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Dietary Characteristics of Children in the CNMI Final Report August 31, 2007

University of Hawaii
in partnership with
Northern Marianas College and the
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CNMI

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- ADAP

Note: These data are not authorized to be published in another format without permission. The report can be referenced as Novotny, R. University of Hawaii, Northern Marianas College, Dept. Public Health CNMI: Dietary characteristics of Children in the CNMI. Final Report July 31, 2007

This document replaces the previous preliminary survey report. Results presented in the preliminary report are also presented here. The preliminary report contained dietary data analyzed from a sub-sample of children. Those data are replaced here with analysis from the total sample. Minor changes have been made to some sections previously reported, in accordance with statistics generated from the full data set.

Preliminary results of the survey were presented on Saipan and printed copies were distributed in June 2006 (**Novotny, R. University of Hawaii, Northern Marianas College, Dept. Public Health CNMI: Nutrition and Health Status of Children in the CNMI, Preliminary Report, June 24, 2006).**

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TABLE OF CONTENTS

List of Tables

Figures

EXECUTIVE SUMMARY

Four hundred twenty children, ages six months-10 years old were studied for indicators of nutrition and health in the Commonwealth of the Northern Mariana Islands in June and July of 2005 using a two-stage cluster survey. Over two thirds of children 5-10 years old had no physical activity outside of school (68%), although 61% of children engaged in 1-3 days of physical activity while at school. Children of all ages watched television an average of four hours per day.

Analysis of the diets of 420 children, found that children of all ages had high intakes of protein compared to recommended levels. Sodium (salt) intake was also high and calcium intake was low. Approximately 35% of the children met Healthy People 2010 objectives of <10% of calories from saturated fat and ≤30% of calories from total fat.
Analysis of food group intakes confirms the high protein and low calcium intakes in all age groups, with high intakes of processed meats and low intakes of dairy, fruits and vegetables. It also indicates that fruit and vegetable consumption is below recommended levels for children from one year through 10 years of age.
Dietary analysis using the USDA Healthy Eating Index found that only 2% of the children in CNMI had diets that could be classified as "good". The remaining children had diets that "need improvement" (54%) or were "poor" (44%).

Seventy-three percent of children were breast fed. 25% were still breastfeeding at six months and 22% were still breastfeeding at 12 months. Nine percent breastfed exclusively until six months. 47% introduced complementary food before six months.

Thirty-four percent of children over two years were overweight or at risk for overweight (CDC, 2000). The prevalence of overweight tended to increase after 5 years of age. Overweight prevalence was similar across ethnic groups. Two to five percent of children were identified as underweight (using different indicators), which is within an expected range in a normal population. Nine cases of Acanthosis nigricans were identified, all among overweight children. These children were significantly more likely to have high blood pressure and early pubertal maturation.

Dietary analysis shows that there is probably no widespread Vitamin A Deficiency (VAD), which is confirmed by the current absence of clinically reported VAD. However, indications of low intake in some individuals, warrants further investigation to identify 'at risk' segments of the population.

High cholesterol levels (>200mg/dl) were found in over 13% of children 5 years and over. Twenty six percent (26%) of children under five years had anemia, as did 17% of 5-10 year old children according to World Health Organization (WHO) cut-off points. One fifth of the children had high blood pressure.

Alternative activities to television and video games, alternative foods to high fat meats and increased consumption of foods containing calcium as well as increased amounts of fruits and vegetables are recommended to improve nutritional status, weight status and health among children in the CNMI.

Papers published or accepted for publication and presentations made to date:

Breastfeeding is associated with lower body mass index among children of the Commonwealth of the Northern Marianas Islands. Rachel Novotny, Patricia Coleman, Lynn Tenorio, Nicola Davison, Tayna Camacho, Vickie Ramirez, Vinutha Vijayadeva, Pedro Untalan, Margaret Tudela. Journal of the American Dietetic Association. Manuscript # ADAJ-D-06-00381R3. Accepted for publication on May 8, 2007. In press.

Breast feeding is associated with lower risk of overweight among children of the Commonwealth of the Northern Marianas Islands Rachel Novotny, Patricia Coleman, Lynn Tenorio, Nicola Davison, Tayna Camacho, Vickie Ramirez, Ephrosine Danigellis, Vinutha Vijayadeva, Peter Untalan, and Margaret Tudela. *FASEB J.* 2006 20:A157 Accessed July 24th 2007. http://www.fasebj.org/cgi/content/meeting_abstract/20/4/A157-a?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=Novotny&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourcetype=HWCIT

Acanthosis nigricans among Pacific Islander children in the Commonwealth of the Northern Marianas Rachel Novotny, Patricia Coleman, Lynn Tenorio, Nicola Davison, Tayna Camacho, Vickie Ramirez: *FASEB J.* 2007 21:532.7 Accessed July 24th 2007. http://www.fasebj.org/cgi/content/meeting_abstract/21/5/A313-c?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&author1=Novotny&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourcetype=HWCIT

INTRODUCTION

Background
Asian and Pacific Islanders are experiencing a drastic rise in the prevalence of obesity and related disease compared to Whites [1 2 3].

