8.5		
15.0	109	8.2	71	9.2	26	7.5	30	8.3	54	9.1	5	13.8	3	17.6	179	9

^aNumber of children^bMeasured with a Harpenden caliper at the mid-portion of the upper arm on the nondominant side.^cFrom Frisancho (7).

Reference: Lichten, I., et al., 1984, p. 13.

Table 35 Hawaii percentiles--skinfold thickness, mm, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
<u>Hawaiian and part-Hawaiian females</u>										
5.5	27	10.0	2.2	6.8	7.4	8.2	9.6	12.4	13.1	14.0
6.0	37	9.9	3.1	6.5	7.0	7.5	9.3	11.2	13.4	16.4
6.5	33	10.7	2.6	7.3	7.6	8.4	10.8	12.3	14.4	17.1
7.0	42	10.8	3.5	6.5	7.3	8.6	9.9	12.3	14.9	19.7
7.5	37	11.1	3.6	6.5	7.0	8.4	10.9	12.4	17.1	20.1
8.0	45	11.1	3.1	7.3	7.6	8.8	10.7	12.6	15.0	18.6
8.5	34	12.6	4.2	7.6	8.0	9.6	11.5	14.4	19.5	21.9
9.0	31	11.7	3.7	6.0	6.8	9.2	11.8	12.8	17.3	19.8
9.5	52	12.8	4.9	7.2	8.2	9.0	11.6	15.2	21.6	24.4
10.0	49	14.8	4.9	7.8	8.5	10.3	14.5	18.6	22.3	23.7
10.5	34	13.8	5.9	6.6	7.1	9.2	12.2	18.4	23.4	25.2
11.0	42	13.6	4.8	8.2	8.7	10.0	12.0	16.7	19.4	24.0
11.5	31	12.3	4.1	6.9	7.3	9.8	11.3	13.5	17.6	22.4
12.0	33	14.9	5.0	7.9	9.1	11.3	14.2	18.6	23.0	26.1
12.5	55	13.5	4.7	7.6	8.0	10.3	12.3	16.4	21.9	22.3
13.0	33	14.5	4.7	8.5	9.2	10.6	13.2	18.2	19.8	23.9
13.5	59	16.5	5.6	9.2	9.8	12.1	15.6	18.7	24.5	26.3
14.0	47	14.8	4.4	8.7	9.3	11.7	14.0	17.4	22.1	22.9
14.5	24	14.9	3.4	9.2	10.0	12.6	14.8	17.4	20.1	21.5
15.0	26	16.5	4.2	9.6	11.4	13.6	15.8	18.9	22.8	26.2

Reference: Lichton, I., et al., 1984, p. 66.

TABLE 36 Hawaii percentiles--skinfold thickness, mm, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
Hawaiian and part-Hawaiian males										
5.5	28	9.3	3.4	6.1	6.2	7.0	8.9	11.3	12.3	18.4
6.0	42	8.5	2.3	5.8	6.2	7.1	8.0	9.4	11.0	14.5
6.5	31	9.1	2.1	5.7	6.4	7.5	9.0	10.8	11.5	13.0
7.0	32	9.3	3.4	6.1	6.2	7.5	8.4	10.2	13.2	17.6
7.5	39	9.7	4.1	5.4	6.2	7.0	8.0	12.2	15.5	19.0
8.0	41	10.1	4.2	5.6	6.1	7.2	8.8	12.6	15.8	18.2
8.5	29	10.4	5.5	5.1	5.6	6.6	8.1	13.4	16.7	25.2
9.0	41	11.8	5.9	6.0	6.7	8.2	9.6	14.0	20.0	27.9
9.5	46	10.8	4.4	5.9	6.2	7.6	9.3	13.3	18.5	21.6
10.0	30	11.3	4.9	6.5	6.7	7.6	9.4	14.4	20.5	23.2
10.5	45	10.7	4.4	6.1	6.2	7.3	9.4	12.8	17.0	20.8
11.0	53	12.5	4.8	6.2	7.4	8.8	10.7	15.8	19.7	22.5
11.5	33	11.8	4.3	6.7	7.4	9.0	10.4	13.6	19.2	23.4
12.0	35	13.4	6.1	6.7	7.8	8.2	10.9	18.4	22.3	28.6
12.5	50	14.2	6.2	6.2	7.3	9.0	13.0	19.2	22.8	27.2
13.0	44	13.6	6.3	6.2	6.4	8.2	11.4	17.6	22.8	27.4
13.5	54	12.2	5.6	6.3	6.6	8.0	10.1	15.8	19.4	24.0
14.0	42	10.3	3.9	5.7	6.4	7.5	9.2	12.4	16.7	19.2
14.5	42	10.5	5.8	5.9	6.1	6.6	8.9	10.9	19.9	27.7
15.0	30	10.3	5.4	5.8	6.4	7.5	8.3	10.6	21.5	25.4

Reference: Lichton, I., et al., 1984, p. 73.

TABLE 37
Mid-upper arm circumferences of Hawaii and mainland children, cm, 50th
percentiles

Age years	Caucasian n	Caucasian cm	Japanese n	Japanese cm	Filipino		Hawaiian and part-Hawaiian		Chinese		Korean		Samoan		Mainland Caucasian	
					n	cm	n	cm	n	cm	n	cm	n	cm	n	cm
Girls																
5.0	21	17.4	19	17.2	11	16.8	9	16.5	19	17.1	3	16.5	4	19.5	233	16.9
5.5	48	17.6	49	17.4	24	17.0	27	18.2	33	16.5	12	17.0	17	19.4	259	17.0
6.0	57	18.1	65	18.2	32	17.6	37	18.3	35	17.2	6	18.0	23	19.2	273	17.8
6.5	78	18.2	83	18.3	34	17.2	33	19.0	35	17.5	21	18.3	24	19.5	270	18.3
7.0	96	18.4	77	18.3	35	18.5	42	18.8	49	18.2	22	18.6	30	19.2	284	19.2
7.5	67	19.1	85	18.5	57	18.8	37	18.7	52	18.5	15	17.6	20	20.0	276	20.3
8.0	66	19.6	72	19.3	42	18.0	45	19.7	37	19.1	14	18.8	26	20.8	268	21.0
8.5	77	19.9	81	19.2	45	18.9	34	20.0	36	19.2	20	18.9	22	21.6	267	22.0
9.0	67	20.3	60	19.9	42	19.8	31	20.5	53	19.1	23	20.1	20	21.8	229	23.0
9.5	82	20.7	79	20.1	45	19.9	52	20.5	37	19.7	18	19.8	23	23.5	184	24.0
10.0	81	21.5	77	21.3	45	20.5	49	22.5	37	20.1	23	20.1	26	22.3	197	24.5
10.5	83	21.4	91	20.8	43	20.7	34	21.8	46	20.6	18	21.0	11	20.7		
11.0	97	21.8	87	21.6	55	21.1	42	22.3	50	20.8	14	20.6	18	22.9		
11.5	104	22.6	82	21.8	41	20.7	31	22.5	43	21.3	23	22.2	16	24.8		
12.0	116	22.7	121	22.1	44	23.0	33	25.1	61	21.9	23	21.4	8	24.7		
12.5	136	23.3	133	22.6	59	22.0	55	23.8	63	22.7	26	23.3	20	25.6		
13.0	140	24.2	124	22.7	59	23.0	33	24.5	65	23.6	16	22.2	9	27.3		
13.5	124	24.2	109	23.8	54	23.5	59	25.4	41	23.3	26	24.0	16	26.4		
14.0	131	24.2	111	23.9	55	23.6	47	24.6	73	23.4	18	23.4	12	29.6		
14.5	130	24.4	102	24.0	28	23.6	24	25.2	54	24.0	14	23.6	10	24.8		
15.0	92	25.5	65	24.8	7	24.8	26	26.4	38	23.8	7	25.2	3	30.3		

Reference: Lichton, I., et al., 1984, p. 14.

TABLE 37

Age years	Caucasian n ^a	cm ^a	Japanese		Filipino		Hawaiian and part-Hawaiian		Chinese		Korean		Samoan		Mainland Caucasians ^b	
			n	cm	n	cm	n	cm	n	cm	n	cm	n	cm	n	cm
Boys																
5.0	20	17.4	37	16.7	12	16.6	9	17.6	19	17.0	5	18.5	11	18.1	262	16.9
5.5	44	17.2	68	17.3	35	17.2	28	18.2	37	17.2	9	18.2	19	19.0		
6.0	55	17.7	74	17.6	41	17.4	42	18.0	34	17.3	9	17.3	23	19.2	264	17.2
6.5	72	18.0	92	18.2	27	16.9	31	18.7	35	17.9	12	17.2	20	19.8		
7.0	58	18.3	78	17.9	37	17.9	32	18.2	32	18.4	16	18.6	23	19.5	309	17.6
7.5	69	18.4	78	18.4	43	18.4	39	19.1	42	18.7	15	19.1	18	20.0		
8.0	63	18.8	106	18.8	61	18.4	41	19.5	45	18.0	13	20.7	27	20.2	301	18.5
8.5	84	19.2	73	19.4	41	19.5	29	19.3	41	18.8	16	19.9	19	20.2		
9.0	82	19.8	83	19.9	53	21.2	41	20.9	43	19.0	22	21.0	19	22.1	287	19.0
9.5	80	20.0	98	20.2	44	20.4	46	20.5	48	19.8	15	19.1	14	22.9		
10.0	97	21.4	86	20.5	39	20.8	30	21.0	41	19.9	28	19.9	20	22.6	315	20.0
10.5	77	20.7	95	21.7	37	20.6	45	21.1	54	21.0	23	20.0	22	22.4		
11.0	93	21.2	82	22.6	48	22.1	53	23.2	51	21.2	21	21.6	11	25.2	294	20.8
11.5	83	22.7	92	22.6	29	20.6	33	22.2	56	20.9	18	22.4	12	22.6		
12.0	106	22.6	101	23.0	32	23.2	35	23.9	49	21.5	22	22.5	10	25.1	294	21.6
12.5	133	23.1	130	23.2	47	22.5	50	24.8	73	22.2	22	24.3	16	25.4		
13.0	132	23.7	103	23.6	51	22.8	44	26.0	73	23.2	23	23.3	8	25.1	266	23.0
13.5	120	24.3	123	23.5	53	24.0	54	26.1	66	24.2	27	24.6	11	26.8		
14.0	140	24.5	114	25.4	45	25.3	42	25.0	59	23.7	13	24.6	6	25.6	207	24.3
14.5	127	25.6	81	25.9	36	25.2	42	26.1	65	25.4	13	24.0	5	27.3		
15.0	109	26.4	71	26.9	26	25.8	30	27.0	54	27.0	5	28.9	3	35.3	179	25.3

^aNumber of children.^bMeasured with Ross Laboratories Ensore Inscr-Tape at the mid-portion of the upper arm on the nondominant side.^cFrom Friaancho (1).

Reference: Lichten, I., et al., 1984, p. 15.

TABLE 38 Hawaii percentiles--arm circumference, cm, Continued

Age years	N ¹	Mean	sq ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
Hawaiian and part-Hawaiian females										
5.5	27	18.3	1.1	16.5	17.1	17.5	18.2	19.4	19.8	20.6
6.0	37	18.6	2.2	16.2	16.5	17.0	18.3	19.4	21.3	23.1
6.5	33	19.2	2.1	16.6	17.0	18.0	19.0	19.8	21.8	24.9
7.0	42	19.3	2.4	16.5	17.1	17.7	18.8	20.0	22.5	25.9
7.5	37	19.6	2.6	16.6	16.7	17.4	18.7	22.1	23.6	24.6
8.0	45	20.1	2.4	16.8	17.6	18.2	19.7	21.4	23.9	24.9
8.5	34	20.9	2.8	17.4	17.8	19.1	20.0	22.6	24.7	26.3
9.0	31	20.6	2.1	17.7	18.1	18.8	20.5	22.3	23.3	24.8
9.5	52	21.6	3.1	17.3	18.3	19.2	20.5	23.7	25.1	28.8
10.0	49	23.1	3.4	18.0	19.2	20.9	22.5	25.0	27.5	29.6
10.5	34	23.2	4.3	17.0	18.1	20.2	21.8	25.9	30.2	31.3
11.0	42	23.0	3.7	18.2	19.0	20.2	22.3	24.8	27.7	29.0
11.5	31	23.2	3.7	18.6	19.8	20.9	22.5	25.0	26.8	32.8
12.0	33	24.7	3.5	19.0	20.5	21.3	25.1	27.2	29.5	31.0
12.5	55	24.4	3.6	19.9	20.7	21.6	23.8	27.0	29.7	31.0
13.0	33	24.4	3.1	18.9	19.7	22.3	24.5	26.4	28.9	30.0
13.5	59	26.0	3.5	21.2	22.6	23.6	25.4	28.2	30.8	33.8
14.0	47	25.1	2.6	21.6	22.0	23.2	24.6	26.9	29.1	30.0
14.5	24	25.5	2.7	20.8	22.3	24.1	25.2	26.2	30.2	32.4
15.0	26	26.8	3.0	20.6	22.8	25.5	26.4	28.2	29.7	34.1

Reference: Lichton, I., et al., 1984, p. 80.

TABLE 39 Hawaii percentiles--arm circumference, cm, Continued

Age years	N ¹	Mean	SD ²	PERCENTILE						
				5th	10th	25th	50th	75th	90th	95th
Hawaiian and part-Hawaiian males										
5.5	28	18.2	2.1	15.5	16.2	16.6	18.2	19.1	20.3	23.6
6.0	42	18.5	1.7	16.3	16.6	17.3	18.0	19.3	20.8	21.6
6.5	31	18.9	1.5	16.7	16.8	17.9	18.7	20.1	20.7	21.9
7.0	32	19.1	2.1	17.0	17.2	17.6	18.2	20.2	21.7	24.1
7.5	39	19.9	2.8	16.1	17.4	18.2	19.1	21.2	24.5	26.0
8.0	41	20.0	2.4	17.0	17.4	18.2	19.5	21.6	22.7	24.1
8.5	29	20.6	3.7	17.1	17.4	18.0	19.3	21.8	27.9	29.9
9.0	41	21.6	3.8	17.7	18.2	19.0	20.9	22.7	26.2	33.6
9.5	46	21.3	2.7	18.1	18.2	19.2	20.5	23.0	25.0	26.2
10.0	30	22.3	4.4	18.0	18.9	19.9	21.0	23.9	30.0	34.7
10.5	45	21.5	2.6	18.4	18.8	19.5	21.1	22.4	25.5	27.2
11.0	53	23.5	3.8	18.2	19.2	20.4	23.2	25.2	29.1	29.9
11.5	33	23.4	3.8	18.7	19.9	21.2	22.2	24.3	29.9	33.2
12.0	35	25.0	4.0	20.4	21.0	21.7	23.9	27.5	31.2	33.7
12.5	50	25.8	4.3	19.0	20.6	22.6	24.8	28.5	31.8	35.0
13.0	44	26.1	3.7	20.3	20.8	23.6	26.0	28.7	30.8	34.4
13.5	54	27.0	4.0	21.9	22.6	23.6	26.1	29.6	33.2	35.6
14.0	42	25.3	3.0	20.2	21.2	23.2	25.0	27.9	29.2	29.9
14.5	42	26.5	4.3	21.0	22.4	23.9	26.1	27.4	29.9	37.3
15.0	30	28.0	4.2	21.5	22.8	24.9	27.0	30.8	33.6	36.0

Reference: Lichton, I., et al., 1984, p. 87.

Table 40 Extent of Race Mixture in
Hawaii: 1950 Census

Racial Group	No.	Per cent Mixed
Hawaiian (Polynesian)	86,091	85.8
Chinese	32,376	8.9
Caucasian	114,793	—
Filipino	61,071	12.6
Japanese	184,611	2.2
Other racial groups	20,852	27.3

Reference: Bassett, D., et al. Cardiovascular Renal Mortality
in Hawaii. Am. J. Publ. Hlt. 1962:52 #9:1418.

FIGURE 10

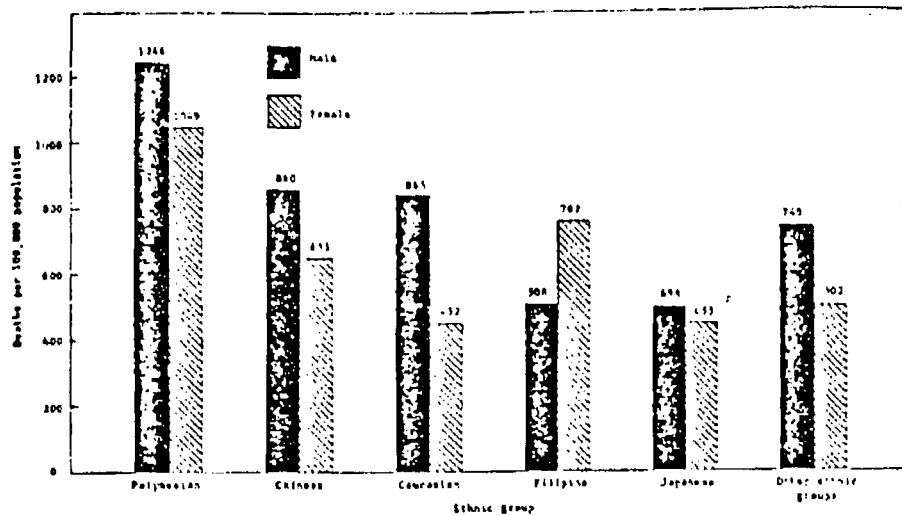


Figure 3—Age-Adjusted Death Rates for Major Cardiovascular-Renal Diseases Among Persons 35 to 74 Years by Ethnic Groups: Hawaii

Reference: Bassett, D., G. Tokuyama and T. McBride.
Cardiovascular-Renal Mortality in Hawaii.
American Journal of Public Health.
1962:52#9:1418.