Obesity
From 1963 to 1980 the prevalence of overweight among children and adolescents changed relatively little, but showed a noticeable increase from 1988-1994 [4]. Recent studies show that this trend is continuing [5 6]. The most current estimates from the National Health and Nutrition Examination Surveys (NHANES) 2003 – 2004 are that 17% of children and adolescents, ages 6-19 years, are overweight [7].

Pacific Obesity & Chronic disease
Small studies among several Native Hawaiian and Samoan populations indicate that these Pacific Island groups have among the highest prevalence of obesity-related diseases in the world, especially type 2 diabetes and cardiovascular disease. Pacific Islanders are experiencing an especially drastic rise in the prevalence of obesity and related disease compared to Whites [1 2 3]. Over 60 percent of Pacific Islanders in Hawaii are obese, compared to 10.5% of Filipinos, 14% of Whites, and 10% of Chinese [8].

Diet
Adolescents who were mostly or only fed breast milk vs. mostly or only fed infant formula in the first 6 months of life were at an approximately 22% lower risk of being overweight [9] Breast feeding has great potential as a public health intervention to decrease overweight and obesity. Early rapid growth has been shown to be associated with later obesity [10].
Major causes of morbidity and mortality in the United States are related to poor diet and a sedentary lifestyle. Some specific diseases linked to poor diet and physical inactivity include cardiovascular disease, type 2 diabetes, hypertension, osteoporosis, and certain cancers. Furthermore, poor diet and physical inactivity, resulting in an energy imbalance (more calories consumed than expended), are the most important factors contributing to the increase in overweight and obesity[11].

Survey Purpose

- To identify rates of overweight & risk for overweight among children in CNMI and related risk factors for chronic disease

- To identify dietary, physical activity, and socio-economic factors influencing nutrition status& health of children in the CNMI

CHAPTER 1. METHODS & MATERIALS

CNMI HLPI Nutrition Survey was conducted in June/July 2005. The survey was a collaborative project of: University of Hawaii (UH), Northern Marianas College (NMC), Dept of Public Health, CNMI (DPH)

Target population:

- Children 6 months to 10 years (<11yrs)
- Two-stage random cluster survey, proportionate to population (n=420) Sampled in 16 neighborhoods using data from Census 2000 (Table 1.)

Table 1. Study sample

Area	Children studied
Capital Hill	28
Chalan Kanoa	28
Dandan	42
Garapan	28
Gualo Rai	14
Kagman	70
Koblerville	42
Navy Hill	14
San Antonio	14
San Jose (Saipan)	14
San Jose (Tinian)	14
San Vicente	42
Songsong (Rota)	14
Susupe	14
Tanapag	28

Survey Teams

Four survey teams were utilized, each consisting of one nurse from the DPH, one dental hygienist from DPH, one interviewer from NMC or UH, and two anthropometrists from NMC or UH. Survey teams were trained and standardized during a one week training held prior to the survey.

Survey Instruments

The survey consent and assent forms were prepared and administered in 9 languages (English, Chamorro, Carolinian, Chuukese, Chinese Mandarin (both traditional & simplified), Korean, Thai, and Tagalog). Questionnaires were in English but translated verbally by team members with the relevant language skills. Survey forms and procedures were reviewed and approved by the Institutional Review Board at the University of Hawaii. Survey instruments included:

- Socio-demographic Questionnaire for the caregiver
- A single 24-hour dietary recall was collected from children with help from their caregivers.
- Length/height, weight and arm circumference were collected from all the children surveyed.
    - Children under 24 months were measured for length while lying down, and children 24 months and over were measured standing up using a Shorr Board™.
    - Weight was measured using a Seca™ scale. Children under 24 months were measured using the scale's tare function, allowing the parent to stand on the scale with the child. Children 24 months and over stood on the scales by themselves.
    - Mid-upper arm circumference (MUAC) was assessed on all children using a circumference tape at the midpoint between the elbow and shoulder (between the lateral projection of the acromial process of the scapula and olecranon process of the ulna) with the elbow flexed at 90 degrees. Children with MUACs less than 12.5 cm were referred to the Department of Public Health.
    - Body mass index-for-age (BMI) percentiles were calculated for all children using the following calculation:

      Weight (kg) ÷ Height/Length (cm) ÷ Height/Length (cm) x 10,000

      Children falling under the 5th percentile (underweight) and over the 95th percentile (overweight) using the CDC growth chart (www.cdc.gov/growthcharts) were referred to the Department of Public Health.