FIGURE 11

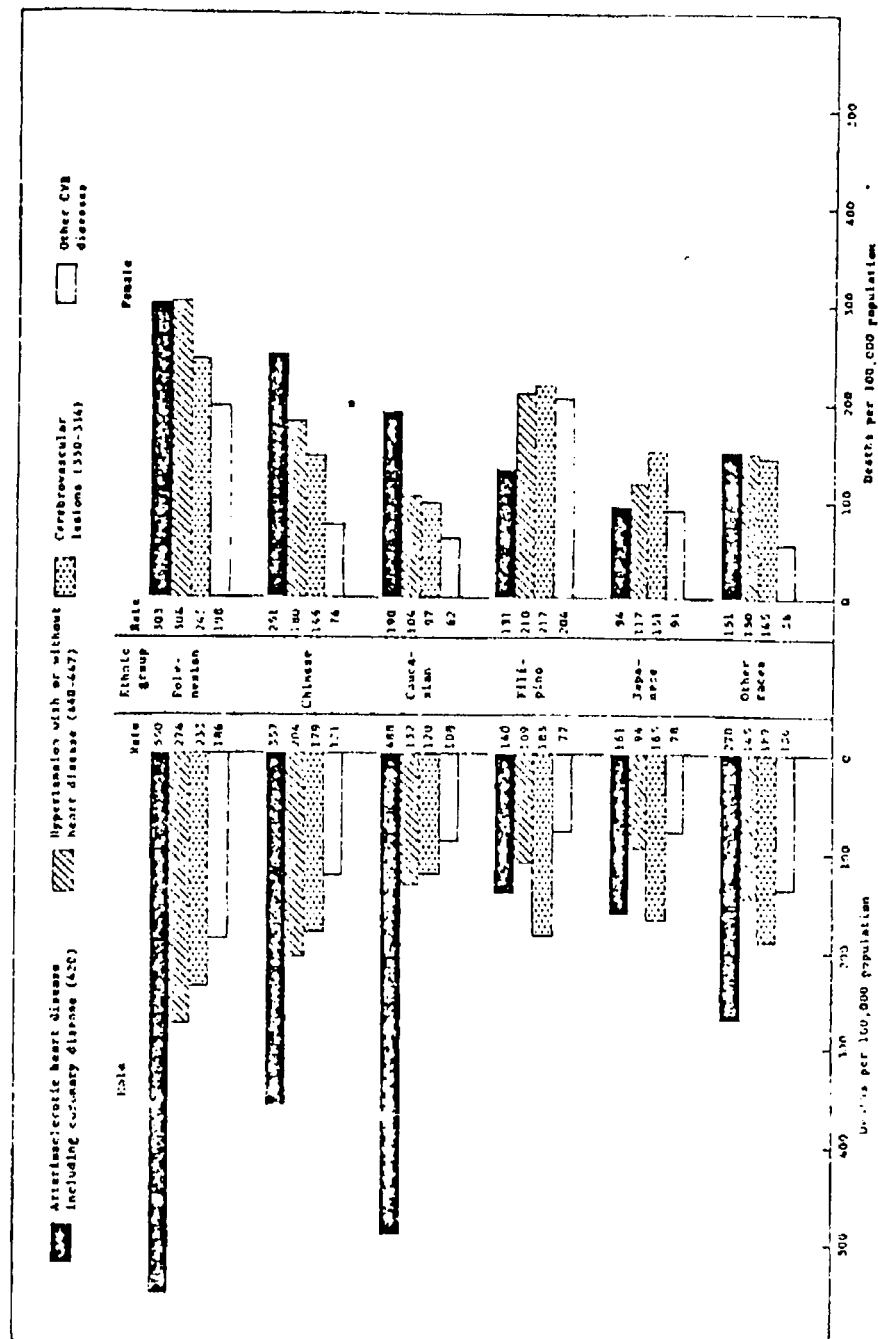


Figure 11. Age-Adjusted Death Rates for Major Cardiovascular-Renal Diseases Among Persons 35 to 74 Years by Ethnic Groups and Category of Disease: Hawaii

Reference: Bassett, D., G. Tokuyama and T. McBride. Cardiovascular-Renal Mortality in Hawaii. American Journal on Public Health. 1962;52#9:1418.

Table 41
Cardiovascular, Metabolic, and Anthropometric Measurements (Mean Values)

Age-range	Group					Total Mean (range) ± SD
	I 34 & under	II 35-44	III 45-54	IV 55 & over	V	
Number in group	13	9	3	5	30	
Weight (lb)	162.3	222.0	196.0	181.0	195.0 (140-275)	± 35.2
Height (inches)	68.5	70.1	67.0	69.2	68.9 (64-75)	± 2.04
Weight/height index	2.66	3.10	2.92	2.62	2.83 (2.19-4.04)	± 0.522
Serum cholesterol (mg%)	210	232	209.3	209.6	213.1 (134-322)	± 30.50
Random serum triglyceride (mg%)	238.3	247.7	229.3	182.6	231.0 (40-622)	± 120.8
Uric acid (mg%)	5.0	5.4	5.3	4.8	5.14 (4.1-8.0)	± 0.839
Hematocrit (%)	53.6	55.3	49.7	51.9	53.0 (40-64)	± 5.00
Whole blood viscosity (centipoise)	5.08	5.34	4.84	5.19	5.14 (3.75-6.45)	± 0.739
Systolic blood pressure (mm Hg)	140	144.2	150.6	144.8	143.5 (122-170)	± 14.40
Diastolic blood pressure (mm Hg)	88.7	91.1	93.3	84.8	89.3 (50-120)	± 14.38
BI-acromial diameter (cm)	34.2	34.3	33.7	35.8	34.5 (30-40)	± 2.12
Bi-iliac diameter (cm)	27.8	30.2	27.7	29.2	28.7 (23-35)	± 2.77
Upper-arm circumference (cm)	29.6	32.9	30.0	29.0	30.5 (25-40)	± 3.30
Right upper-arm skin fold (mm)	8.3	14.4	10.3	8.2	10.3 (4-25)	± 5.18
Right subscapular skin fold (mm)	15.0	23.0	13.7	14.6	17.2 (7-34)	± 7.73

*Range is given on second line.

Reference: Bassett, D., G. Rosenblatt, R. Moellering and A. Hartwell. Cardiovascular Disease, Diabetes Mellitus, and Anthropometric Evaluation of Polynesian Males on the Island of Niihau, 1963. Circulation 1966:XXXIV:1088.

Table 42
Mean and Standard Deviation of Daily Nutrient
Intake of 26 Subjects

	Mean	Standard deviation
Calories	2072	665.3
Protein (g)	166	59.3
Fat (g)	72	52.8
Carbohydrate (g)	187	51.8
Alcohol (g)	0	0.0
Saturated fatty acids (g)	25	19.3
Unsaturated fatty acids (g)	42	30.4
Oleic acid (g)	25.5	23.21
Linoleic acid (g)	11.3	6.24
Linolenic acid (g)	0.1	0.12
Other fatty acids (g)	5.9	4.03
Cholesterol (mg)	440.0	162.00
Fiber (g)	2.1	0.81
% Calories from:		
Fat	28.5	12.83
Protein	33.0	10.30
Saturated fatty acids	9.6	4.93
Polyunsaturated fatty acids*	7.3	3.83

*Linoleic, linolenic, and "other" fatty acids.

Circulation, Volume XXXIV, December 1966

Reference: Bassett, D., G. Rosenblatt, R. Moellering and A. Hartwell. Cardiovascular Disease, Diabetes Mellitus, and Anthropometric Evaluation of Polynesian Males on the Island of Niihau, 1963. *Circulation* 1966:XXXIV:1088.

TABLE 43 ANTHROPOMETRIC DATA

Group	Mean values, and standard errors of mean				t-tests Comparisons between races	
	Cases		Controls combined		Cases	Controls combined
	H	J	H	J		
	I	II	III + V	IV + VI	H→I vs. vs. J→II	III + V vs. IV + VI
No. of subjects	42	68	84	136	110	220
Height (in.)	67.6 0.4	64.1 0.3	67.6 0.3	64.6 0.2	***	***
Weight (lbs)	182.2 3.8	142.4 3.0	183.1 3.4	142.2 1.8	***	***
Bulk index $\frac{\text{wt. in g}}{(\text{ht. in cm})^3}$	2.81 0.06	2.43 0.04	2.82 0.04	2.40 0.02	***	***
Right subscapular skin fold (mm)	20.6 1.0	15.6 0.8	21.1 1.0	14.6 0.5	***	***
Right upper arm (triceps) skinfold (mm)	10.1 0.5	8.2 0.5	10.1 0.3	7.8 0.2	**	***

*Figures for these anthropometric measurements have been deposited as Document # NAPS-00025 with the ASIS National Auxiliary Publications Service. See footnote page 565 for details regarding the ordering of copies.

Subsequent data referred to in this paper and deposited here are designated "NPS" in this paper.

Reference: Bassett, D., R. Moellering, G. Rosenblatt, D. Greenberg and J. Stokes. Coronary Heart Disease in Hawaii. Serum Lipids, and Cardiovascular, Anthropometric and Related Findings in Japanese and Hawaiian Men. J. Chron. Dis. 1969:21:565.

TABLE 44

Comparison of average daily nutrient intake, nutrient intake in relation to body surface area, and "current physical activity" in Hawaiian and Japanese men with and without known coronary heart disease

Group Race: Number of subjects	Cases		Controls combined	
	I H 42	II J 68	III + V H 84	IV + VI J 136
Body surface area (BSA)	1.949 ± 0.021	1.687 ± 0.019	1.951 ± 0.021	1.694 ± 0.012
<i>P</i>	0.001		0.001	
Current physical activity index ^a (P.A.)	30.0 ± 1.03	28.2 ± 0.06	32.4 ± 0.77	31.8 ± 0.55
<i>P</i>	0.05		NS	
Calories	1,931 ± 114.3	1,838 ± 58.9	2,497 ± 104.3	2,380 ± 55.0
<i>P</i>	NS		NS	
Calories, BSA	996 ± 60.2	1,095 ± 35.0	1,284 ± 51.6	1,409 ± 32.2
<i>P</i>	NS		0.05	
Calories, (BSA × PA)	34.5 ± 2.37	39.9 ± 1.44	41.3 ± 1.84	45.8 ± 1.24
<i>P</i>	0.05		0.05	
Mean % deviation of calorie intake	19.5 ± 2.14	16.0 ± 1.12	17.4 ± 1.05	14.7 ± 0.82
<i>P</i>	NS		0.05	
Protein, g	81 ± 3.5	85 ± 3.0	105 ± 4.4	100 ± 2.3
<i>P</i>	NS		NS	
Protein, BSA	41.8 ± 1.85	50.6 ± 1.80	54.1 ± 2.15	59.4 ± 1.33
<i>P</i>	0.005		0.05	
Protein, (BSA × PA)	1.45 ± 0.080	1.84 ± 0.071	1.75 ± 0.084	1.94 ± 0.054
<i>P</i>	0.001		NS	
% Calories from protein	17.9 ± 0.68	18.8 ± 0.42	17.5 ± 0.53	17.2 ± 0.30
<i>P</i>	NS		NS	
Fat, g	75 ± 5.45	62 ± 2.95	98 ± 4.80	84 ± 2.89
<i>P</i>	0.05		0.025	
Fat, BSA	38.4 ± 2.82	37.0 ± 1.75	50.2 ± 2.38	49.7 ± 1.68
<i>P</i>	NS		NS	
Fat, (BSA × PA)	1.34 ± 0.116	1.35 ± 0.068	1.62 ± 0.09	1.61 ± 0.06
<i>P</i>	NS		NS	
% Calories from fat	34.4 ± 1.21	30.6 ± 1.04	35.7 ± 0.96	31.5 ± 0.68
<i>P</i>	0.025		0.001	
Carbohydrate, g	223 ± 14.8	230 ± 8.8	270 ± 13.9	288 ± 7.7
<i>P</i>	NS		NS	
Carbohydrate, BSA	115.0 ± 7.81	137.2 ± 5.29	130.6 ± 6.84	170.6 ± 4.52
<i>P</i>	0.025		0.001	
Carbohydrate, (BSA × PA)	3.97 ± 0.288	5.00 ± 0.208	4.44 ± 0.249	5.53 ± 0.164
<i>P</i>	0.005		0.001	
% Calories from carbohydrate	46.2 ± 1.38	50.0 ± 1.14	43.0 ± 0.97	48.6 ± 0.74
<i>P</i>	0.05		0.001	
Alcohol, g	6.2 ± 2.97	2.4 ± 0.86	16.2 ± 4.56	9.3 ± 1.70
<i>P</i>	NS		NS	
Alcohol, BSA	3.2 ± 1.56	1.4 ± 0.49	8.4 ± 2.40	5.6 ± 1.00
<i>P</i>	NS		NS	
Alcohol, (BSA × PA)	0.10 ± 0.052	0.05 ± 0.019	2.61 ± 0.070	1.93 ± 0.038
<i>P</i>	NS		NS	
% Calories from alcohol	1.7 ± 0.77	0.8 ± 0.28	3.68 ± 0.89	2.55 ± 0.44
<i>P</i>	NS		NS	
Fiber, g	3.0 ± 0.26	3.7 ± 0.22	3.0 ± 0.19	3.9 ± 0.17
<i>P</i>	0.05		0.005	

Values are means ± standard errors of mean. * See METHODS for derivation.

Reference: Bassett, D., M. Abel, R. Moellering, G. Rosenblatt and J. Stokes. Coronary Heart Disease in Hawaii: Dietary Intake, Depot Fat, "Stress", Smoking, and Energy Balance in Hawaiian and Japanese Men. Am. J. Clin. Nutr. 1969:22:1483.

TABLE 45
Average daily intake of cholesterol and fatty acids

	Cases		Controls combined	
Group Race Number of subjects	I H 42	II J 68	III + V H 84	IV + VI J 116
Cholesterol, mg	510 ± 42.5	466 ± 26.1	680 ± 47.0	507 ± 21.3
P	NS		0.025	
Cholesterol BSA	262.1 ± 21.74	277.6 ± 15.32	348.2 ± 17.78	347.3 ± 12.53
P	NS		NS	
Cholesterol (BSA × P.A.)	9.15 ± 0.826	10.10 ± 0.576	11.26 ± 0.653	11.25 ± 0.433
P	NS		NS	
Saturated fatty acids, g	28.6 ± 2.19	21.6 ± 1.23	36.2 ± 1.92	29.9 ± 1.06
P	0.005		0.025	
% Calories from saturated fats	13.3 ± 0.55	10.7 ± 0.46	13.2 ± 0.39	11.1 ± 0.27
P	0.001		0.001	
Oleic acid, g	29.9 ± 2.21	24.4 ± 1.30	37.8 ± 2.02	32.3 ± 1.16
P	0.05		0.025	
Linoleic acid, g	8.7 ± 0.87	9.4 ± 0.48	12.0 ± 0.66	12.8 ± 0.58
P	NS		NS	
Linolenic acid, g	0.6 ± 0.09	0.6 ± 0.05	0.8 ± 0.09	0.8 ± 0.05
P	NS		NS	
"Other" fatty acids, g ^a	2.6 ± 0.22	2.6 ± 0.20	3.4 ± 0.20	3.3 ± 0.14
P	NS		NS	
% Calories from "polyunsaturated" FA (PUFA)	5.4 ± 0.33	6.3 ± 0.28	5.9 ± 0.24	6.3 ± 0.19
P	0.05		NS	
% Calories from saturated FA	2.46 ± 0.203	1.70 ± 0.097	2.45 ± 0.100	1.90 ± 0.056
P	0.001		0.001	

^a Values are means ± standard error. ^b "Other" fatty acids include palmitoleic (16:1) and polyunsaturated fatty acids of chain length longer than C₁₈. ^c Polyunsaturated fatty acids (FA) = sum of computer output for linoleic, linolenic, and other FA. The value for "polyunsaturated" FA will slightly overestimate the true amount of polyunsaturated FA because of the inclusion of palmitoleic (16:1, a monounsaturated FA) in the category of other FA.

Reference: Bassett, D., et al. Coronary Heart Disease in Hawaii: Dietary Intake, Depot Fat, "Stress", Smoking and Energy Balance in Hawaii. Am. J. Clin. Nutr. 1969:22:1483.

TABLE 46
Dietary intake of "sucrose and fructose"

	Group Race Number of subjects	Cases		Controls combined	
		I H 42	II J 68	III + V H 84	IV + VI J 136
Sucrose and fructose, g		57.8 ± 5.48	65.4 ± 4.70	57.6 ± 4.74	69.2 ± 3.76
P		NS		NS	
Sucrose and fructose, g BSA		30.0 ± 2.93	38.9 ± 2.78	29.4 ± 2.29	40.7 ± 2.17
P		0.05		0.001	
Sucrose and fructose (BSA × P.A.)		1.03 ± 0.101	1.42 ± 0.103	0.96 ± 0.081	1.33 ± 0.075
P		0.025		0.005	
% Calories from sucrose-fructose		12.8 ± 1.19	14.3 ± 0.93	9.4 ± 0.68	11.6 ± 0.57
P		NS		0.025	

Values are means ± standard error and represent summation of total carbohydrate calories derived from fruit juices and cooked fruits, raw fruits and vegetables, concentrated sweets, and desserts.

TABLE 47
Average daily intake of caffeine, number of cups of coffee or tea, and number of 6-oz bottles of cola beverage

	Group Race Number of subjects	Cases		Controls combined	
		I H 42	II J 68	III + V H 84	IV + VI J 136
Caffeine, total milligrams		236.9 ± 24.0	225.3 ± 19.3	209.6 ± 15.9	261.5 ± 15.5
P		NS		0.05	
Caffeine, BSA		121.2 ± 12.51	134.4 ± 11.56	107.1 ± 8.02	153.9 ± 9.07
P		NS		0.001	
Caffeine, (BSA × P.A.)		4.18 ± 0.425	4.93 ± 0.422	3.49 ± 0.284	5.04 ± 0.405
P		NS		0.001	
Number of cups of coffee		2.1 ± 0.3	1.7 ± 0.2	1.7 ± 0.2	2.0 ± 0.1
P		NS		NS	
Number of cups of tea		0.3 ± 0.1	0.9 ± 0.1	0.4 ± 0.1	0.8 ± 0.1
P		0.001		0.005	
Number of 6-oz bottles cola beverage		0.2 ± 0.1	0.1 ± 0.2	0.2 ± 0.1	0.1 ± 0.03
P		NS		NS	

Values are means ± standard error.

Reference: Bassett, D., et al. Coronary Heart Disease in Hawaii: Dietary Intake, Depot Fat, "Stress", Smoking and Energy Balance in Hawaii. Am. J. Clin. Nutr. 1969;22:1483.

Table 48
Comparison of Hawaiian and Maori Men

	Hawaiian	Maori*	Difference (P)
Number of subjects	49	110	...
Number with known diabetes	6	7	...
Height, inches (cm)	68 (173)	67 (170)	ns+
Weight, lb (kg)	187 (85)	175 (79)	ns
Relative obesity	114	114	ns
Cholesterol (mg/100 ml)	211	208	ns
Uric acid (mg/100 ml)	5.4	7.18†	0.001

* Reported by Prior et al.¹

+ Not significant.

† Corrected for difference in uric acid methods (7.4-0.22 mg/100 ml).

Reference: Healey, L., J. Caner, D. Bassett and J. Decker. Serum Uric Acid and Obesity in Hawaiians. JAMA 1966;196:152.

TABLE 49
Serum cholesterol concentrations in Honolulu men

Ancestry	20-39 years			40-49 years			50-59 years			All ages		
	No.	Mean age	Cholesterol	No.	Mean age	Cholesterol	No.	Mean age	Cholesterol	No.	Mean age	Cholesterol
			mg/100 ml			mg/100 ml			mg/100 ml			mg/100 ml
Caucasian	23	27	226 ± 42 ¹	39	44	266 ± 50 ¹	19	55	269 ± 44 ¹	81	41	256 ± 48 ¹
Chinese	18	28	247 ± 45	32	43	278 ± 39	25	57	282 ± 51	75	44	272 ± 47
Filipino	16	28	196 ± 31	124	45	251 ± 41	57	54	263 ± 40	197	46	250 ± 44
Hawaiian (part and full)	75	27	240 ± 46	44	44	252 ± 49	22	55	289 ± 55	141	37	251 ± 51
Japanese ²	57	23	230 ± 34	89	43	269 ± 39	29	54	276 ± 44	175	38	257 ± 43
Various others	18	24	219 ± 32	25	43	263 ± 47	12	56	275 ± 44	55	40	251 ± 48

¹ Mean $\pm$ standard deviation.