- Physical examinations for Acanthosis nigricans (AN) & skin rashes were conducted on all children. All survey team members received training from a DPH nurse in identifying AN prior to the start of the survey. The majority of children were examined in light clothing (shorts/T-shirt) and no attempt was made to observe the skin lesions in the groin and breast regions. Observations were made primarily from the back & sides of neck or armpits (during the measurement for the MUAC). Children with visible signs of AN were referred to the Department of Public Health.

- A visual examination (with child clothed) for pubertal development was done for both boys and girls in the upper age range (8-10 years), including developing breasts, acne, armpit hair, voice changes, and facial hair. No further physical assessments were conducted.

- Dental examinations were conducted on all children. Trained dental assistants identified decayed, missing, and filled teeth and the health of gums. The survey form included a checklist to indicate if decayed or filled teeth were found and if the gums were inflamed and/or bleeding. Children with dental concerns were referred to the dental services at the Department of Public Health.

- Blood pressure measurements were conducted on children 3 years and older using a BpTRU™ device. Children ages 36-60 months with blood pressures over 105/65, and children ages 5-10 years with blood pressures over 110/70, were referred to the Department of Public Health.

- Fingerstick/Heelstick blood tests were conducted on all children measuring hemoglobin, using the HemoCue™ Hb 201+ analyzer. Young children incapable of holding still for the fingerstick test were administered a heelstick. Children with anemia were referred to the Department of Public Health.

- Fingerstick blood tests were also conducted on children ages 5-10y for cholesterol testing using the Cardio Check™ PA. Children with cholesterol readings higher than 240 mg/dL were referred to the Department of Public Health.

CHAPTER 2. SOCIO ECONOMIC CHARACTERISTICS

Household Characteristics

Two stage random sampling, proportionate to the population, resulted in 30 clusters, each containing 14 children (n = 420 total) of which 28 clusters were on Saipan island and one cluster was sampled on each of the islands of Tinian and Rota. The resulting distribution of the child participants by island is found in Table 2.

Table 2. Distribution of participants by island of residence

Island	n
Rota	14
Tinian	14
Saipan	392
Total	**420**

There was no attempt to sample by gender during house to house sampling. The resulting sample had 10 more males than females (Table 3).

Table 3. Distribution of participants by gender

Gender	N
Female	205
Male	215
Total	**420**

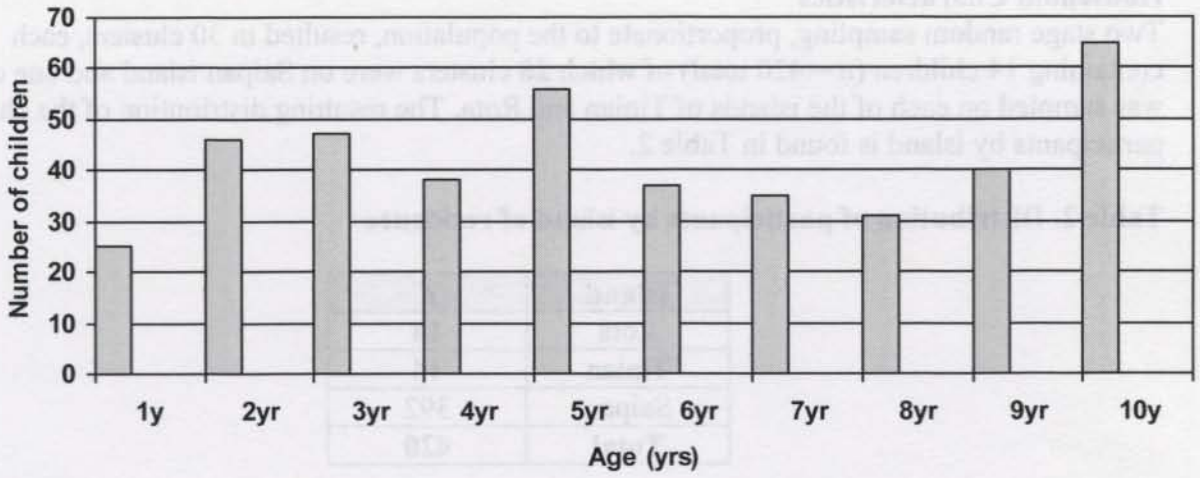
There was no attempt to sample by age distribution during house to house sampling. The resulting age distribution of study children is shown in Table 4 and Figure 1.

Table 4. Distribution of children by age group

Age group, yr (≤)	n	%
≤1	25	6
>2 to ≤3	46	11
>3 to ≤4	47	11
>4 to ≤5	38	9
>5 to ≤6	56	13
>6 to ≤7	37	9
>7 to ≤8	35	8
>8 to ≤9	31	7
>9 to ≤10	40	9
>10 to <11	65	16

Percentage might not add up to 100 due to rounding
(n=420)

Figure 1: Distribution of children by age group



A total of 23 children were adopted (6%).

Household sizes of 4-7 people were most common (Table 5). The median household size was 6 people.

Table 5. Number of people living in the study household

Number of people in household	Frequency	Percent %
2	5	1.2
3	41	9.8
4	72	17.1
5	83	19.8
6	60	14.3
7	69	16.4
8	37	8.8
9	26	6.2
10	27	6.4

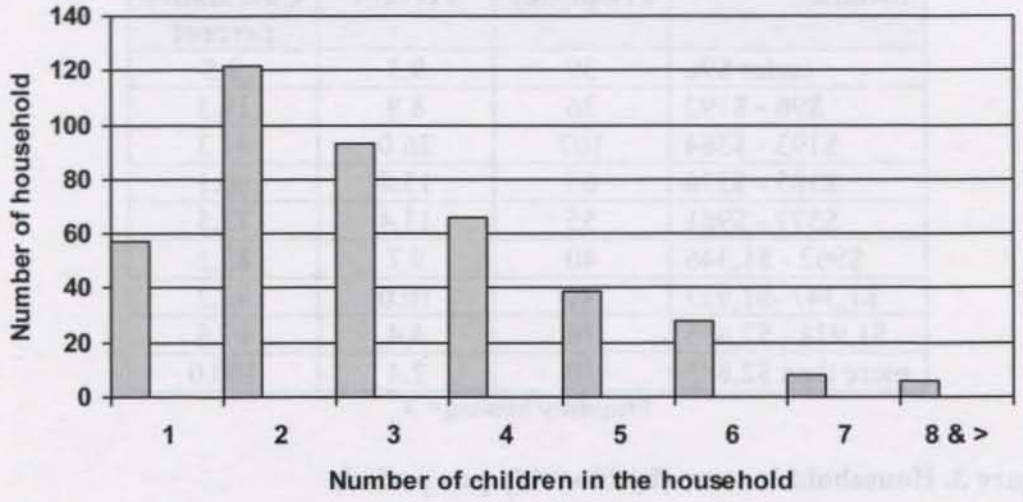
Households with 2-3 children were most common (Table 6 and Figure 2). The median number of children per household was 3.

Table 6. Number of children living in the study household

Number of children in household	Frequency	Percent %
1	57	13.6
2	122	29.1
3	93	22.2
4	66	15.8
5	39	9.3
6	28	6.7
7	8	1.9
8	6	1.4

Frequency Missing = 1

Figure 2. Distribution of children living in the household



The majority of households had both piped water and a flush toilet. Over forty percent of people grew their own food, but only 17% of households owned livestock (Table 7).

Table 7. Household characteristics

Grow own food	Livestock owned by household	Piped water	Flush Toilet
42% (n=416)	17% (n= 415)	95% (n=420)	86% (n=420)

Economic Assistance Programs

Sixty five percent of the selected households received some kind of economic assistance in the last 12 months (Table 8).

Table 8. Economic Assistance Programs

Assistance	% households (n=420)
Food Stamps	40
FEMA[#]	27
Free school breakfast and lunch	36
LIHEAP[†]	9

[#] FEMA - Federal Emergency Management Agency
† LIHEAP - Low Income Home Energy Assistance Program

Socio-economics

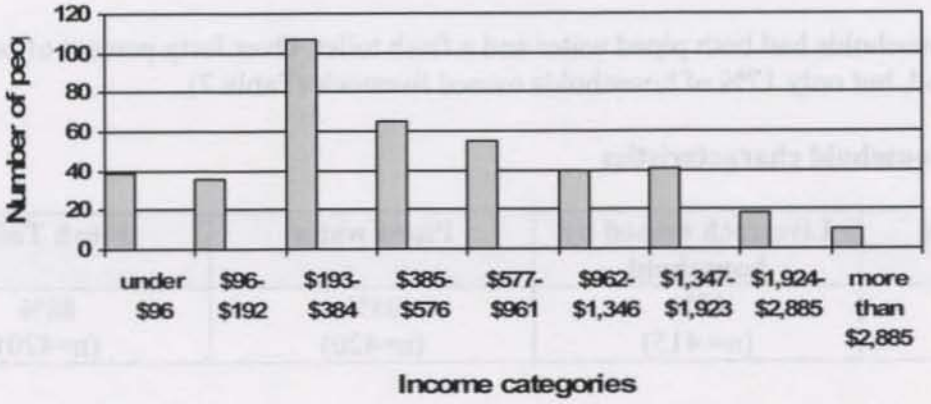
The median income was $385 - $576 for one biweekly pay period (see Table 9 and Figure 3). 26% of the study population had an income of $193-$384.