^aData were also obtained for Japanese men aged 60-89 years: N = 19; mean age = 77; mean cholesterol = 225.

TABLE 50
Significance of observed differences in serum cholesterol of various ethnic groups

Groups compared (adult men)	Age range	Difference in group means	Degrees freedom	t	Probability of larger t value ¹
		mg/100 ml			less than
Honolulu: Japanese vs. Filipino	20-39	34	71	3.45	0.1%
Caucasian vs. Filipino	20-39	30	37	2.34	2.5
Chinese vs. Japanese	20-39	17	73	2.44	2.5
Chinese vs. Filipino	40-49	27	154	3.39	0.1
Hawaiian vs. Filipino	50-59	26	77	2.26	5.0
Chinese vs. Caucasian	20-59	16	163	2.18	5.0
Honolulu Filipino vs. Lanai Filipino	50-59	37	91	4.20	0.1
Honolulu Filipino vs. Lanai Filipino	40-49	30	139	2.22	1.0
Honolulu Caucasian vs. Lanai Filipino	20-39	26	38	2.12	5.0

¹ The probabilities that the difference among other groups of a given age range occurred by chance are calculated to be greater than 5%. Probabilities were taken from Snedecor ('56').

Reference: Adamson, L. Serum Cholesterol Concentrations of Various Ethnic Groups in Hawaii. J. Nutr. 1960;71:27.

Table 51 Height, weight, and skinfold measurements of Honolulu policemen and firemen, by occupation, ethnic group, and occupation-ethnic group, 1968

Classification	Number examined	Age (years)		Height (inches)		Weight (pounds)		Skinfold (mm.)		Weight-height (ratio)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Occupation:											
Policemen.....	552	35	10	71	2	188	23	19	3	2.7	0.31
Firemen.....	619	37	9	69	2	177	21	18	2	2.6	.27
Ethnic group:											
Part-Hawaiian.....	692	35	10	70	2	186	23	19	3	2.7	.39
Caucasian.....	196	35	10	71	2	184	24	19	3	2.6	.32
Oriental.....	283	39	9	69	2	171	17	17	2	2.5	.22
Occupation-ethnic:											
Policemen:											
Part-Hawaiian.....	311	33	10	71	2	192	24	20	4	2.7	.33
Caucasian.....	117	34	10	71	2	190	23	19	3	2.7	.31
Oriental.....	124	38	10	70	2	178	18	18	2	2.5	.24
Firemen:											
Part-Hawaiian.....	381	37	9	69	2	181	20	18	3	2.6	.27
Caucasian.....	79	36	10	70	2	176	24	18	3	2.5	.31
Oriental.....	159	39	9	68	2	166	15	17	1	2.4	.19

¹ Significant at the $P=0.05$ level.

NOTE: S.D. means standard deviation.

Table 52 Comparison of overweight and obesity by occupation, ethnic group, and by occupation-ethnic group, Honolulu policemen and firemen, 1968

Classification	Overweight			Obese	
	Mean pounds	Number	Percent	Number	Percent
Occupation:					
Policemen.....	22	389	70.5	103	18.7
Firemen.....	17	404	65.3	31	5.0
Ethnic group:					
Part-Hawaiian.....	21	507	73.3	95	13.7
Caucasian.....	20	128	65.3	33	16.8
Oriental.....	13	158	55.8	6	2.1
Occupation-ethnic:					
Policemen:					
Part-Hawaiian.....	24	235	75.6	70	22.5
Caucasian.....	21	81	69.2	27	23.1
Oriental.....	15	73	58.9	6	4.8
Firemen:					
Part-Hawaiian.....	18	272	71.4	25	6.6
Caucasian.....	17	47	59.5	6	7.6
Oriental.....	11	85	53.5		

¹ Significant at the $P=0.05$ level.

Reference: Morioka, H. and M. Brown. Incidence of Obesity and Overweight Among Honolulu Police and Firemen. Public Health Reports. 1970:85#5:433.

Table 53 Weight increase of Honolulu policemen and firemen from employment to 1968, by ethnic group and occupation-ethnic group

Classification	Number	Weight gain (5 pounds or more)		Mean gain (pounds)
		Number	Per- cent	
Ethnic group:				
Part-Hawaiian.....	228	123	55	16.3
Caucasian.....	89	53	60	15.0
Oriental.....	126	59	47	13.1
Police-men:				
Part-Hawaiian.....	109	68	62	19.0
Caucasian.....	59	39	66	16.7
Oriental.....	78	37	47	13.1
Firemen:				
Part-Hawaiian.....	119	57	48	13.0
Caucasian.....	30	14	47	10.1
Oriental.....	48	22	46	13.2

¹ Significant at the $P=0.05$ level.

Reference: Morioka, H. and M. Brown. Incidence of obesity and overweight among Honolulu police and firemen. Public Health Reports. 1970:85#5:433.

TABLE 54 Weight, height and Quetelet index (QI)¹ of subjects by race, means $\pm$ SEM

Racial classification ²		CAU	CHI	FIL	HPH	JAP	KOR
<u>Men</u> -- No. of subjects		24	23	18	13	18	6
Weight, kg		70.4	65.0	67.4	74.8	64.8	70.4
		± 1.46	± 1.65	± 2.68	± 2.38	± 2.14	± 7.55
Height, cm		175.7	171.4	168.5	175.6	168.1	172.3
		± 1.92	± 1.64	± 1.55	± 1.34	± 1.38	± 2.93
QI		229.2	221.4	236.4	242.3	230.3	233.8
		± 5.70	± 4.92	± 6.65	± 7.25	± 8.80	± 17.0
<u>Women</u> -- No. of subjects		27	30	21	23	33	4
Weight, kg		59.9	51.1	51.3	58.4	51.4	50.3
		± 2.38	± 1.36	± 1.73	± 1.71	± 1.39	± 2.65
Height, cm		165.5	160.2	157.2	163.4	156.5	159.4
		± 2.01	± 0.92	± 1.32	± 1.76	± 1.35	± 1.60
QI		218.6	198.6	207.4	219.2	209.7	198.2
		± 7.70	± 4.12	± 6.46	± 6.38	± 5.05	± 10.5

¹QI = (weight/height²) $\times$ 100,000.

²CAU Caucasian; CHI Chinese; FIL Filipino; HPH Hawaiian and part-Hawaiian;

JAP Japanese; KOR Korean. See text for method of determining racial classification.

Reference: Young, F., et al. Body Weight, Blood Pressure and Electrolyte Excretion of Young Adults From Six Ethnic Groups in Hawaii. To Be Published.

TABLE 55 Systolic (SBP) and diastolic (DBP) blood pressures¹ by race, means $\pm$ SEM

Racial classification ²	CAU	CHI	FIL	HPH	JAP	KOR
<u>Men</u> ³						
SBP, mm Hg	122.0	119.3	118.4	127.6	121.8	120.9
	± 1.56	± 1.76	± 1.73	± 2.50	± 2.53	± 3.71
DBP, mm Hg	75.2	81.4	79.4	84.7	78.4	78.8
	± 1.31	± 1.50	± 1.39	± 2.03	± 3.00	± 2.72
<u>Women</u> ³						
SBP, mm Hg	110.2	109.4	106.0	108.6	107.8	100.8
	± 1.63	± 1.75	± 1.58	± 1.97	± 2.02	± 2.94
DBP, mm Hg	71.6	76.3	72.1	75.0	71.6	70.2
	± 1.58	± 1.08	± 1.20	± 0.95	± 1.38	± 1.26

¹Blood pressures were measured on three separate occasions and averaged for each subject.

²See footnote to Table 1 for description of racial classification.

³Number of subjects same as in Table 1.

Reference: Young, F., et al. Body Weight, Blood Pressure and Electrolyte Excretion of Young Adults From Six Ethnic Groups in Hawaii. To Be Published.

FIGURE 12

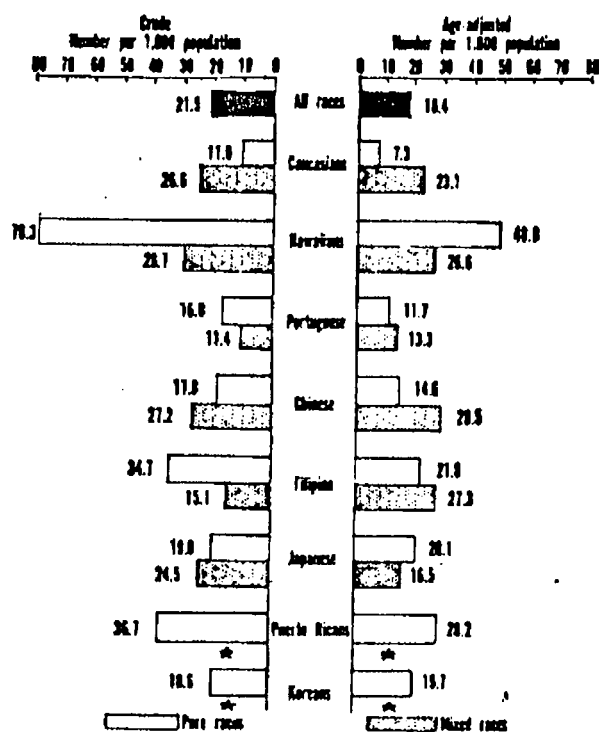


Fig 3.—Comparison of crude and age-adjusted prevalence rates for each ethnic group. Star indicates one diagnosed patient in each group.

Reference: Sloan, N. Ethnic Distribution of Diabetes Mellitus in Hawaii. JAMA 1963;183#6:123.

Table 56 Number, Percentage Distribution, and Diabetes Rates/1,000 Persons Among Part-Hawaiians by Ethnic Mixtures

Ethnic Groups	Total Positive Participants		New and Known Diabetics		Rate 1,000 Partic- pants
	No.	%	No.	%	
Total part-Hawaiians	304	100	137	100	28.5
Hawaiian-Caucasian	113	37	51	37	27.6
Hawaiian-Chinese	108	36	44	32	29.1
Hawaiian-Caucasian-Chinese	58	19	17	12	23.9
Other part-Hawaiians*	90	29	23	17	33.1

* Include Hawaiian-Chinese and Hawaiian-Caucasians mixed with other ethnic groups as well as other part-Hawaiians.

Reference: Varney, J. and M. Sato. Diabetes in Hawaii: Arthritis/Rheumatism and Gout in Hawaii: Some Statistical Analysis. Hawaii Medical Journal. 1979:38:197.

TABLE 57: Age-adjusted prevalence of diabetes per 1,000 persons by sex and ethnicity: Hawaii, 1974-1976

ETHNICITY	MEN	WOMEN
Caucasian	13	13
Chinese	27	17
Filipino	19	20
"Hawaiian"	32	31
Japanese	24	25
Other	23	35

TABLE 58: Amount of Activity Limitation in persons with diabetes by ethnicity: Hawaii, 1974-1976

ETHNICITY	ACTIVELY LIMITED				TOTAL WITH LIMITATION	TOTAL
	NONE	MINOR	MODERATE	SEVERE		
Caucasian	2,981 94.4%	66 2.0%	67 2.1%	43 1.4%	176 5.6%	3,157
Chinese	1,232 98.2%	22 1.8%	0	0	22 1.8%	1,254
Filipino	2,005 96.2%	0	22 1.1%	58 2.8%	80 3.8%	2,085
"Hawaiian"	2,877 46.7%	133 2.2%	131 2.1%	22 0.4%	286 4.6%	3,163
Japanese	7,712 97.1%	81 1.0%	87 1.1%	64 0.8%	232 2.9%	7,944
Other	1,551 96.0%	43 2.7%	22 1.4%	0	65 4.0%	1,616
Total	18,358 96.5%	315 1.8%	329 2.8%	187 1.0%	861 4.5%	19,219

Reference: Varney, J. and M. Sato. Diabetes in Hawaii: arthritis/rheumatism and gout in Hawaii: some statistical analysis. Hawaii Medical Journal. 1979:38:197.

TABLE 59. Age adjusted prevalence of ARTHRITIS per
1,000 persons by sex and ethnicity: Hawaii, 1974-1976

ETHNICITY	MEN	WOMEN
✓ Caucasian	18	58
Chinese	13	25
✓ Filipino	14	20
✓ "Hawaiian"	21	36
Japanese	9	24
Other	23	36

TABLE 60. Age adjusted prevalence of GOUT per
1,000 persons by sex and ethnicity: Hawaii, 1974-1976

ETHNICITY	MEN	WOMEN
✓ Caucasian	13	4
✓ Chinese	32	4
✓ Filipino	26	9
✓ "Hawaiian"	26	7
Japanese	19	3
Other	16	5

Reference: Varney, J. and M. Sato. Diabetes in Hawaii:
arthritis/rheumatism and gout in Hawaii: some
statistical analysis. Hawaii Medical Journal.
1979:38:197.

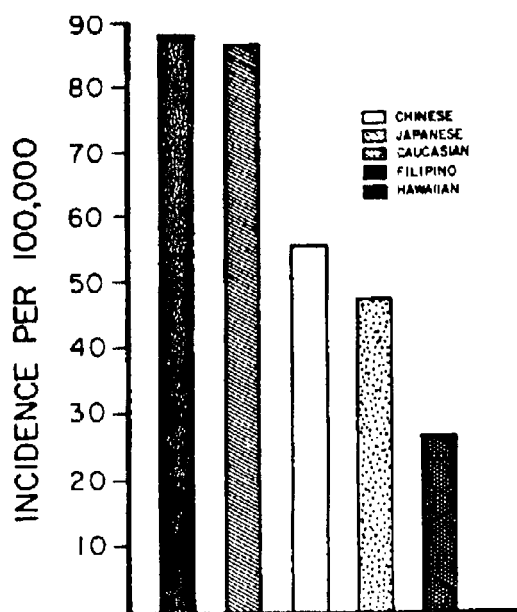


FIGURE 13
Breast Cancer Incidence in Females
in Hawaii
1973-1977

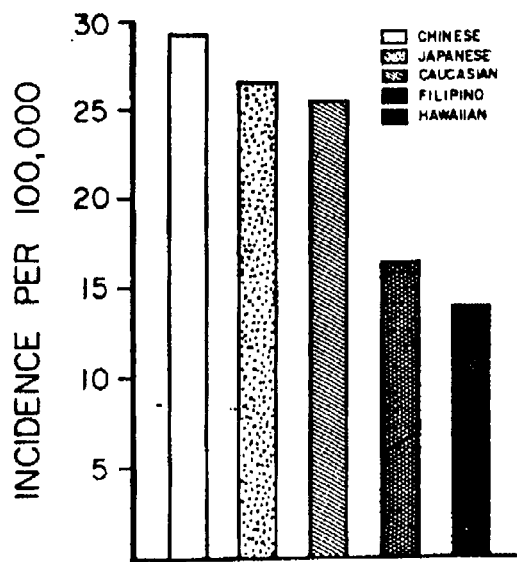


FIGURE 15
Colon Cancer Incidence in Males in
Hawaii
1973-1977

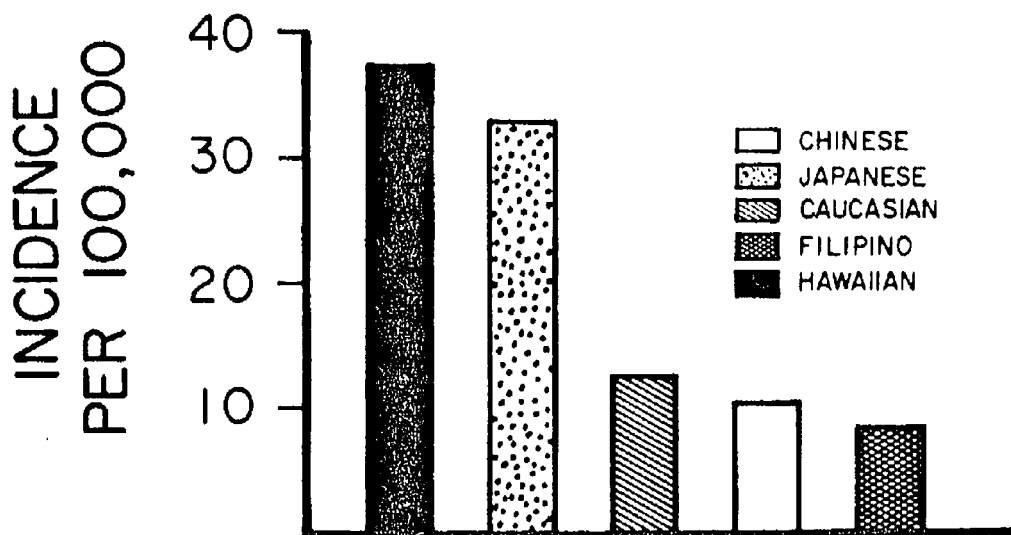


FIGURE 14
Stomach Cancer Incidence in Males
in Hawaii
1973-1977

Reference: Hankin, J. Diet and Cancer. Community Health Studies. 1981: V#2:126.

Table 61 Average daily food and nutrient intake among adults (45 years and older) of the five main ethnic groups in Hawaii ^a

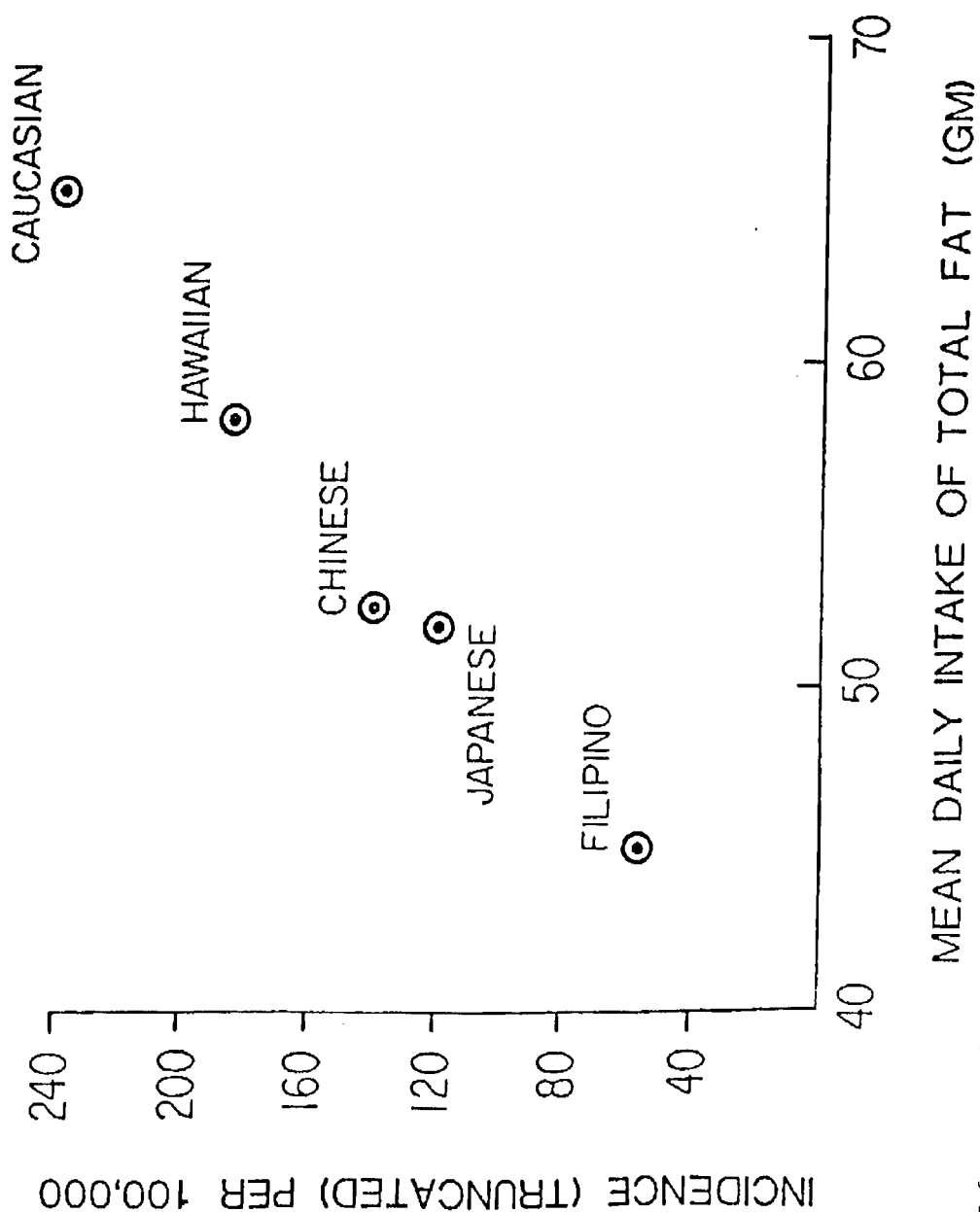
		MEN				
		Caucasian	Japanese	Chinese	Filipino	Hawaiian
Total fat	(g)	81.9	68.0	72.1	57.9	74.8
Total protein	(g)	69.6	66.0	65.3	61.8	69.1
Vitamin C ^b	(g)	305.6	292.4	200.7	136.1	262.6
Rice	(g)	90.2	339.9	237.2	431.9	218.6
Beef	(g)	51.4	40.4	41.1	34.6	46.5
Pork	(g)	34.3	38.3	43.0	37.7	41.2
Fish	(g)	23.0	37.3	30.5	32.7	36.0
Broccoli	(g)	6.8	4.2	5.9	3.6	4.8
Papaya	(g)	32.6	45.7	46.2	28.1	38.0
		WOMEN				
		Caucasian	Japanese	Chinese	Filipino	Hawaiian
Total fat	(g)	63.0	53.0	56.7	48.1	58.7
Total protein	(g)	54.4	51.3	53.8	51.2	53.4
Vitamin C ^b	(g)	349.9	288.1	227.3	208.1	239.2
Rice	(g)	59.8	211.8	172.5	300.6	133.7
Beef	(g)	37.0	30.5	30.9	24.2	34.5
Pork	(g)	22.2	24.6	35.1	27.1	29.5
Fish	(g)	19.1	28.3	22.4	25.8	25.1
Broccoli	(g)	7.1	4.3	6.2	3.5	3.9
Papaya	(g)	32.1	51.0	37.3	36.3	35.4

^a Age-adjusted by analysis of covariance.

^b Includes supplements.

Reference: Kolonel, L., Hankin, J., Nomura, A. and Ward Hinds, M. Studies of Nutrients and Their Relationship to Cancer in the Multiethnic Population in Hawaii. Unpublished Communication. Cancer Center of Hawaii, 1985.

FIGURE 16



Reference: Kolonel, L., et al. Cancer Center of Hawaii, 1985.

Figure 17

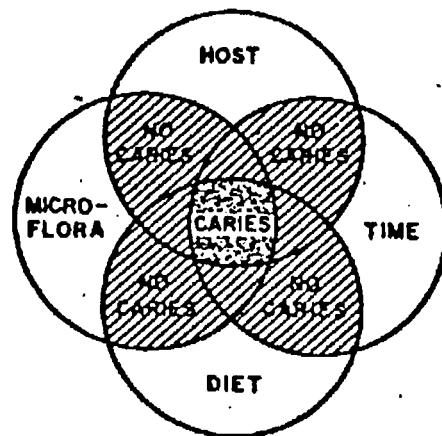
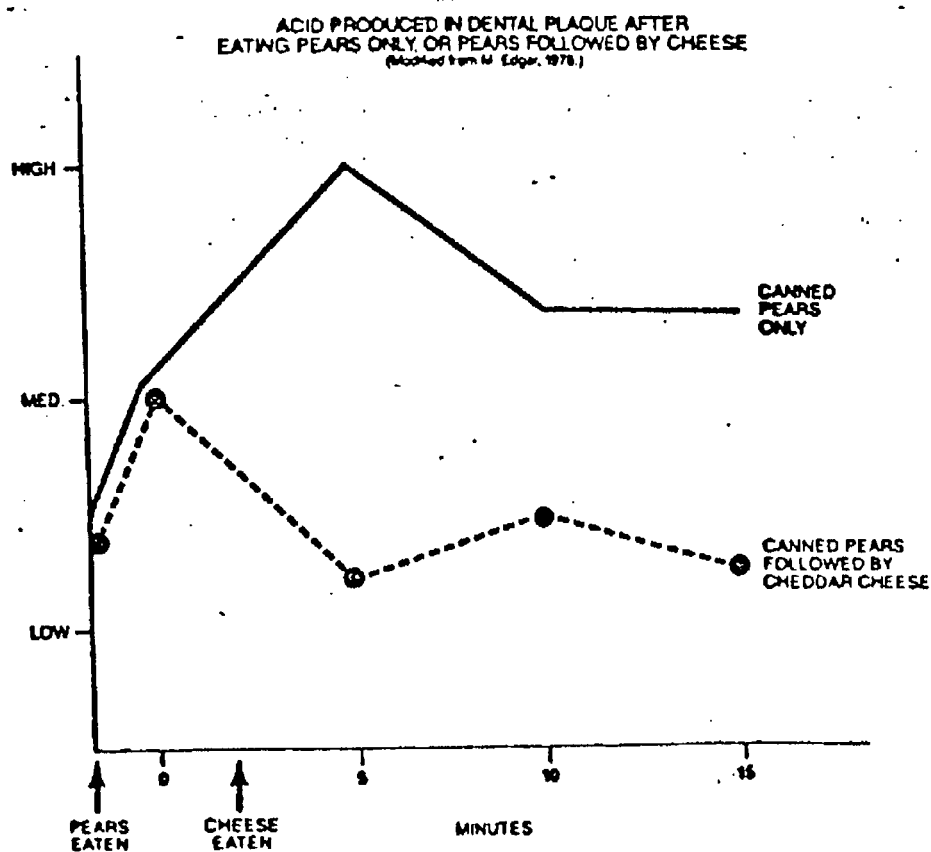


Fig. 17 Parameters involved in the caries process. All four factors must be acting concurrently (overlapping of the circles) for caries to occur.

Alfano
Cereal Foods World
Volume 26, No. 1

FIGURE 18



Inverted Stephan curves demonstrating the beneficial effect of eating cheese after an acidogenic snack on plaque pH (modified from Edgar [23]).

Reference: Alfano, M. C. Dental caries: the nature of the problem. Cereal Foods World 26:1, p. 5, January 1981.

TABLE 62

Selected Rankings of Cariogenic
Potential Index (CPI) in Rats Fed Human
Foods as Snacks

Food Tested	CPI
Sucrose	1.0
Filled chocolate cookie	1.4
Cereal (14% sucrose)	1.1
Cereal (8% sucrose)	1.0
Cereal (60% sucrose)	0.9
Coated chocolate candy	0.9
Potato chips	0.8
Caramel	0.7
Chocolate bar	0.7
Cereal (2% sucrose)	0.5
Starch	0.5
Sucrose and 7.5% DiCal	0.4
No meals by mouth	0.0

Source: Bowen (22).

TABLE 63

Selected Rankings of Caries
Scores in Rats Fed Human Foods as
Snacks

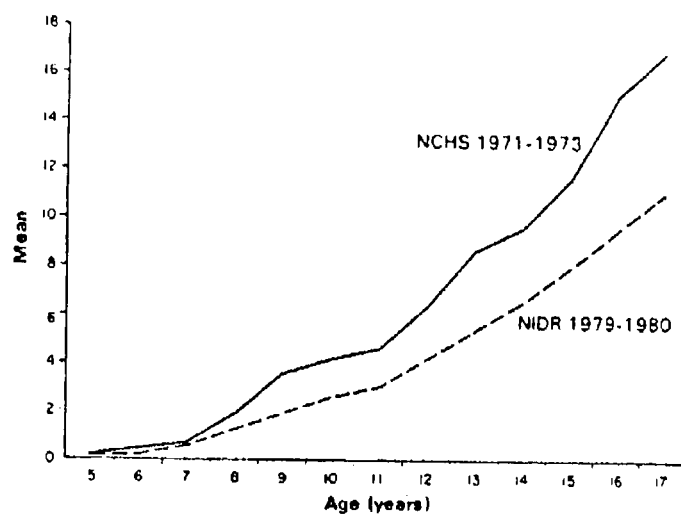
Food Tested	Caries Standard Scores	Error
Peanuts	0.0	0.0
Popcorn	0.0	0.0
Sorbitol	0.0	0.0
White bread and butter	4.9	1.0
White bread	9.2	1.3
White bread and raspberry jam	10.2	1.6
Figs	10.3	1.9
Rye bread	12.7	3.0
Caramels	16.0	6.2
Bananas	21.0	6.0
Candy mints	24.7	8.4
Raisins	30.9	5.3
White bread and grape jelly	36.7	7.2
Sucrose	62.1	8.6

Source: Stephan (21).

Reference: Alfano, M. C. Dental caries: the nature of the problem. Cereal Foods World 26:1, p. 5, January 1981.

Figure 19

FIGURE 2. Mean DMFS* for children aged 5-17 years — United States †



*Decayed, missing (due to caries), and or filled permanent tooth surfaces

†From the 1971-1973 National Center for Health Statistics (NCHS) Survey and the 1979-1980 National Institute of Dental Research (NIDR) Survey

Reference: Center for Disease Control, MMWR, February 1985.

Table 64
Dental Status of Children

GROUPS AND AGES	TOTAL NUMBER IN EACH GROUP	NUMBER WITH CARIOUS TEETH	NUMBER WITH PERFECT TEETH	D.M.F. TOTAL	D.M.F. PER SUBJECT	ASSESSED UNEXCISED TEETH		ABSCESSED PERMANENT TEETH OTHER THAN FIRST MOLAR
						Total Number	Per Subject	
Hawaiian								
2-5	81	56	25	348	4.30	24	.29	0
6-8	58	57	1	491	8.46	75	1.29	0
9-11	50	50	0	368	7.36	36	.72	1
12-14	39	38	1	336	8.62	2	.05	2
15-20	20	19	1	201	10.05	0	—	4
Oahu								
Japanese								
2-5	31	28	3	258	8.32	62	2.00	0
6-8	28	28	0	336	12.00	90	3.21	1
9-11	33	33	0	298	9.03	17	.51	1
12-14	33	33	0	310	9.39	2	.06	2
15-20	27	27	0	306	11.33	0	—	6
Kona								
Japanese								
2-5	17	14	3	116	6.82	7	.41	0
6-8	24	24	0	322	13.41	69	2.87	0
9-11	22	22	0	188	8.54	19	.86	1
12-14	29	29	0	276	9.51	0	—	2
15-20	24	24	0	252	10.50	0	—	1
Chinese								
2-5	4	3	1	27	6.75	9	2.25	0
6-8	5	5	0	82	16.50	23	4.60	0
9-11	6	6	0	52	8.66	14	2.33	0
12-14	5	5	0	34	6.80	3	.60	0
15-20	9	9	0	103	11.44	0	—	0

Reference: Potgeiter, M. and K. Nakatani. Diet and Health in Rural Hawaii. Tech. Bulletin #21, University of Hawaii, 1954.

FIGURE 20

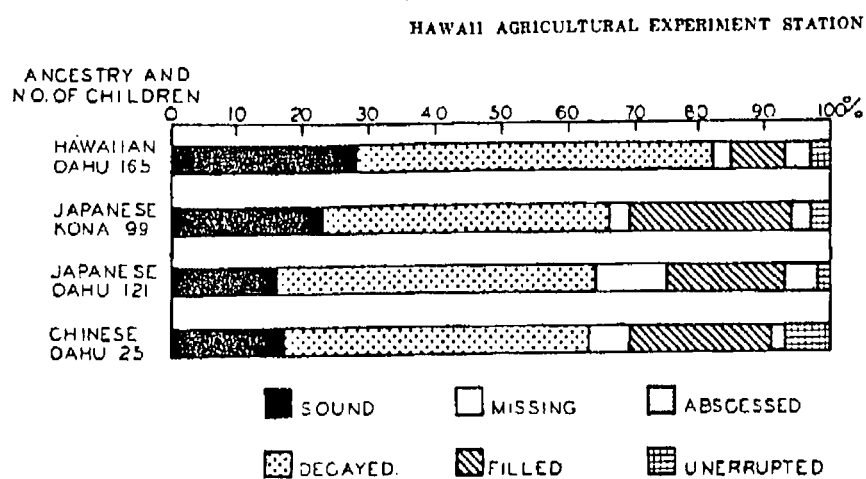


Figure 6. Condition of first molars, ages 6 to 20 years.

Reference: Potgeiter, M. and K. Nakatani. Diet and Health in Rural Hawaii, 1954.

TABLE 65

* Number of DMF permanent teeth per person among children 6-14 years of age in the State of Hawaii and other specified nonfluoride areas

Area*	Children 6-14 yrs. in sample	Age of last birthday										Mean 6-14 years
		6	7	8	9	10	11	12	13	14		
Woonsocket, R. I. 1947 ^a	5,929	1.53	2.87	3.65	4.57	5.92	7.57	10.36	12.01	14.10	6.98	
Muskegon, Mich. 1944-45 ^b	3,329	.81	1.99	2.81	3.81	4.91	6.32	8.66	9.98	12.00	5.70	
HAWAII, 1958	37,942	.72	1.79	2.78	3.75	5.12	6.48	8.45	10.30	11.36	5.64	
Grand Rapids, Mich. ^c 1944-45	15,106	.78	1.89	2.95	3.90	4.92	6.41	8.07	9.73	10.95	5.51	
Richmond, Ind. 1947 ^d	4,572	1.26	2.50	2.91	3.77	4.75	6.10	8.26	8.90	10.54	5.44	
Sedalla, Mo. 1952 ^e	820	.58	2.04	2.91	3.64	4.73	5.92	8.65	9.37	9.32	5.22	
Providence, R.I. 1952 ^f	8,132	.45	1.69	2.59	3.40	4.16	5.23	7.07	8.43	9.55	4.75	
Sixteen cities, Calif. ^g 1952-56	25,130	.7	1.4	2.3	3.0	3.7	4.8	6.1	7.6	8.8	4.3	
Newburgh-Kingston, N.Y. ^h 1944-46	5,824	.44	1.07	1.98	2.90	3.86	4.85	6.36	7.83	8.55	4.20	
New Jersey 1944-46 ⁱ	47,562	.44	1.54	2.32	2.90	3.62	4.42	5.68	7.11	8.12	4.04	
Nicollet County, Minn. 1940	2,237	.51	1.43	2.30	2.66	3.39	4.16	5.50	6.32	7.69	3.80	
Montgomery and Prince Georges Counties, Md. 1952	11,291	.34	1.09	1.76	2.44	3.19	3.79	5.10	6.35	7.85	3.52	

* Some of these areas have fluoridated their water supplies since the survey period.

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TABLE 66

Number of DMF permanent teeth per person among children attending the public schools, 6-14 years of age, by race, State of Hawaii, 1958

Racial extraction	Children 6-14 yrs. in sample	Age at last birthday									Age adjusted 6-14 years†
		6	7	8	9	10	11	12	13	14	
All races	37,942	.72	1.79	2.78	3.75	5.12	6.46	8.45	10.30	11.26	4.62
Japanese	13,536	.82	2.09	3.33	4.51	6.22	7.97	10.22	11.81	13.17	5.57
Part Hawaiian	6,781	.90	2.01	2.83	3.74	5.14	6.72	8.11	9.91	10.45	4.67
Filipino	3,411	.87	2.00	3.04	3.91	5.20	6.14	7.80	9.17	10.53	4.58
Hawaiian	499	1.11	1.73	2.79	4.06	4.47	5.99	8.09	9.12	8.92	4.35
Chinese	1,648	.45	1.42	2.49	3.19	4.76	6.01	7.22	8.84	10.10	4.11
Caucasian	7,953	.33	1.23	1.93	2.78	3.52	4.33	4.43	8.13	9.14	3.41
All other*	3,714	.72	1.74	2.60	3.33	4.83	5.96	7.59	9.01	10.73	4.30

*Includes other races and mixtures that could not be classified as predominantly a single race.

†Adjusted on total of all races 6-14 years in sample.

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TABLE 67

DMF RATES AND FREQUENCY OF EATING SELECTED FOODS BY RACE AND FLUORIDE EXPOSURE

	Caucasian		Japanese		Hawaiian		Other		Total	
	Fl	Non-Fl	Fl	Non-Fl	Fl	Non-Fl	Fl	Non-Fl	Fl	Non-Fl
Number	113	59	186	45	199	55	175	78	673	237
DMF	6.47	5.00	7.04	7.94	8.72	9.38	6.62	6.50	7.33	7.07
Bread and cereals	2.10	2.13	1.34	1.29	1.96	2.20	1.61	2.02	1.72	1.95
Meat, fish, and poultry	1.86	1.82	1.89	1.97	1.61	1.47	1.75	1.64	1.77	1.66
Starchy foods	1.49	1.18	1.89	2.02	2.96	2.94	2.06	2.48	2.18	2.18
Vegetables	1.68	1.34	1.63	1.89	1.63	1.46	1.61	1.54	1.63	1.50
Sweet beverages	2.98	2.41	2.46	2.00	3.81	3.76	2.91	3.29	3.06	2.94
Dessert items	2.98	2.41	1.98	1.91	4.96	5.47	3.07	4.29	3.31	3.64
Miscellaneous snacks	1.39	1.19	1.27	1.11	2.58	2.92	1.80	2.42	1.82	1.98
Candy and gum	2.14	2.40	1.95	1.74	3.60	3.74	2.81	3.48	2.69	2.94

Note: Exposure pertains only to use of dietary fluoride supplements, topical applications of fluoride, or both. Fl, exposed to fluoride; Non-Fl, not exposed to fluoride.