Table 9. Household Income (by biweekly pay period)

Income	Frequency	Percent	Cumulative percent
under $96	39	9.5	9.5
$96 - $192	36	8.8	18.3
$193 - $384	107	26.0	44.3
$385 - $576	65	15.8	60.1
$577 - $961	55	13.4	73.5
$962 - $1,346	40	9.7	83.2
$1,347 -$1,923	41	10.0	93.2
$1,924 - $2,885	18	4.4	97.6
more than $2,885	10	2.4	100.0

Frequency Missing = 9

Figure 3. Household Income (by biweekly pay period)



Parental Education

Almost all parents could read, and both mothers and fathers had a mean education level of over 11 years (elementary plus some high school) (Table 10).

Table 10. Parental Education

Parent	Read	Mean years of education
Father	98.5% (n=392)	11.8 ± 2.13 (n=363)
Mother	99% (n=419)	11.9 ± 2.28 (n=413)

Tobacco Use

Fifty-four percent (54%) of households had at least one member that smoked (Table 11) and 45% had at least one member that chewed tobacco (Table 12). Chewing tobacco was often associated with chewing betel nut; this was noted in the response but not directly asked.

Table 11. Household smokers

Number of smokers in household	Frequency (n=415)	Percent (%)
0	192	46.3
1	170	41.0
2	35	8.4
3	14	3.4
4	4	1.0

This figure for smokers in a household is much higher than the percentage Asian/Pacific Islander households reported as containing smokers (6.2%) from a U.S. National Study (2005 Pediatric Nutrition Surveillance), and also of all households of children under 5 years (all ethnicities) containing smokers (16.9%).

There were more households with one or more smokers (58.3%) among those earning the median income or below (<$576 biweekly) than those with a higher income (>$576 biweekly) 45.9%.

Table 12. Household tobacco chewers:

Number of tobacco chewers in household	Frequency (n= 411)	Percent (%)
0	225	54.7
1	89	21.7
2	47	11.4
3	24	5.8
4	11	2.7
5	15	3.7

* Note: tobacco chewing was often (but not always) associated with betel nut chewing

Over sixty percent (62.8%) of households receiving any kind of assistance had one or smoker in the household.

Food Security
Ninety percent of households said that they always had enough food to eat, while 10% of households said that sometimes there is not enough food to eat.

Medical care
Six percent (27/417) of the child participants utilized medical services in the last week due to illness. Of those 27, 11% had diarrhea, 19% had vomiting, 33% had fever and 66% had other reasons such as ear pain, asthma cough etc.

Vitamin A
See chapter 10 (p. 49) for details

Anemia
One percent (2/420) of children were reported to have been diagnosed or treated for anemia in the past 6 months.

Worms
Two percent (9/420) of children were reported to have received medicine to treat intestinal worms in the past 6 months.

Dengue fever
One child (1/419) was reported to have been diagnosed or treated for dengue fever in the past 6 months.

Dietary Supplements
Thirty-two percent (132/417) of children took some kind of dietary supplement. Among children less than 5 years old 34% took supplements, while fewer children in the 5 years and older age group took supplements (29%).

Multivitamins were among the most commonly taken supplements. A large number of children were taking dietary supplements imported from the Philippines e.g. Tynor Cherifer Syrup.

24.5% of breastfed children were receiving supplements compared to 7.2% of children who were never breastfed. Over seventy eight (78.5%) of overweight (BMI-for-age >95th percentile) children were not taking any kind of supplement. Fifty six percent (56%) of underweight children (BMI-for-age <5th percentile) were taking a supplement.

More children who had diets that were classified 'needs improvement' and 'poor' by the HEI index were taking supplements (58.3% and 37.9% respectively) than children whose diets were classified as 'good' (3.8%).

CHAPTER 3. PHYSICAL ACTIVITY RESULTS

Children 5-10 years old (≥5 yrs) were asked about the amount of physical activity they undertook in school and outside of school (n = 208).

Fifteen percent of children ages 5-10 years (n=31) reported having no physical activity while at school (Table 13). Sixty one percent (54.5%) reported doing physical activity at school 1-3 days a week, while 23% were active at school 4-5 days a week.

Table 13. Number of days children 5-10 years old did physical activity at school

Days of physical activity at school	Number of children	Percent %
None	31	15.5
1	52	26.0
2	43	21.5
3	14	7.0
4	4	2.0
5	42	21.0
Don't know	14	7.0
Total	200	-

Missing = 8

Seventy four percent (74%) of children 5-10 years did not engage in sports activities outside of school. Twenty one percent (21%) of children played sports outside of school at least once per week (Table 14).

Table 14. Number of days children 5-10 years old played sports outside of school

Days children played sport outside school	Number of children	Percent %
None	149	74.1
1	11	5.5
2	7	3.5
3	3	1.5
4	2	1.0
5	20	10.0
Don't know	9	4.5
Total	201	-

Missing = 7

Seventeen percent (17%) of children did not engage in any physical activity, whether at school or outside of school. Forty seven percent (47%) of children were active 1-3 days a week (Table 15). It is recommended that children and adolescents participate in at least 60 minutes of moderate intensity physical activity most days of the week, preferably daily (Dietary Guidelines for Americans 2005)[11].

Table 15. Number of days children 5-10 years old engaged in any physical activity (in school or outside school)

Days children engaged in physical activity	Number of children	Percent %
None	34	16.7
1	41	20.2
2	37	18.2
3	17	8.4
4	3	1.5
5	50	24.6
Don't know	21	10.3
Total	203	-

Missing =5

See also page 44 for physical activity related to BMI-for-age.

TV watching

Questions about TV watching were asked of all children (6 months – 10 years).
Caregivers were asked "how much TV (or video/DVD games or movies) does your child usually watch (play) on a typical school day/weekend day?" The question does not specifically elicit answers about computer use, which may therefore underestimate the time some children spend in sedentary pastimes.

Children (all ages) watched TV an average of 4 hours per day both during weekdays and weekend days (Tables 16 & 17).

TV watching on the weekend is a targeted opportunity for improvement as 28% of children watched five hours of TV per day on the weekend.

Table 16. Hours children spent watching TV during school days

Hours children watched TV on a school day	Number of children	Percent %*
None	94	23
1	72	17
2	49	12
3	47	11
4	28	7
5	45	11
Don't know	83	20
Total	418	-

Frequency Missing = 2

*percentages may not add to 100% due to rounding

Table 17. Hours children spent watching TV during weekends

Hours children watched TV on weekends	Number of children	Percent %
None	78	19
1	39	9
2	46	11
3	56	13
4	36	9
5	117	28
Don't know	46	11
Total	418	-

Frequency Missing = 2

CHAPTER 4. DIETARY RESULTS

4:1 NUTRIENT INTAKES

The previous report, in June 2006, presented results from a sub-sample of 61 children. The results here include the full sample of 420 children and may differ from the results presented previously. These results are more representative of the child population as a whole. No results were given previously for the under 1 year old population because the earlier sub-sample included only one individual.

Because only a single diet recall was completed for each child the analysis for individuals is not considered to be accurate for that individual. As a population estimate, the single 24 hour recalls can be considered an accurate estimate of the population intake.

For analytic purposes the children were divided into the following age categories (see Table 18), which correspond to the age ranges used for dietary recommendations.

Table 18: Age distribution for dietary analysis

Age	n
Children < 1 yr	25
Children ≥ 1yr - < 4 yr	131
Children ≥ 4yr - < 9 yr	199
Children ≥ 9yr	65
Total	**420**

The Dietary Guidelines for Americans[11] does not provide guidelines for children under 2 years of age.

The Dietary Reference Intakes[12] provide 2 sets of values that serve as goals for nutrient intake – Recommended Dietary Allowance (RDA) and Adequate Intakes (AI).

The **RDA** is the daily amount of a nutrient considered adequate to meet the needs of most healthy people. It is the population mean intake plus two standard deviations. If there is not enough evidence to determine an RDA, then an AI is set.

The **AI** is the average amount of a nutrient that a group of healthy people consumes. It is used when there is not enough evidence to provide an RDA.

24-hour recalls in adults have been shown to be accurate to with ±10% when estimating energy, protein and fat intakes[13].

Nutrient Intakes of children under 1 year of age

Children under one year of age consumed protein well above recommended levels (Table 19). Carbohydrate and energy intakes are low, likely reflecting under reporting typical of 24 hour recalls[14].

Two micronutrients of concern (iron and Vitamin A) appear to be adequate in this population. Although it is important to remember that adequacy at the population level does not preclude deficiency in individuals.