TABLE 68
UNADJUSTED MEANS OF DIFFERENT VARIABLES FOR MAJOR RACIAL GROUPS

Father	Mother	No.	Age (Years)	DMF	DM	DMF	Proportion of Caries-free Individuals	OHIS	PI
Caucasian	Caucasian	475	16.00	9.31	0.198	0.029	0.672	0.346	
Hawaiian	Hawaiian	57	15.12	9.56	0.607	0	1.251	0.523	
Chinese	Chinese	548	16.08	10.08	0.112	0.013	0.551	0.252	
Filipino	Filipino	721	15.57	9.26	0.314	0.022	0.790	0.347	
Japanese	Japanese	3,885	15.98	11.54	0.094	0.006	0.469	0.198	
Puerto Rican	Puerto Rican	62	15.71	7.15	0.425	0.032	0.766	0.389	
Korean	Korean	42	15.86	11.07	0.091	0.024	0.452	0.098	
Caucasian	Japanese	165	16.01	10.51	0.200	0.012	0.507	0.181	
Japanese	Caucasian	37	15.46	9.27	0.211	0.054	0.581	0.262	
Chinese	Japanese	72	15.68	9.06	0.080	0.014	0.493	0.153	
Japanese	Chinese	34	15.97	10.35	0.071	0.029	0.485	0.159	
Caucasian	Part Hawaiian*	146	15.74	9.62	0.294	0.017	0.783	0.338	
Part Hawaiian	Caucasian	180	15.61	9.37	0.277	0.017	0.793	0.310	
Hawaiian	Part Hawaiian	183	15.46	10.46	0.458	0.016	1.120	0.699	
Part Hawaiian	Hawaiian	143	15.21	9.97	0.435	0.021	1.152	0.643	
Filipino	Part Hawaiian	224	15.47	9.55	0.369	0.027	0.929	0.420	
Part Hawaiian	Filipino	42	15.67	8.81	0.237	0	0.902	0.417	
Part Hawaiian	Part Hawaiian	977	15.45	10.81	0.355	0.018	0.925	0.473	
TOTAL		9,912	15.78	10.43	0.208	0.015	0.660	0.302	

* Sum of part Hawaiian unspecified and all other Hawaiian biracial combinations.

Chung et al. J. Dental Res. 49:6, December 1970.

TABLE 69

MEAN NUMBER OF TEETH WITH HEAVY PLAQUE BY DAILY FREQUENCY OF CONSUMPTION OF SPECIFIC FOOD ITEMS OVER ALL RACIAL GROUPS

Food Items	Mean No. of Times Food Items Were Eaten per Day													
	0--		1--		2--		3--		4--		5--		6--	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Sweet rolls, sweet bread, manaque, or mochi	729	13.36	112	15.13	31	18.32	11	18.45	1	14.00	0		1	22.0
Poi	813	13.47	44	18.20	18	16.22	7	17.57	2	24.00	1	25.00	0	
Fruit drinks	490	14.29	289	13.45	73	12.14	19	14.37	8	13.00	4	10.50	2	20.5

Chung, Hankin, Miyamoto and Kau.
J. Dent. Res. January 1977.

TABLE 70
Racial group means of periodontal variables adjusted for significant
demographic and health variables

	Number	Gingi- vitis	Average pocket	Deepest pocket	Calculus	Contact	Attrition	Mobility	Plaque	First principal com- ponent
Caucasian (C)	334	1.24	1.47	2.08	0.32	0.20	1.08	0.04	0.82	-0.85
Japanese (J)	134	1.27	1.42	2.08	0.38	0.17	1.06	0.08	0.86	-0.83
Filipino (F)	188	1.55	1.84	2.85	1.17	0.24	1.25	0.08	1.08	0.77
Hawaiian or part-Haw. (H)	103	1.53	1.94	2.87	0.78	0.40	1.17	0.08	1.11	0.72
Samoa (S)	88	1.82	2.04	2.82	1.11	0.25	1.24	0.08	1.28	1.00
Other (O)	111	1.38	1.58	2.30	0.82	0.15	1.08	0.04	1.08	-0.18
Multiple Range Test at 5 % level		<u>CJOHFS</u>	<u>JCOHFS</u>	<u>CJOFSH</u>	<u>CJOHSF</u>	<u>OJCFSH</u>	<u>JCONSF</u>	<u>COJFSH</u>	<u>CJOFSH</u>	<u>CJOHSF</u>

Chung, Kau, Chung and Schendel
J. Periodontal Res.
Volume 12, 1977

Table 71 Number of Students with Recorded Health Problems

<u>Problems</u>	<u>Preschool-Gr 3</u>	<u>Gr 4-6</u>	<u>Gr 7-9</u>	<u>Gr 10-12</u>	<u>Total</u>
Overweight	112	163	165	89	529
Underweight	26	17	21	3	67
Dental Conditions	125	59	19	13	216
Skin/Scalp Conditions	50	58	61	41	210
Iron-Deficiency Anemia	16	16	4	10	46
Food Allergies	275	210	186	103	774
Diabetes Mellitus	4	7	7	7	25

Reference: Hawaii Nutrition Education Needs Assessment Report, 1980.

Table 72

NUMBER OF FAMILIES WITH OR WITHOUT MEDICAL COVERAGE PER
100 FAMILIES BY HEAD OF FAMILIES EMPLOYMENT STATUS,
1978-1979

	<u>WITH MEDICAL COVERAGE</u>	<u>WITHOUT MEDICAL COVERAGE</u>
Employed	96.5	3.5
Unemployed	95.8	4.2

Data from the 'Cost of Medical and Dental Survey'

NUMBER OF FAMILIES WITH OR WITHOUT DENTAL COVERAGE PER
100 FAMILIES BY HEAD OF FAMILIES EMPLOYMENT STATUS,
1979

	<u>WITH DENTAL COVERAGE</u>	<u>WITHOUT DENTAL COVERAGE</u>
Employed	57.4	36.4
Unemployed	42.6	63.6

Data from the 'Dental Survey, April-June 1979.

Department of Health
Research and Statistics Office
Health Surveillance Program

Table 73

Number and Percent of Subjects with Dental Insurance,
Dental Repair and Cost of Restoration in the Pregnant Women

	1970-73			1980-82		
	Total Sample	N	%	Total Sample	N	%
Dental insurance	63			40		
None		44	70		28	74
Private		10	16		6	16
Medicaid		8	13		4	11
Other		1	2		0	0
Dental work done	100			101		
Extraction		18	18		6	6
Root Canal		7	7		1	1
Crowns		6	6		2	2
X-ray and exams		35	35		18	18
Oral surgery		0	0		1	1
Prophylaxis		36	36		16	16
Other:		34	34		16	16
Fillings		32	32		15	15
Dentures		2	2		1	1
Cost of restoration	45			19		
< \$50		8	18		2	11
\$51-\$149		11	25		9	47
\$150-\$299		12	27		3	16
\$300-\$599		12	27		4	21
\$600-\$1,000 +		2	4		1	5

Reference: Dirige, O. and Hughes-Ho, C., 1985.

Table 74

Demographic Characteristics of the Pregnant Native Hawaiian Women
in the MIC Project at Waimanalo

Characteristics	1970-1973			1980-1982		
	N	Range	Mean *	N	Range	Mean *
Age of subjects (yrs.)	100	15-40	22.3 ± 5	101	14-39	22.1 ± 5
Years of schooling (yrs.)	100	6-14	11.4 ± 1.3	100	8-15	11.7 ± 1.2
Number of pregnancies (gravity)	64	1-8	2.6 ± 1.8	57	1-6	2.1 ± 1.3 +
Number of live births (parity)	61	1-7	2.6 ± 1.7	47	1-5	1.8 ± 1.2 *
Weeks of gestation at initial visit (wks.)	100	6-36	16.9 ± 7.6	101	5-35	14.5 ± 6.9 ‡
Weeks of gestation at delivery (wks.)	100	27-47	38.8 ± 3.4	101	27-44	38.6 ± 2.5

* mean ± standard deviation

+ significantly different from 1970-73, p<.05

* significantly different from 1970-73, p<.005

‡ significantly different from 1970-73, p<.02

Table 75
Physical Characteristics of the Pregnant Native Hawaiian Women
in the MIC Project at Waimanalo

Characteristics	1970-73			1980-82		
	N	Range	Mean *	N	Range	Mean *
Height (cm)	100	144.8-177.8	162.3 ± 6.5	101	149.8-180.3	160.9 ± 6.2
Pre-pregnancy wt. (kg)	100	43.0-125.0	65.0 ± 16.5	101	38.0-105.0	59.6 ± 12.0 +
Weight at first visit (kg)	100	48.2-127.3	70.6 ± 17.1	101	40.4-108.7	63.6 ± 14.0 +
Average weight gain per week (kgs)	98	0.9-3.6	0.5 ± .41	101	0.1-1.4	0.5 ± 0.2
Total weight gain (kgs)	98	2.7-35.2	15.8 ± 6.5	100	4.7-35.0	16.1 ± 6.2

* mean ± standard deviation
+ significantly different from 1970-73, p<.01
+ significantly different from 1970-73, p<.002

Table 76
Laboratory Characteristics of the Pregnant Native Hawaiian
Women in the MIC Project at Waimanalo

Characteristics	1970-73			1980-82		
	N	Range	Mean *	N	Range	Mean *
Hemoglobin (gm/dl)						
1st trimester	45	9.2-15.7	12.9 ± 1.3	63	10.3-14.4	12.7 ± 0.9 +
2nd trimester	47	9.5-14.3	12.3 ± 1.1	64	8.5-13.7	11.7 ± 1.1 †
3rd trimester	88	8.5-13.7	11.7 ± 1.1 x	98	8.5-14.5	11.7 ± 1.0
Post partum	73	9.5-16.0	12.8 ± 1.3	80	10.0-14.5	12.5 ± 1.1

* mean ± standard deviation

x significantly different from 2nd trimester, p<.002

+ significantly different from 2nd trimester, p<.001

† significantly different from 1970-73, p<.005

Table 77

Birth Outcome Characteristics of the Pregnant Native Hawaiian Women
in the MIC Project at Waimanalo

Characteristics	1970-73			1980-82		
	N	Range	Mean *	N	Range	Mean *
Birth weight of infant (kgs)	100	1.3-4.5	3.3 ± 0.6	101	1.1-5.2	3.3 ± 0.7
Birth length (cm)	100	38.1-54.6	49.6 ± 2.4	101	38.5-60.0	50.9 ± 3.1 +
Birth head circumference (cm)	10	31.8-36.8	33.5 ± 1.5	100	22.5-52.1	34.0 ± 2.8
Apgar score of infant at:						
1 minute	99	4-10	7.7 ± 1.0	101	1-9	7.8 ± 1.3
5 minutes	99	7-10	9.4 ± 0.7	101	3-10	8.8 ± 0.8 †

* mean + standard deviation

+ significantly different from 1970-73, p<.002

† significantly different from 1970-73, p<.001

Table 78

Other Demographic, Medical and Nutritional Characteristics
of the Pregnant Native Hawaiian Women in the MIC Project

Characteristics	1970-1973			1980-1982		
	Total No.	N	%	Total No.	N	%
Type of medical insurance	100			101		
None		25	25		26	26
Private		52	52		32	32
Medicaid		19	19		42 *	41
Other		4	4		1	1
Use of programs	100			101		
WIC		0	0		88	87
Food stamps		26	26		34	34
Method of feeding in hospital	100			101		
Breast		42	42		60 +	59
Formula		58	58		41	41
Past reproductive history	100			101		
Miscarriage						
one		10	10		11	11
2 or more		0	0		3	3
Elective abortion						
one		0	0		10 #	10
2 or more		0	0		1	1
Previous Caesarean section		4	4		12 @	12
Intake of substances	100			100		
Alcohol		1	1		26 *	26
Drugs		2	2		3	3
Tobacco		47	47		46	46
Vitamin/mineral pills	94	87	93	98	93	95

* Significantly different from 1970-73, x2 test, $p < .001$

+ Significantly different from 1970-73, x2 test, $p < .001$

Significantly different from 1970-73, x2 test, $p < .001$

@ Significantly different from 1970-73, x2 test, $p < .004$

* Significantly different from 1970-73, x2 test, $p < .001$

Table 79

Medical and Nutritional Problems and Food Habits
of the Pregnant Native Hawaiian Women in the MIC Project

	1970-1973			1980-1982		
	Total			Total		
Characteristics	No.	N	%	No.	N	%
Maternal complications	100			101		
Infections		4	4		3	3
Incompetent cervix		0	0		1	1
Hemorrhage		1	1		2	2
Psychological distress		3	3		0	0
Anemia		4	4		3	3
Asthma		4	4		1	1
Backache		2	2		3	3
Nutritional problems	100			101		
Nausea		58	58		64	64
Vomiting		34	34		30	30
Constipation		7	7		25	25
Poor appetite		13	13		13	13
Food allergies		7	7		3	3
Diarrhea		3	3		2	2
Cravings for foods	100			100		
Sweets		6	6		11	11
Salty foods		5	5		13	13
Chinese food		2	2		0	0
Raw liver		2	2		0	0
Fruits		0	0		4	4
Raw fish		1	1		2	2

Table 80

Number and Percent of Women with Physical, Laboratory and Birth Outcome Characteristics that Fell Below or Rose Above the Standard

Characteristics	1970-1972			1980-1982		
	N	No. of Cases	%	N	No. of Cases	%
Pre-pregnancy weight	100			101		
< 5th percentile		2	2		4	4
>95th percentile		13	13		6	6
Hemoglobin (gm/dl)						
1st trimester						
<11.0	45	3	7	63	2	3
2nd trimester						
<11.0	47	15	32	64	19	30
3rd trimester						
<11.0	100	24	24	98	30	30
Post partum						
<11.0	73	8	11	80	10	13
Birth weight of infant						
<2.5 kgs	100	8	8	101	11	11
Apgar score						
1 minute						
<4	99	3	3	101	4	4
5 minutes						
<4	99	0	0	101	1	1

Table 81
Intake of the Different Food Groups
by the Pregnant Women in Waimanalo

Food Group/Vitamin Mineral Supplements	1970-1973			1980-1982		
	Total Sample	No. of Subjects Consuming	%	Total Sample	No. of Subjects Consuming	%
Milk	100			40 *		
Daily		25	25		6	15
Several times/day		52	52		20	50
Several times/week		10	10		3	8
Sometimes		5	5		5	13
Meats/alternates	100			40 *		
Daily		38	38		10	25
Several times/day		58	58		23	58
Several times/week		2	2		3	8
Sometimes		2	2		1	3
Vegetable - Fruits	100			40 *		
a. Vitamin A						
Daily		62	62		5	13
Several times/day		12	12		2	5
Several times/week		19	19		15	38
Sometimes		3	3		12	30
b. Vitamin C						
Daily		41	41		13	33
Several times/day		31	31		7	18
Several times/week		17	17		9	23
Sometimes		9	9		9	23
c. Other fruits & vegetables						
Daily		26	26		6	15
Several times/day		10	10		2	5
Several times/week		12	12		15	38
Sometimes		5	5		4	10
Cereals	100			40 *		
Daily		30	30		9	23
Several times/day		63	63		24	60
Several times/week		1	1		4	10
Sometimes		1	1		0	0

Table 81 (continued)
Intake of the Different Food Groups
by the Pregnant Women in Waimanalo

Food Group/Vitamin Mineral Supplements	1970-1973			1980-1982		
	Total	No. of Subjects		Total	No. of Subjects	
	Sample	Consuming	%	Sample	Consuming	%
Other:	100			40 *		
Snacks						
Daily		22	22		10	25
Several times/day		29	29		12	30
Several times/week		6	6		7	18
Sometimes		16	16		7	18
Sweets						
Daily		23	23		12	30
Several times/day		22	22		11	28
Several times/week		9	9		7	18
Sometimes		28	28		5	13
Coffee, tea						
Daily		18	18		16	40
Several times/day		0	0		4	10
Several times/week		0	0		2	5
Sometimes		5	5		0	0
Condiments						
Daily		0	0		2	5
Several times/day		0	0		4	10
Several times/week		0	0		2	5
Sometimes		0	0		0	0

* Although the total number of records abstracted was 101, only 40 of them had complete food intake records and this was tabulated.

Reference: Dirige, O. and Hughes-Ho, C., 1985.

Table 82

Dietary Analysis of the Diet of the Pregnant Women
at the Initial Interview

Nutrient and % of the RDA	1970-1973			1980-1982		
	Total No.	N	%	Total No.	N	%
Protein	96			101		
< 66% RDA *		29	30		32	32
> 66% RDA		67	70		69	68
Calories	91			101		
< 66% REI +		8	9		32	32
> 66% REI		62	68		45	46
> 120% REI		21	23		24	24
Iron	97			101		
< 66% RDA		42	43		76	75
> 66% RDA		55	57		25	25
Calcium	97					
< 66% RDA		48	49		77	76
> 66% RDA		49	51		24	24
Vitamin C	97			101		
< 66% RDA		33	34		53	52
> 66% RDA		64	66		48	48
Vitamin A	97			101		
< 66% RDA		30	31		76	75
> 66% RDA		67	69		25	25
Overall analysis	66			95		
< 66% RDA		23	35		67	71
> 66% RDA		43	65		28	29

* Recommended Dietary Allowance, 1968 (for the year 1970-73) and 1980 (for the year 1980-82)