Table 19: Nutrient Intake of children < 1yr (n = 25)

Nutrient	Unit of measure	Mean	Standard deviation	Recommendations (daily)
ENERGY	Kcal/day	578	± 253	676-743 kcal/day ψ (range for active male or female children 7-12 months)
PROTEIN	g/day	21	± 13	7-12 mths 9g ψ ¶
CARBOHYDRATE	g/day	70	± 30	100g/day†
TOTAL FAT	g/day	24	± 13	7-11 mths : 30 ††
SATURATED FAT	g/day	8	± 7	*
VITAMIN A	µg/day	290	± 317	7-11 mths : 500††
VITAMIN E	mg/day	3.2	± 3.6	*
CALCIUM	mg/day	390	± 268	7-11 mths : 270††
FOLATE	µg/day	60.8	± 40.2	*
IRON	mg/day	7	± 5	7-12 mths : EAR 6.9mg†
SODIUM	mg/day	552	± 390	7-11 mths : 370††
ADDED SUGAR	teaspoons	2 (7%)	± 3	≤ 25% total energy ψ
Percent calories from carbohydrate	%	49	± 11	60% §
Percent calories from protein	%	14	± 6	*
Percent calories from fat	%	36	± 10	30% §
Percent calories from saturated fat	%	12	± 4	10% §

¶ Value based on reference weight for 7-12 month old male or female = 16lb. (7kg)
† Estimated Average Requirement (EAR)
†† Adequate Intake (AI)
* No values determined
ψ Dietary Reference Intake (DRI)
§ Daily Value (DV)

Nutrient Intakes of children 1–3 years of age

Children 1-3 years (>1 year - < 4 years) of age are also consuming large amounts of protein (Table 20). The consumption of large amounts of protein is consistent with results for Food Group servings of meat, poultry, & fish (see p.27), indicating that children of this age consumed more than the recommended number of servings of these items. The meat (protein) sources consumed are primarily processed and canned products, which also tend to also be high in salt (sodium) and

fat. This is reflected in the high average intakes for fat, saturated fat and sodium in this age group. There are no recommendations for 1-3 year olds for total fat and saturated fat intakes. The adult DRI is 30% of total daily calories from fat. The mean total fat intake for 1-3 year olds represents 34% of the mean total daily calories (energy).

Table 20: Nutrient Intake of children 1yr – 3 yr (≥ 1yr - < 4) yr (n=131)

Nutrient	Unit of measure	Mean	Standard deviation	Recommendations (daily)
ENERGY	Kcal	1203	± 508	992-1,046 kcal/day ψ (range for moderately active male or female children 1- 3yrs)
PROTEIN	g/day	46	±24	11g/day ψ ¶
CARBOHYDRATE	g/day	150	± 67	100g/day †
TOTAL FAT	g/day	46	± 24	30-40g/day ¥
SATURATED FAT	g/day	16	± 10	*
VITAMIN A	µg/day	502	± 454	210 µg/day †
VITAMIN E	mg/day	3.6	±2.5	5mg/day †
CALCIUM	mg/day	537	± 443	500 mg/day ††
FOLATE	µg/day	154	±110	120 µg/day †
IRON	mg/day	7	± 4	3.0 mg/day †
SODIUM	mg/day	1661	± 998	1000 mg/day ††
ADDED SUGAR	teaspoons	7 (12%)	± 6	≤ 25% total energy ψ
Percent calories from carbohydrate	%	50	± 10	60% §
Percent calories from proteins	%	15	± 4	10% §
Percent calories from fat	%	34	± 9	30% §
Percent calories from saturated fat	%	12	± 5	10% §

¶ Value based on reference weight for 1-3 year old male or female = 29lb. (13kg)
† Estimated Average Requirement (EAR)
†† Adequate Intake (AI)
* No values determined
ψ Dietary Reference Intake (DRI)
§ Daily Value (DV)
¥ Acceptable Macronutrient Distribution Range (AMDR)

Of potential concern is the low intake level for calcium. Calcium is an important nutrient in bone formation particularly in growing children. Low intakes during childhood can lead to problems of osteoporosis in later life. In other cultures, milk is an important source of calcium for children. Many Pacific Island cultures do not have a tradition of dairy product consumption. Traditionally the consumption of foods such as small fish (consumed whole – with bones) may have contributed to calcium intakes in the population. In industrialized economies there has been a shift from milk consumption to the consumption of sodas among children, which has also contributed to decreased calcium intakes. Either or both of these factors could be influences on the levels of calcium intake among children in CNMI.

Nutrient Intakes of children 4 years – 8 years of age

The results for the 4 yr - 8 yr age group (≥ 4yr - < 9 yr) also indicate high protein intakes, along with even higher fat and salt (sodium) intakes (Table 21). The average protein intake in this age

group is over FOUR times higher than the recommended level (intake of 61g vs. recommended 15g). The fat intake is almost double the acceptable macronutrient range (AMDR) and sodium intake above the recommended upper limit (UL). The low energy intake likely reflects under reporting that is typical of 24 hour recalls.