+ Recommended energy intake, 1968 and 1980

Figure 21

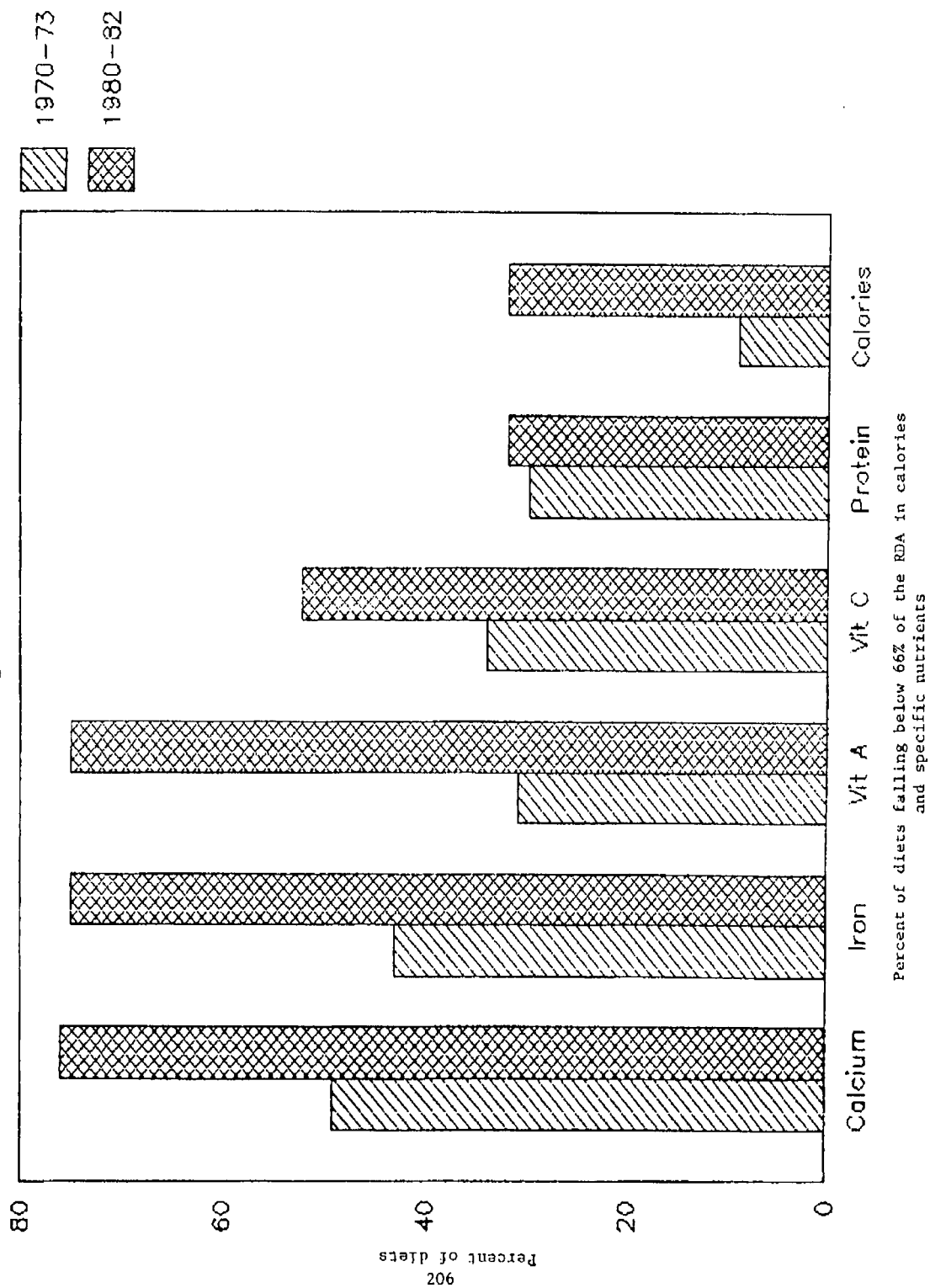


Table 83

Demographic and Physical Characteristics at birth of the Infant Population

Characteristics	1972-1973			1981-1982		
	N	Range	Mean*	N	Range	Mean*
Age of subject (mon.)	48	0.1-12.0	1.96 $\pm$ 2.8	50	0.1-10.0	1.37 $\pm$ 1.53
No. of Children in the family (no.)	50	1-6	2.5 $\pm$ 1.6	50	1-6	2.4 $\pm$ 1.5
Birth length (cm) total	41	38.1-53.34	49.5 $\pm$ 2.9	49	38.5-55.9	50.67 $\pm$ 3.0
Males (cm)	24	45.1-53.3	50.0 $\pm$ 2.1	26	48.3-55.9	51.6 $\pm$ 2.1 ⁺
Females (cm)	17	38.1-53.3	48.8 $\pm$ 3.6	23	38.5-54.6	49.6 $\pm$ 3.5
Birth weight (kgs) total	49	1.3-4.1	3.2 $\pm$ 0.6	50	1.1-4.8	3.2 $\pm$ 0.63
Males (kgs)	28	2.1-3.9	3.2 $\pm$ 0.5	27	2.1-4.8	3.3 $\pm$ 0.6
Females (kgs)	21	1.3-4.1	3.2 $\pm$ 0.7	23	1.1-4.2	3.1 $\pm$ 0.7
Birth head circumference (cm)	3	26.7-33.5	30.3 $\pm$ 3.5	42	22.5-38.0	33.6 $\pm$ 2.4
Males (cm)	1	-	33.7	23	30.5-36.8	33.8 $\pm$ 1.8
Females (cm)	2	26.7-30.5	28.6 $\pm$ 2.7	19	22.5-38.0	33.5 $\pm$ 3.1
Apgar score at birth at:						
1 minute	30	3-9	7.5 $\pm$ 1.2	47	4-9	7.7 $\pm$ 1.2
5 minutes	30	7-10	9.2 $\pm$ 0.7	47	6-10	8.7 $\pm$ 0.8*

* Mean $\pm$ standard deviation+ Significantly different from 1972-73, $p < .01$ * Significantly different from 1972-73, $p < .01$

- No data obtained

Table 84

Length of the Male and Female Infant Population at Different Months

Length (cm) at months:	1972-1973			1981-1982		
	N	Range	Mean*	N	Range	Mean*
1-3 (total)	43	48.9-64.9	57.9 ± 3.7	45	53.0-62.0	55.8 ± 2.4
Males	25	51.4-64.9	58.7 ± 3.2	26	54.0-62.0	57.8 ± 2.2
Females	18	48.9-62.2	56.8 ± 4.3	19	53.0-61.5	57.7 ± 2.7
4-6 (total)	42	54.6-70.8	65.4 ± 3.4	44	57.0-72.0	66.4 ± 3.1
Males	25	60.9-70.8	66.4 ± 2.6	26	59.5-72.0	67.4 ± 2.5
Females	17	54.6-68.9	63.9 ± 4.0 [†]	18	57.0-69.0	65.1 ± 3.4 [†]
7-9 (total)	22	61.6-78.7	69.7 ± 4.1	33	65.0-77.5	71.7 ± 3.1 [‡]
Males	13	64.0-78.7	70.9 ± 3.9	18	69.0-77.5	72.6 ± 2.6
Females	9	61.6-72.7	67.9 ± 3.9	15	65.0-75.5	70.6 ± 3.5
10-12 (total)	42	66.0-81.8	75.5 ± 3.2	45	70.5-87.0	76.0 ± 3.4
Males	24	69.8-81.8	76.5 ± 2.8	24	73.0-87.0	77.1 ± 3.3
Females	18	66.0-79.4	74.5 ± 3.4	20	70.5-80.5	74.7 ± 3.0 [@]

* Mean ± standard deviation

† Significantly different from males 1981-82, p<.01

‡ Significantly different from males 1972-73, p<.02

§ Significantly different from 1972-73, p<.05

@ Significantly different from males 1981-82, p<.02

Table 85

Weights of the Male and Female Infant Population at Different Months

Weight (kgs) at months:	1972-1973			1981-1982		
	N	Range	Mean*	N	Range	Mean*
1-3 (total)	43	3.1-7.8	5.5 ± 1.1	45	4.2-7.2	5.5 ± 0.6
Males	25	3.6-7.8	5.6 ± 1.0	26	4.4-7.2	5.6 ± 0.7
Female	18	3.1-7.4	5.2 ± 1.2	19	4.2-6.2	5.3 ± 0.6
4-6 (total)	42	4.9-9.6	7.5 ± 1.1	44	3.8-9.9	7.8 ± 1.1
Males	25	6.0-9.5	7.7 ± 0.9	26	6.2-9.9	8.2 ± 0.7 ⁺
Females	17	4.9-9.6	7.2 ± 1.3	18	3.8-9.3	7.2 ± 1.3 [‡]
7-9 (total)	22	6.4-10.2	8.6 ± 1.1	34	5.8-11.3	9.0 ± 1.1
Males	13	7.4-10.2	8.9 ± 0.8	18	7.9-11.3	9.4 ± 0.8
Females	13	6.4-9.8	8.3 ± 1.3	16	5.8-10.6	8.5 ± 1.3 [‡]
10-12 (total)	42	7.7-11.8	9.9 ± 1.1	44	7.3-12.0	9.9 ± 1.0
Males	24	8.3-11.8	10.2 ± 1.0	24	9.1-12.0	10.1 ± 0.8
Females	18	7.7-11.5	9.6 ± 1.0	19	7.3-11.9	9.6 ± 1.2

* Mean ± standard deviation

+ Significantly different from males 1972-73, p<.02

‡ Significantly different from males 1981-82, p<.002

‡ Significantly different from males 1981-82, p<.02

Table 86

Head circumference of the male and female infant population
at different months

Head Circumference (cm) at months:	1972-73			1981-82		
	N	Range	Mean*	N	Range	Mean*
1-3 (total)	42	33.7-43.2	39.7 ± 2.0	45	37.5-42.5	39.5 ± 1.3
Males	25	33.7-43.2	40.0 ± 2.1	26	37.5-41.8	39.5 ± 1.2
Females	17	35.6-42.5	39.2 ± 1.9	19	37.7-42.5	39.4 ± 1.4
4-6 (total)	42	40.0-47.5	43.5 ± 1.9	44	39.0-45.5	43.2 ± 1.3
Males	25	40.6-47.5	44.1 ± 1.7	26	41.0-45.5	43.6 ± 1.1
Females	17	40.0-45.7	42.5 ± 1.8 ⁺	18	39.0-45.5	42.7 ± 1.5 ⁺
7-9 (total)	18	41.6-47.6	45.1 ± 2.0	33	41.5-48.5	45.0 ± 1.7
Males	11	43.2-47.6	45.3 ± 1.9	18	44.0-48.5	45.6 ± 1.3
Females	7	41.6-47.0	44.7 ± 2.2	15	41.5-48.3	44.3 ± 1.9 ⁺
10-12 (total)	34	44.4-50.8	47.2 ± 1.8	44	43.0-49.0	46.3 ± 1.3 ⁺
Males	21	45.7-50.8	47.8 ± 1.7	25	44.8-49.0	46.3 ± 1.1 ^φ
Females	13	44.4-49.5	46.3 ± 1.6 [@]	19	43.0-48.6	45.8 ± 1.3 [#]

* Mean ± standard deviation

+ Significantly different from males, 1972-73, $p < .01$

Significantly different from males, 1981-82, $p < .03$

± Significantly different from 1972-73, $p < .01$

@ Significantly different from males 1972-73, $p < .01$

φ Significantly different from males 1972-73, $p < .01$

Significantly different from males 1981-82, $p < .04$

Table 87

Laboratory Characteristics of the Infant Population at Different Time Periods

Hematocrit (%) at months:	1972-73			1981-82		
	N	Range	Mean*	N	Range	Mean*
1-3 months	2	32-34	33.0 ± 1.4	4	32.0-46.4	37.9 ± 6.4
4-6 months	4	28-36	32.8 ± 3.6	7	32.0-41.0	36.4 ± 3.3
7-9 months	1	-	37.0	26	32.0-42.0	36.5 ± 2.9
10-12 months	2	32-35	33.5 ± 2.2	5	28.0-38.0	34.6 ± 3.9

* Mean $\pm$ standard deviation
 - No data obtained

Table 38

Other Demographic, Medical and Nutritional Characteristics of
the Infant Population in the MIC Project

Characteristics	1972-1973			1981-1982		
	Total No.	N	%	Total No.	N	%
Medical Insurance	50			50		
None		14	28		7	14
Private		24	48		23	46
Medicaid		12	24		20	40
Use of programs	50			50		
WIC		0	0		39	78
Food stamps		4	8		13 +	26
Method of feeding in hospital	45			50		
Breast		15	33		23	46
Formula		28	62		19	38
Mixed		2	5		8 @	16
Method of delivery	49			50		
Normal		46	94		42	84
Caesarean		3	6		8	16
Neonatal problems	50			50		
Anemia		2	4		0	0
Congenital anomaly		1	2		3	6
Jaundice		7	14		16	32
Phototherapy		1	2		1	2
Other		3	6		4	8
Medical problems	50			50		
Vomiting		19	38		14	28
Diarrhea		26	52		23	46
Cough		22	44		38	76
Fever		27	54		29	58
Upper respiratory tract infection		12	24		12	24
Anemia		12	24		1	2
Otitis media		8	16		10	20

+ Significantly different from 1972-73, x² test, p<.02

@ Significantly different from 1972-73, x² test, p<.05

Table 89

Number and Percent of Infants Who Fell Below
or Rose Above the Physical and Laboratory Standards

Characteristics	1972-1973			1981-1982		
	N	No. of Cases	%	N	No. of Cases	%
Birth length						
< 5th percentile	49	3	6	50	2	4
>95th percentile		0	0		7	14
Birth weight (kgs)						
<2.5 kgs	49	6	12	50	6	12
>95th percentile		1	2		2	4
Birth head circumference (cm)						
< 5th percentile	3	2	68	42	10	23
>95th percentile		0	0	42	1	2
Apgar score at:						
1 minute						
<4	30	1	3	47	3	6
5 minutes						
<4	30	0	0	47	0	0
Length (cm) at:						
1-3 months						
< 5th percentile	43	5	12	45	0	0
>95th percentile	43	4	9	45	1	2
4-6 months						
< 5th percentile	42	2	5	44	3	7
>95th percentile	42	4	10	44	0	0
7-9 months						
< 5th percentile	22	2	9	33	1	3
>95th percentile	22	1	5	33	5	15
10-12 months						
< 5th percentile	42	2	5	45	0	0
>95th percentile	42	2	5	45	5	11

Table 89 (continued)

Number and Percent of Infants Who Fell Below
or Rose Above the Physical and Laboratory Standards

Characteristics	1972-1973			1981-1982		
	N	No. of Cases	%	N	No. of Cases	%
Weight (kgs) at:						
1-3 months						
< 5th percentile	43	3	7	45	0	0
>95th percentile	43	5	12	45	1	2
4-6 months						
< 5th percentile	42	0	0	44	1	2
>95th percentile	42	4	10	44	4	9
7-9 months						
< 5th percentile	22	0	0	34	1	3
>95th percentile	22	2	9	34	3	9
10-12 months						
< 5th percentile	42	1	2	44	2	5
>95th percentile	42	3	7	44	4	9
Head circumference (cm) at:						
1-3 months						
< 5th percentile	42	2	5	45	0	0
>95th percentile	42	4	10	45	3	7
4-6 months						
< 5th percentile	42	0	0	44	1	2
>95th percentile	42	5	12	44	2	5
7-9 months						
< 5th percentile	18	0	0	33	1	3
>95th percentile	18	2	11	33	2	6
10-12 months						
< 5th percentile	34	0	0	44	1	2
>95th percentile	34	4	12	44	1	2

Table 89 (continued)

Number and Percent of Infants Who Fell Below
or Rose Above the Physical and Laboratory Standards

Characteristics	1972-1973			1981-1982		
	N	No. of Cases	%	N	No. of Cases	%
Hematocrit (%) at:						
1-3 months						
<31%	2	0	0	4	0	0
4-6 months						
<31%	4	1	25	7	0	0
7-9 months						
<31%	1	0	0	26	0	0
10-12 months						
<31%	2	0	0	5	1	20

Reference: Dirige, O. and Hughes-Ho, C., 1985.

Table 90

Intake of the Different Food Groups and Vitamin/Mineral Supplements
by the Infant Population

Food Group/Vitamin Mineral Supplements	1972-1973			1981-1982		
	No. of	No. of Subjects		No. of	No. of Subjects	
	Records	Consuming Food/ Supplements *	%	Records	Consuming Food/ Supplements *	%
Breast	50			50		
1 month		8 *	16		26 +	52
2-3 months		5	10		16	32
4-6 months		4	8		12	24
7-9 months		2	4		5	10
10-12 months		1	2		4	8
Formula	50			50		
1 month		22 *	44		34 +	68
2-3 months		31	62		40	80
4-6 months		27	54		44	88
7-9 months		18	36		28	56
10-12 months		11	22		26	52
Milk	50			50		
1 month		1 *	2		0 +	0
2-3 months		6	12		0	0
4-6 months		11	22		3	6
7-9 months		13	26		6	12
10-12 months		22	44		24	48
Fruit juice	50			50		
1 month		0	0		1	2
2-3 months		7	14		3	6
4-6 months		12	24		21	42
7-9 months		7	14		22	44
10-12 months		12	24		37	74
Cereals	50			50		
1 month		4	8		2	4
2-3 months		29	58		5	10
4-6 months		26	52		44	88
7-9 months		18	36		27	54
10-12 months		18	36		36	88

Table 90 (continued)

Intake of the Different Food Groups and Vitamin/Mineral Supplements
by the Infant Population

Food Group/Vitamin Mineral Supplements	1972-1973			1981-1982		
	No. of Records	No. of Subjects Consuming Food/ Supplements *	%	No. of Records	No. of Subjects Consuming Food/ Supplements *	%
Vegetable	50			50		
1 month		0	0		0	0
2-3 months		13	26		1	2
4-6 months		23	46		31	62
7-9 months		15	30		22	44
10-12 months		16	32		37	74
Fruits	50			50		
1 month		0	0		0	0
2-3 months		9	18		2	4
4-6 months		18	36		28	56
7-9 months		16	32		22	44
10-12 months		15	30		38	76
Meats/alternate	50			50		
1 month		0	0		0	0
2-3 months		2	4		2	2
4-6 months		22	44		15	30
7-9 months		20	40		17	34
10-12 months		23	46		34	68
High meat/mixed	50			50		
1 month		0	0		0	0
2-3 months		0	0		0	0
4-6 months		11	22		14	28
7-9 months		12	24		15	30
10-12 months		15	30		30	60
Desserts	50			50		
1 month		0	0		0	0
2-3 months		0	0		0	0
4-6 months		1	2		10	20
7-9 months		4	8		15	30
10-12 months		7	14		32	64

Table 90 (continued)

Intake of the Different Food Groups and Vitamin/Mineral Supplements
by the Infant Population

Food Group/Vitamin Mineral Supplements	1972-1973			1981-1982		
	No. of	No. of Subjects		No. of	No. of Subjects	
	Records	Consuming Food/ Supplements *	%	Records	Consuming Food/ Supplements *	%
Table foods	50			50		
1 month		0	0		0	0
2-3 months		0	0		1	2
4-6 months		12	24		17	34
7-9 months		20	40		22	44
10-12 months		30	60		40	80
Finger foods	50			50		
1 month		0	0		0	0
2-3 months		0	0		0	0
4-6 months		4	8		13	26
7-9 months		17	34		20	40
10-12 months		20	40		40	80
Vitamin/minerals	50			50		
1 month		5	10		21	42
2-3 months		7	14		20	40
4-6 months		10	20		17	34
7-9 months		9	18		11	22
10-12 months		7	14		18	36
Fluoride	50			50		
1 month		8	16		40	80
2-3 months		10	20		45	90
4-6 months		8	16		45	90
7-9 months		10	20		27	54
10-12 months		11	22		41	82

* Number of subjects consuming food may not correspond with the number of records due to incomplete food records. Only those with complete food intake records were tabulated.

+ No. of subjects is greater than number of records due to mixed feeding.

Reference: Dirige, O. and Hughes-Ho, C., 1985.

Table 91

Dietary Analysis of the Diet of the Infant Population
at different time periods

Age of subject (months) and % of the RDA	1970-73			1980-82		
	Total No.	N	%	Total No.	N	%
One month	16			45		
< 66% RDA		2	13		2	4
> 66% RDA		13	81		38	85
> 120% RDA		1	6		5	11
Two to three months	26			47		
< 66% RDA		4	15		3	6
> 66% RDA		22	85		36	77
> 120% RDA		0	0		8	17
Four to Six months	23			45		
< 66% RDA		4	17		2	4
> 66% RDA		19	83		32	71
> 120% RDA		0	0		11	25
Seven to Nine months	33			23		
< 66% RDA		14	42		2	9
> 66% RDA		19	58		16	70
> 120% RDA		0	0		5	22
Ten to Twelve months	28			40		
< 66% RDA		8	29		1	2
> 66% RDA		20	71		35	88
> 120% RDA		0	0		4	10

Figure 22

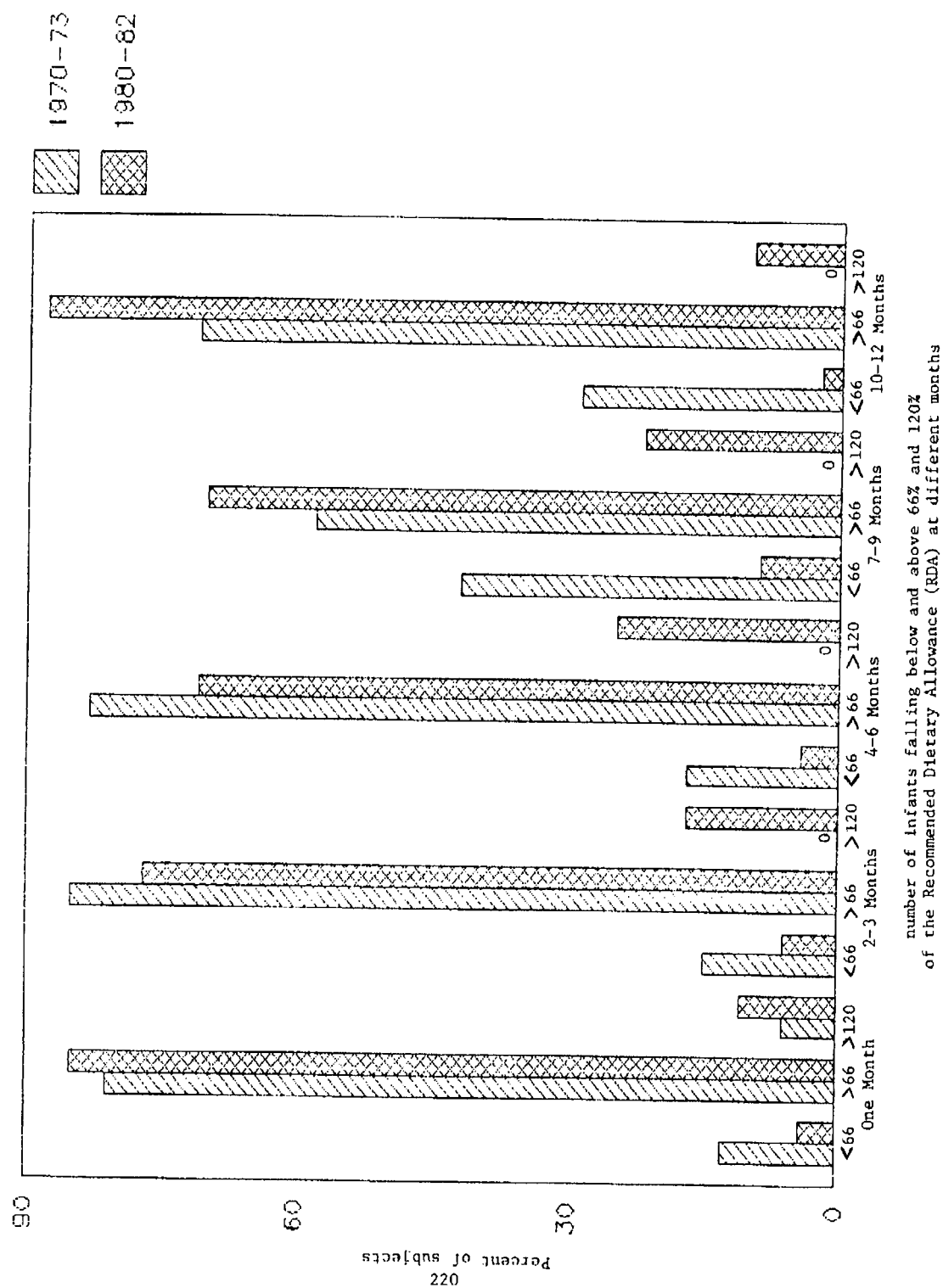


Table 92

Demographic and Physical Characteristics at Birth of the Preschool Population

Characteristics	1972-1973			1982 [®]		
	N	Range	Mean *	N	Range	Mean *
Age of subjects (years)	49	1-5.2	2.3±1.5	49	1-5.1	2.7±1.3
No. of children in family	42	1-7	2.7±1.7	38	1-7	2.6±1.8
Birth length (cm) (total)	25	45.7-54.6	50.6±2.3	47	45.5-60	51.3±3.3
Males (cm)	10	45.7-52.1	49.7±2.3	30	46.0-60	51.7±3.1
Females (cm)	15	48.3-54.6	51.2±2.2	18	45.5-60	50.6±3.4
Birth weight (kgs)	48	1.7-4.5	3.3±0.5	48	2.3-5.2	3.5±0.6
Males (kgs)	26	1.7-4.5	3.3±0.6	31	2.3-4.7	3.4±0.5
Females (kgs)	22	2.6-3.9	3.3±0.4	18	2.3-5.2	3.4±0.6
Birth head circumference (cm)	-	-	-	34	30.5-37.5	34.4±1.6
Males (cm)	-	-	-	20	31.7-36.8	34.5±1.5
Females (cm)	-	-	-	14	30.5-37.5	34.1±1.8
Birth Apgar score at:						
1 minute	13	7-9	7.9±0.6	40	1-9	7.6±1.7
5 minutes	13	9-10	9.6±0.5	41	8-10	8.9±0.4 +

* Mean ± standard deviation

+ Significantly different from 1972-73, p<.001

- No data was collected

[®] The number of records needed were obtained during this year so only one year was collected

Table 93

Length or Height of the Preschool Children (Boys and Girls)
at Different Years in Two Time Periods

Characteristic	1972-73					1982				
	N	Age (MON. or YRS.)	Length or Height (cm)	Mean*	Range	N	Age (MON. or YRS.)	Length or Height (cm)	Mean*	Range
Total (1-2 yrs.)	35	12-28 MON.	18±6	80.5±6.2	71.1-95.2	42	12-28 MON.	17.0±5.9	69.5-91.5	79.6±6.4
Boys	20	12-28 MON.	18±6	80.6±6	74.0-95.2	27	12-28 MON.	18.4±6.0	72.0-91.5	81.6±6.3
Girls	15	12-28 MON.	18±6	80.2±6.5	71.1-90.2	15	12-24 MON.	14.6±4.9 +	69.5-88.0	76.0±5.1 #
Total (3-4 yrs.)	22	2.5-4.2 YRS.	3.4±0.6	96.3±6.1	85.1-114.0	36	2.7-4.2 YRS.	3.1±0.3 #	85.0-105.5	93.9±4.2
Boys	13	2.5-4.2 YRS.	3.4±0.6	97.2±6.7	88.3-114.0	24	2.7-4.2 YRS.	3.1±0.4 #	86-105.0	94.6±4.1
Girls	9	2.5-4.2 YRS.	3.4±0.6	94.9±5.3	85.1-102.0	12	3.0-3.5 YRS.	3.1±0.2	85.0-101.0	92.3±4.3
Total (5-6 yrs.)	18	4.5-6 YRS.	5±0.3	108.7±4.9	100.3-119.4	7	4.8-5 YRS.	5.0±0.1	95.5-112	108.6±6.5
Boys	9	4.5-5 YRS.	5±0.2	108.2±6.0	100.3-119.4	4	4.8-5 YRS.	5.0±0.1	109-117	111.8±3.8
Girls	9	4.5-6 YRS.	5±0.4	109.3±3.8	102.2-114.0	3	5 YRS.	5.0±0.0	95.5-110	104.5±7.9

* Mean ± standard deviation

+ Significantly different from age of boys 1982, p<.05

Significantly different from length of boys 1982, p<.01

Ø Significantly different from age at 1972-73, p<.05

Table 94

Weight of the Preschool Children (Boys and Girls)
at Different Years in Two Time Periods

Characteristic	1972-73				1982			
	Age (MON. or YRS.)		Weight (kgs)		Age (MON. or YRS.)		Weight (kgs)	
	N	Range	Mean*	Range	N	Range	Mean*	Range
Total (1-2 yrs.)	34	12-28 MON.	17.8±5.8	7.7-15.0	42	12-28 MON.	17.0±5.9	7.3-14.5
Boys	20	12-28 MON.	17.7±5.9	8.9-15.0	27	12-28 MON.	18.4±5.0 #	9.3-14.5
Girls	14	12-28 MON.	18.1±6.0	7.7-13.6	15	12-24 MON.	14.6±4.9	7.3-11.2
Total (3-4 yrs.)	22	2.5-4.2 YRS.	3.4±0.6	11.8-18.3	36	2.7-4.2 YRS.	3.1±0.3 /	11.4-20.0
Boys	13	2.5-4.2 YRS.	3.4±0.6	12.9-18.1	24	2.7-4.2 YRS.	3.1±0.4 /	11.5-20.0
Girls	9	2.5-4.2 YRS.	3.4±0.6	11.8-18.3	12	3.0-3.5 YRS.	3.1±0.2	11.4-16.4
Total (5-6 yrs.)	18	4.5-6 YRS.	5±0.3	15.6-30.0	7	4.8-5 YRS.	4.97±0.1	15.5-25.3
Boys	9	4.5-5 YRS.	4.9±0.2	16.1-30.0	4	4.8-5 YRS.	4.95±0.1	19.3-25.3
Girls	9	4.5-6 YRS.	5.0±0.4	15.6-24.1	3	5 YRS.	5.0±0.0	15.5-19.2

* Mean ± standard deviation

+ Significantly different from weight of girls in 1972-73, p<.01

Significantly different from age of girls in 1982, p<.05

@ Significantly different from weight of girls, 1982, p<.0001

x Significantly different from weights at 1972-73, p<.05

/ Significantly different from age at 1972-73, p<.05

Table 95
Head Circumference of the Preschool Children (Boys and Girls)
at Different Years in Two Time Periods

Characteristic	1972-73					1982				
	Age (MONTHS)		Head Circumference (cm)		N	Age (MONTHS)		Head Circumference (cm)		
	Range	Mean*	Range	Mean*		Range	Mean*	Range	Mean*	
Total Population	13	12.2±0.6	44.4-50.8	47.4±1.7	41	12-25	16.8±5.7	45.0-50	47.4±1.4	
1-2 years										
Boys	9	12.3±0.7	45.7-50.8	47.6±1.7	26	12-25	18.0±5.8	45.3-50	48.0±1.2	
Girls	4	12.0±0.0	44.4-47.6	46.5±1.4	15	12-24	14.6±4.9	45-48.8	46.2±1.2	

* Mean ± standard deviation

+ Significantly different from age in 1972-73, p<.01

Significantly different from head circumference of boys in 1982, p<.001

Table 96

Hematocrit Values of the Preschool Population
at Different Years in Two Time Periods

Characteristic	1972-73					1982				
	Time Period	Age (MON. or YRS.)	Hematocrit (%)	N		Age (MON. or YRS.)	Hematocrit (%)			
Collected	N	Range	Mean*	Range	Mean*	Range	Mean*	Range	Mean*	
Total Population	12	12-28 MON.	19.8±6.2	26-39	35.3±3.5	12-30 MON.	17.5±5.3	28.5-40	36.1±2.4	
1-2 years										
Total Population	7	2.5-4 YRS.	3.2±0.6	33-38	35.9±1.7	3-4.3 YRS.	3.3±0.5	33-42.0	37.4±2.3	
3-4 years										
Total Population	6	4.5-5.5 YRS.	5.0±0.3	34-39	35.6±1.9	4.8-5 YRS.	5.0±0.1	33-42.0	37.4±2.9	
5-6 years										

* Mean ± standard deviation

Table 97
Number and Percent of Preschool Children Who Fell Below
or Rose Above the Physical and Laboratory Standards

Characteristics	1972-1973			1982*		
	N	No. of Cases	%	N	No. of Cases	%
Birth weight (kgs)	48			48		
<2.5 kgs		2	4		3	6
>95th percentile		0	0		4	8
Birth head circumference						
< 5th percentile	-	-	0	34	4	12
>95th percentile	-	-	0	34	1	3
Birth Apgar score at:						
1 minute						
<4	13	0	0	40	2	5
5 minutes						
<4	13	0	0	41	0	0
Length or height (cm) at:						
1-2 years						
< 5th percentile	35	2	6	42	3	7
>95th percentile	35	1	3	42	3	7
3-4 years						
< 5th percentile	22	2	9	36	2	6
>95th percentile	22	0	0	36	0	0
5-6 years						
< 5th percentile	18	0	0	7	1	14
>95th percentile	18	1	6	7	0	0
Weight (kgs) at:						
1-2 years						
< 5th percentile	34	0	0	42	5	12
>95th percentile	34	3	9	42	2	5
3-4 years						
< 5th percentile	22	0	0	36	2	6
>95th percentile	22	1	5	36	0	0
5-6 years						
< 5th percentile	18	0	0	7	0	0
>95th percentile	18	1	6	7	1	14

Table 97 (continued)
Number and Percent of Preschool Children Who Fell Below
or Rose Above the Physical and Laboratory Standards

Characteristics	1972-1973			1982*		
	N	No. of Cases	%	N	No. of Cases	%
Head circumference (cm) at:						
1-2 years						
< 5th percentile	13	0	0	41	2	5
>95th percentile	13	1	8	41	1	2
Hematocrit (%) at:						
1-2 years						
<31%	12	1	8	26	1	3
3-4 years						
<34%	7	1	14	19	1	5
5-6 years						
<34%	6	0	0	8	1	13

- No data was collected

* Complete number of records were obtained during this year
so only this year was included

Reference: Dirige, O. and Hughes-Ho, C., 1985.

Table 98
Other Demographic, Medical and Nutritional Characteristics
of the Preschool Population

Characteristics	1972-1973			1982		
	Total No.	No. of Cases	%	Total No.	No. of Cases	%
Medical Insurance	49			49		
None		9	18		9	18
Private		30	61		27	55
Medicaid		10	20		13	27
Use of WIC Program	59	0	0	49	33	68
Method of feeding in hospital	32			44		
Breast		8	25		20	46
Formula		24	75		24	55
Method of delivery	48			49		
Normal		47	98		37	76
Caesarean		1	7		12 +	25
Neonatal problems						
Anemia	49	0	0	48	1	2
Congenital anomalies	48	1	2	46	3	6
Jaundice	47	2	4	49	16 #	33
Phototherapy	49	0	0	46	3	6
Premature	49	0	0	47	2	4
Medical problems						
Allergy	45	4	8	49	0	0
Obesity	47	2	4	48	1	2
Surgery	48	1	2	46	3	6
Heart disease	48	1	2	48	1	2
Behavioral disorder	44	5	10	49	0	0
Upper respiratory tract infection	49	20	40	49	27	55
Anemia	39	13	33	47	2 #	4
Dental caries	45	4	8	43	6	12
Others:						
Otitis media	49	8	16	49	23 *	47
Asthma	49	1	2	49	5	10

+ Significantly different from 1972-73, x2 test, p<.001

Significantly different from 1972-73, x2 test, p<.001

® Significantly different from 1972-73, x2 test, p<.001

* Significantly different from 1972-73, x2 test, p<.001

Table 99

Dietary Analysis of the Diet of the Preschool Population

Age of Subject (years)	1972-1973			1982		
	Total	No. of		Total	No. of	
	No.	Cases	%	No.	Cases	%
1-2 years	12			42		
<66% RDA		7	58		7	17
>66% RDA		5	42		34	81
>120% RDA		0	0		1	2
2-3 years	30			8		
<66% RDA		11	37		0	0
>66% RDA		16	53		8	100
>120% RDA		3	10		0	0
3-5 years	7			2		
<66% RDA		5	71		0	0
>66% RDA		2	29		2	100
>120% RDA		0	0		0	0

Figure 23

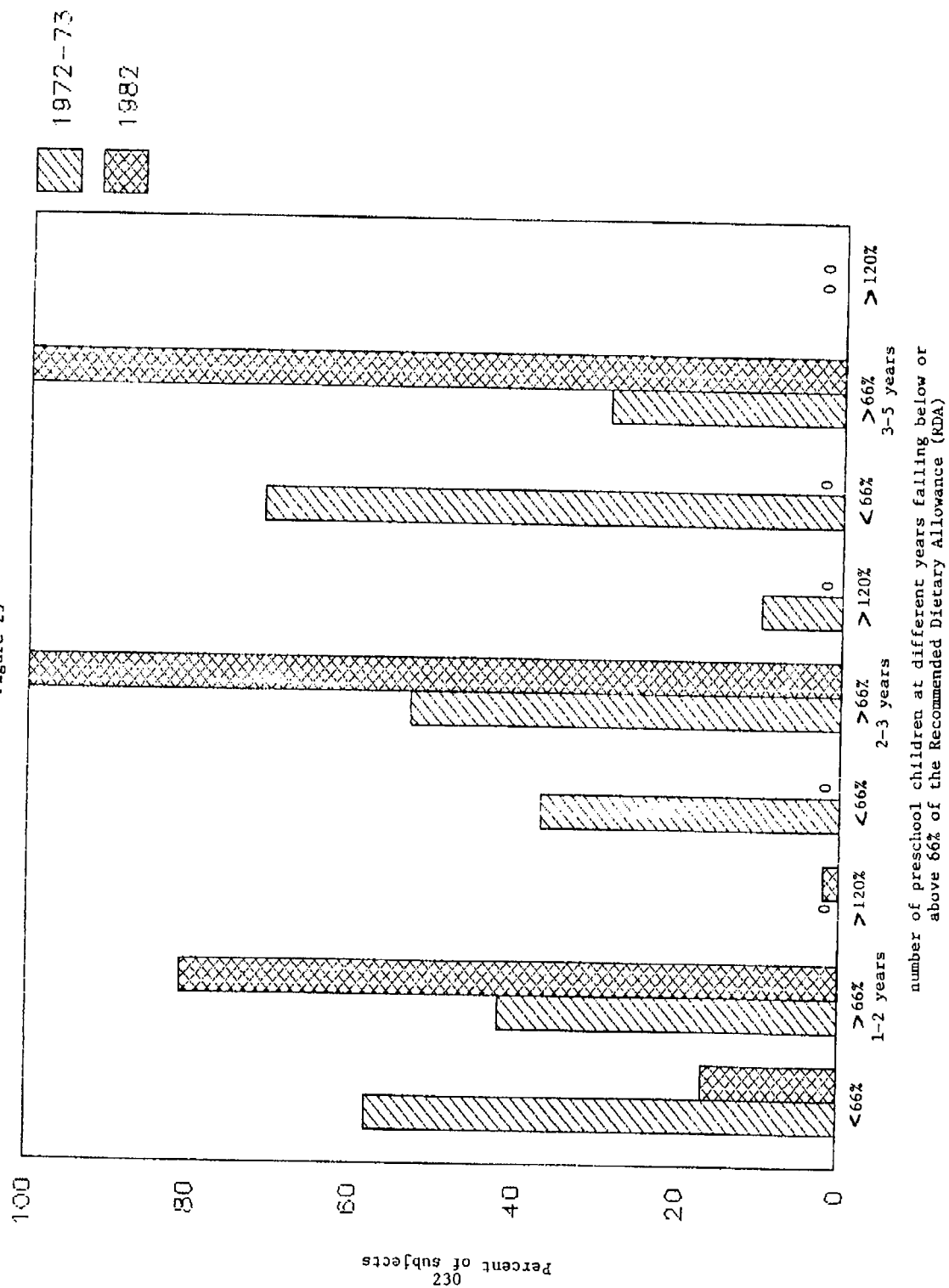


TABLE 100

Risk Condition By Age Group
Hawaiian Nutrition Patient Population - WCCHC

(N = 900)

RISK/CONDITION	0-12 Y.O.	13-18 Y.O.	19-34 Y.O.	35-55 Y.O.	56+ Y.O.	TOTAL
Poor Diet *	478	68	211	31	-0-	719
Underweight/ + Growth Regression	249	23	83	2	-0-	544
Obesity ‡	103	8	49	54	14	228
Anemia ‡	107	37	101	9	-0-	254
Multiparity ¶	-0-	9	122	19	-0-	150
Miscarriage ¶	-0-	1	59	8	-0-	67
Stillbirth/ Neonatal Death ¶	-0-	-0-	9	-0-	-0-	9
Premature/SGA ¶	33	4	18	3	-0-	58
Drug/ETOH Abuse □	1	4	29	3	-0-	37
Congenital Anomalies ☒	8	2	3	-0-	-0-	13
Diabetes	-0-	2	9	31	11	51
Hypertension	-0-	-0-	4	8	4	16
Cardiovascular Disease	-0-	-0-	4	8	4	16
Arthritis/Gout	-0-	-0-	-0-	7	4	11
Cancer	1	1	-0-	-0-	1	3

Explanation for Table 100:

+ Underweight - < 5th percentile weight for height/length (for children under 18 years old); < 85% IBW (ideal body weight) for adults (prior to conception, if pregnant); failure to thrive; growth regression (children); poor pattern of growth (children and perinatal women).

† Obesity - > 95th percentile weight for height/length (children under 18 years old); > 120% IBW for adults (prior to conception if pregnant).

The above categories do not include > 95th percentile weight/age, height/age; < 5% weight/age, height age.

‡ Anemia - Hemoglobin/hematocrit as follows:

0-12 mos. = < 10.0/31.0

13 mos. - 12 y.o. = < 11.0/34.0

Pregnant Women = < 12.0/37.0 (1st and 2nd trimester)
< 11.0/34.0 (3rd trimester)

Nursing Women = < 11.0/34.0 (6 wk. PP)
< 12.0/37.0 (6wk. - 1 yr. PP)

Postpartum Women (PP) = < 11.0/34.0 (6 wk. - 6 mos.
PP)

Other Adult Women = < 12.0/37.0

¶ Perinatal Complications -

Included all of the following:

Multiparity - 4+ children

Miscarriage - history of or current status
(postpartum)

Stillbirth - history of/current

Neonatal Death - history of/current

Prematurity - 36 wk. gestation delivery (statistics
can reflect a woman with a history
of/current status (PP) or child that
was premature

SGA - small for gestational age; low birth weight
but not premature (self or product of
conception)

☐ Drug/Alcohol Abuse - Self or product of conception

☒ Congenital Anomalies - Self or product of conception (includes
documented developmental delays)

* Poor Diet - Inadequate intake in one or more of the following
nutrients: protein, calcium, iron, vitamin C,
vitamin A, folic acid and calories

APPENDIX

ABSTRACT INFORMATION
WIC - WAIMANALO
INFANTS (0-12 Months)
YEAR _____

Date _____

Abstractor _____

Patient's Name _____

Mother's Name _____

I. Patient Identification

1. Identification Number: Mother's S.S. No.

--	--	--	--	--	--	--	--	--	--

2. Age in Months at First Visit: Birthdate _____

--	--	--	--	--

3. Sex 1. Male 2. Female

☐

4. Medical Insurance (check one)

1. None

3. Medicaid

2. Private

4. Other _____

☐

II. Family History

5. Age of mother: Birthdate _____

--	--

6. Number of Children in Family (including self)

1. One

3. Three

5. Five

2. Two

4. Four

6. Six +

☐

7. Birth Order

1. 1st Child

3. Third

5. 5th

7. 7th

2. 2nd Child

4. Fourth

6. 6th

8. 8th

9. Other _____

☐

III. Neonatal History

8. Method of Delivery

1. Normal

2. Caesarean

3. Other _____

☐

9. Neonatal Problems

1. Anemia

3. Jaundice

2. Congenital
Anomaly

4. Phototherapy

5. Other _____

☐

10. Method of Feeding at the Hospital (check one)

1. Bottle

3. Breast and Formula

2. Formula

4. Other _____

☐

11. Apgar Score

1. One Minute
2. Five Minutes

12. Birth Weight (kgs)

13. Birth Length (cm)

14. Head Circumference (cm)

	.			
		.		
		.		

IV. Anthropometric Assessment

	1-3 Mo.	4-6 Mo.	7-9 Mo.	10-12 Mo.
15. Length (cm)				
16. Weight (kgs)				
17. Head Circumference (cm)				

V. Laboratory Data

	1-3 Mo.	4-6 Mo.	7-9 Mo.	10-12 Mo.
18. Hematocrit %				

VI. 19. Medical Problems in Infancy (check all that applies)

1. Colic	☐
2. Vomiting	☐
3. Allergy	☐
4. Diarrhea	☐
5. Constipation	☐
6. Irregular Meals	☐
7. Cough	☐
8. Fever	☐
9. Other _____	☐

VII. Dietary Assessment

20. Type of Food (check all that applies)

	1 Mo.	2-3 Mo.	4-6 Mo.	7-9 Mo.	10-12 Mo.
1. Breast	☐	☐	☐	☐	☐
2. Formula	☐	☐	☐	☐	☐
3. Milk	☐	☐	☐	☐	☐

4. Fruit Juice	☐	☐	☐	☐	☐
5. Cereals	☐	☐	☐	☐	☐
6. Vegetables	☐	☐	☐	☐	☐
7. Fruits	☐	☐	☐	☐	☐
8. Meats/Alternates	☐	☐	☐	☐	☐
9. High Meat or Mixed Dinners	☐	☐	☐	☐	☐
10. Desserts	☐	☐	☐	☐	☐
11. Table Foods	☐	☐	☐	☐	☐
12. Finger Foods	☐	☐	☐	☐	☐
13. Vitamin/Minerals	☐	☐	☐	☐	☐
14. Fluoride	☐	☐	☐	☐	☐
15. Other _____	☐	☐	☐	☐	☐

21. Dietary Analysis: Check for Adequacy at Different Months

	1 Mo.	2-3 Mo.	4-5 Mo.	7-9 Mo.	10-12 Mo.
1. Total Diet Adequacy	☐	☐	☐	☐	☐
1. Poor 2. Fair 3. Adequate 4. Excess					

22. Developmental Assessment

	Birth	3 Mo.	6 Mo.	9 Mo.	12 Mo.
1. On Solids	☐	☐	☐	☐	☐
2. Cup	☐	☐	☐	☐	☐
3. Off Bottle	☐	☐	☐	☐	☐
4. Finger Foods	☐	☐	☐	☐	☐
5. Spoon Foods	☐	☐	☐	☐	☐
6. Eats Alone	☐	☐	☐	☐	☐
7. Brushes Teeth	☐	☐	☐	☐	☐

23. Use of the Following Programs (check all that applies)

1. WIC	☐
2. Food Stamps	☐

- 3. Castle Hospital
- 4. La Lecheleague
- 5. Other _____

ABSTRACT INFORMATION
WIC - WAIMANALO
PREGNANT WOMEN
YEAR _____

Date _____

Abstractor _____

I. Patient Identification: Name _____

1. Identification Number (S.S. No.)

2. Age at Time of Visit (Birthdate _____)

II. Background Information

3. Kind of Medical Insurance (check one)

1. None 3. Medicaid
2. Private 4. Other _____

☐☐

4. Years of Schooling

III. Pregnancy History

5. Number of Pregnancies Before Present Pregnancy (Gravida)
(check one)

1. One 3. Three 5. Five
2. Two 4. Four 6. Six +

☐

6. Number of Live Births (Parity) (check one)

1. One 3. Three 5. Five
2. Two 4. Four 6. Six +

☐

7. Number of Occurrences of the Following
(check all that applies)

a. Miscarriage or Spontaneous Abortion

1. One 2. Two 3. Three 4. Other _____

☐

b. Elective Abortion

1. One 2. Two 3. Three 4. Other _____

☐

c. Stillbirth

1. One 2. Two 3. Three 4. Other _____

☐

8. Maternal Complications or Problems During Pregnancy

1. Toxemia

☐

2. Diabetes

☐

3. Infections

☐

4. Incompetent Cervix
5. Hemorrhage
6. Psychosocial Distress
7. Other _____

IV. Anthropometric Assessment

8. Pre-Pregnancy Weight (kgs) lbs = _____

--	--	--	--	--
9. Pregnancy Weight at First Visit (kgs) lbs = _____

--	--	--	--	--
10. Height (cm) inch = _____

--	--	--	--	--
11. Weeks of Gestation at Initial Visit

--	--
12. Weeks of Gestation at Delivery

--	--
13. Total Weight Gain of Mother (kgs) lbs = _____
(weight at delivery - pre-pregnancy weight)

--	--	--	--	--
14. Average Rate of Weight Gain/Wk During Pregnancy
(kgs) lbs = _____
weight at last visit - weight at initial visit
(_____)
time in clinic at last visit

--	--	--	--	--

V. Laboratory Assessment

15. Hemoglobin (gm/dl)
- | | | | | | | | |
|--------------------------------|------------|---|--|--|--|--|--|
| First Trimester (1-12 weeks) | Date _____ | <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td></td><td></td><td></td></tr></table> | | | | | |
| | | | | | | | |
| Second Trimester (13-24 weeks) | Date _____ | <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td></td><td></td><td></td></tr></table> | | | | | |
| | | | | | | | |
| Third Trimester (25-40 weeks) | Date _____ | <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td></td><td></td><td></td></tr></table> | | | | | |
| | | | | | | | |
| Post Partum | Date _____ | <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td></td><td></td><td></td></tr></table> | | | | | |
| | | | | | | | |

VI. Condition of Infant

16. Sex 1. Male 2. Female
17. Birth Weight (kgs)
18. Birth Length (cm)
19. Head Circumference (cm)

20. Apgar Score

1 Minute

5 Minutes

21. Method of Feeding Infant at the Hospital (check one)

1. Breast

4. Soy Milk

2. Formula

5. Evaporated Milk

3. Formula & Iron

6. Other _____

☐

VII. Nutritional Assessment

22. Food Groups (check all that applies)

Initial Visit

	Daily	Several Times/ Day	Several Times/ Week	Sometimes
1. Milk	☐	☐	☐	☐
2. Meats/Alternates	☐	☐	☐	☐
3. Vegetables - Fruits				
a. Vitamin A	☐	☐	☐	☐
b. Vitamin C	☐	☐	☐	☐
c. Other	☐	☐	☐	☐
4. Cereals	☐	☐	☐	☐
5. Other				
Snacks	☐	☐	☐	☐
Sweets	☐	☐	☐	☐
Coffee, Tea	☐	☐	☐	☐
Condiments	☐	☐	☐	☐

23. Dietary Intake (check one)

1. Protein

1. Poor

2. Low

3. Fair

4. Adequate

5. Excess

Initial

Final

☐
☐

2. Iron

1. Poor

2. Low

3. Fair

4. Adequate

5. Excess

☐
☐

- | | | | | |
|--------------|-------------|--------------------------|--------------------------|--|
| 3. Calcium | | | | |
| 1. Poor | 4. Adequate | ☐ | ☐ | |
| 2. Low | 5. Excess | | | |
| 3. Fair | | | | |
| 4. Vitamin C | | | | |
| 1. Poor | 4. Adequate | ☐ | ☐ | |
| 2. Low | 5. Excess | | | |
| 3. Fair | | | | |
| 5. Vitamin A | | | | |
| 1. Poor | 4. Adequate | ☐ | ☐ | |
| 2. Low | 5. Excess | | | |
| 3. Fair | | | | |
| 6. Calories | | | | |
| 1. Poor | 4. Adequate | ☐ | ☐ | |
| 2. Low | 5. Excess | | | |
| 3. Fair | | | | |

24. Dietary Analysis

Total Diet Adequacy

1. Poor 2. Fair 3. Adequate 4. Excess ☐

25. Nutritional Problems Present (check one that applies)

- | | |
|---|--------------------------|
| 1. Nausea | ☐ |
| 2. Vomiting | ☐ |
| 3. Constipation | ☐ |
| 4. Smoking | ☐ |
| 5. Drinking | ☐ |
| 6. Drugs | ☐ |
| 7. Poor Appetite | ☐ |
| 8. Food Allergies | ☐ |
| 9. Cravings: If yes, state what foods _____ | ☐ |
| 10. Other _____ | ☐ |

26. Use of the Following Programs (check all that applies)

- | | |
|----------------|--------------------------|
| 1. WIC | ☐ |
| 2. WC-CHC | ☐ |
| 3. Food Stamps | ☐ |
| 4. EFNEF | ☐ |

5. Other _____

☐

27. Intake of Vitamin/Mineral Pills During Pregnancy

1. Yes

2. No

☐

VIII. Dental Data

28. Dental Insurance (check one)

1. None

3. Medicare

2. Private

4. Other _____

☐

29. Dental Work Done (check all that applies)

1. Extraction

☐

2. Root Canal

☐

3. Crowns

☐

4. Exam and X-Ray

☐

5. Oral Surgery

☐

6. Prophylaxis

☐

7. Other _____

☐

30. Cost of Restoration and Repair (check one)

1. < \$50

4. \$300-599

2. \$51-149

5. \$600-1000 +

3. \$150-299

6. Other _____

☐

ABSTRACT INFORMATION
WIC - WAIMANALO
PRESCHOOL CHILDREN (1-5 YEARS)
YEAR: _____

Date: _____

Abstractor: _____

Patient's Name _____

Mother's Name _____

I. Patient Identification

1. Identification Number: S.S. No.

--	--	--	--	--	--	--	--	--	--

2. Age as of last visit (years) Date of visit _____

Birthdate _____

--	--	--	--

3. Sex

1. Male

2. Female

☐

II. Background Information

4. Number of children in family besides self (Check one)

1. one 3. three 5. five 7. other _____

2. two 4. four 6. six

☐

5. Birth order in the family (Check one)

1. first 3. third 5. fifth 7. other _____

2. second 4. fourth 6. sixth

☐

6. Medical Insurance (Check one)

1. None

3. Medicaid

2. Private

4. Other _____

☐

III. Family and Neonatal History

7. Age of Mother

Birthdate: _____

--	--

8. Method of delivery (Check one)

1. Normal

3. Other _____

2. Caesarean

☐

9. Method of feeding at hospital (Check one)

1. Breast

3. Whole Milk

2. Formula

4. Other _____

☐

10. Neonatal problems (Check all that applies)

1. Anemia

☐

2. Congenital Anomalies

☐

3. Jaundice

☐

4. Phototherapy

☐

5. Low Birth Weight (<2500g)

☐

6. Premature (<37 weeks)

☐

7. Other _____

☐

11. Birth length (cm)

--	--	--	--	--

12. Birth weight (kgs) lbs = _____

--	--	--	--	--

13. Head circumference (cm)

--	--	--	--	--

14. Apgar score

1 minute

☐

5 minutes

☐

IV. Anthropometric Assessment: fill in with available information

	3-5 mos.	6-11 mos.	1-2 yrs.	3 yrs.	5 yrs.																				
	Date _____	Date _____	Date _____	Date _____	Date _____																				
15. Height (cm)	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>				
16. Weight (kgs)	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>				
17. Head Circumference (cm)	<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>					<table border="1"><tr><td></td><td></td><td></td><td></td></tr></table>				

V. Laboratory Data

	3-5 mos.	6-11 mos.	1-2 yrs.	3 yrs.	5 yrs.										
	Date _____	Date _____	Date _____	Date _____	Date _____										
18. Hematocrit (%)	<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>			<table border="1"><tr><td></td><td></td></tr></table>		

VI. 19. Medical Problems (Check all that applies at age period specified)

- | | |
|---------------------------------------|--------------------------|
| 1. Allergy | ☐ |
| 2. Diabetes | ☐ |
| 3. Hypertension | ☐ |
| 4. Obesity | ☐ |
| 5. Surgery | ☐ |
| 6. Heart Disease | ☐ |
| 7. Behavioral Disorder _____ | ☐ |
| 8. Upper Respiratory Tract Infections | ☐ |
| 9. Psychological Disorder | ☐ |
| 10. Anemia | ☐ |
| 11. Dental Caries | ☐ |
| 12. Other _____ | ☐ |

VII. Dietary Assessment (Check all that applies putting additional information in blanks)

20. Type of food 3-6 mos. 6 mos.-1 yr. 1-2 yrs. 2-3 yrs. 3-5 yrs.

	Date _____	Date _____	Date _____	Date _____	Date _____
1. Breast	☐	☐	☐	☐	☐
2. Formula	☐	☐	☐	☐	☐
3. Milk	☐	☐	☐	☐	☐
4. Fruit Juice	☐	☐	☐	☐	☐
5. Cereals	☐	☐	☐	☐	☐
6. Vegetables	☐	☐	☐	☐	☐
7. Fruits	☐	☐	☐	☐	☐
8. Meats/ Alternates	☐	☐	☐	☐	☐
9. High Meat or Mixed Dinners	☐	☐	☐	☐	☐
10. Desserts	☐	☐	☐	☐	☐

	3-6 mos.	6 mos.-1 yr.	1-2 yrs.	2-3 yrs.	3-5 yrs.
	Date _____	Date _____	Date _____	Date _____	Date _____
11. Table Foods	☐	☐	☐	☐	☐
12. Finger Foods	☐	☐	☐	☐	☐
13. Other _____	☐	☐	☐	☐	☐

	3-6 mos.	6 mos.-1 yr.	1-2 yrs.	2-3 yrs.	3-5 yrs.
21. Intake of vitamins & mineral pills	☐	☐	☐	☐	☐
22. Intake of flouride	☐	☐	☐	☐	☐
23. Dietary Analysis Total diet adequacy	☐	☐	☐	☐	☐

Note as:

1. Poor 2. Fair 3. Adequate 4. Excess

24. Developmental Assessment (Check all that applies)

	3-6 mos.	6 mos.-1 yr.	1-2 yrs.	2-3 yrs.	3-5 yrs.
1. On Solids	☐	☐	☐	☐	☐
2. Cup	☐	☐	☐	☐	☐
3. Off Bottle	☐	☐	☐	☐	☐
4. Finger Foods	☐	☐	☐	☐	☐
5. Spoon Foods	☐	☐	☐	☐	☐
6. Eats Alone	☐	☐	☐	☐	☐
7. Brushes Teeth	☐	☐	☐	☐	☐

25. Use of following programs:

1. WIC
2. EFNEF

3. Other _____

☐