Table 21: Nutrient Intake of children 4 yr - 8 yr (≥ 4yr - < 9 yr) n=199

Nutrient	Unit of measure	Mean	Standard deviation	Recommendations (daily)
ENERGY	Kcal	1626	± 691	1642-1742 kcal/day ψ (range for moderately active male or female children 3-8 yrs)
PROTEIN	g/day	63	± 31	15g/day ψ ¶
CARBOHYDRATE	g/day	199	± 96	100g/day †
TOTAL FAT	g/day	63	± 36	25-35 g/day ¥
SATURATED FAT	g/day	22	± 14	*
VITAMIN A	µg/day	556	± 785	275 µg/day †
VITAMIN E	mg/day	4.7	± 3.7	6 mg/day †
CALCIUM	mg/day	400	± 315	800 mg/day ††
FOLATE	µg/day	207	± 136	160 µg/day †
IRON	mg/day	9	± 5	4.1 mg/day †
SODIUM	mg/day	2505	± 1441	1200 mg/day ††
ADDED SUGAR	teaspoons	11 (14%)	± 10	≤ 25% total energy ψ
Percent calories from carbohydrate	%	49	± 12	60% §
Percent calories from protein	%	16	± 5	10% §
Percent calories from fat	%	35	± 10	30% §
Percent calories from saturated fat	%	12	± 4	10% §

¶ Value based on reference weight for 4-8 year old male or female = 48lb. (22kg)
* No values determined
† Estimated Average Requirement (EAR)
¥ Acceptable Macronutrient Distribution Range (AMDR)
§ Daily Value (DV)
†† Average Intake (AI)
ψ Dietary Reference Intake (DRI)

Tolerable upper intake limits (UL) indicate the maximum daily amount of a nutrient that appears safe for most healthy people. Beyond this level there is an increased risk of adverse health effects.

Acceptable macronutrient range (AMDR) indicates the ranges of intakes for the nutrients that provide adequate energy and nutrients and reduce the risk of chronic diseases. Exceeding this range may increase the risk of chronic diseases.

This age group also shows very low intakes of calcium, at less than 1/3rd of the recommended level. Low calcium intakes during periods of active growth, especially if paired with physical inactivity, may compromise the development of peak bone mass. Optimal peak bone mass is considered the best protection against adolescent fractures and adult osteoporosis.

Nutrient Intakes of children over 9 years of age

The results for the 9 year olds and over age group also indicate high protein intake, along with even higher salt (sodium) intake (Table 22). The average protein intake in this age group is double the recommended level (intake of 72g vs. recommended 27-28g). Because this age group includes rapidly growing and maturing adolescents, their requirement for protein increases substantially. Thus, although the protein intake of this age group has increased, the discrepancy between actual and recommended has decreased (actual is double recommended vs. four times the recommended in the younger age group). The sodium intake of this group is almost double the upper limit (UL), increasing the risk of chronic diseases.

This age group also shows very low intakes of calcium, one third of the recommended intake level.

Table 22: Nutrient Intake of children 9 yrs and over (≥ 9yr) (n=65)

Nutrient	Unit of measure	Mean	Standard deviation	Recommendations (daily)
ENERGY	Kcal/day	1904	± 774	2071-2279 kcal ψ (range for moderately active male or female children 9-13 yr)
PROTEIN	g/day	72	± 31	9-10 yrs male: 27g ψ ¶ 9-10 yrs female: 28g ψ ¶
CARBOHYDRATE	g/day	241	± 108	100g/day†
TOTAL FAT	g/day	71	± 39	25-35 g/day ¥
SATURATED FAT	g/day	25	± 17	*
VITAMIN A	µg/day	555	± 683	445µg/day (male) † 420 µg/day (female) †
VITAMIN E	mg/day	4.8	± 3.0	9mg/day †
CALCIUM	mg/day	447	± 332	1300 mg/day ††
FOLATE	µg/day	234	±160	250 µg/day †
IRON	mg/day	11	± 5	5.9 mg/day (male) † 5.7 mg/day (female) †
SODIUM	mg/day	2921	± 1544	1500 mg/day ††
ADDED SUGAR	teaspoons	13 (14%)	± 12	≤ 25% total energy ψ
Percent calories from carbohydrate	%	51	± 10	60§
Percent calories from proteins	%	16	± 4	10§
Percent calories from fat	%	33	± 9	30§
Percent calories from saturated fat	%	11	± 4	10§

¶ Value based on reference weight for 9-13 year old male or female = 8 8lb. (40 kg)

* No values determined

† Estimated Average Requirement (EAR)

¥ Acceptable Macronutrient Distribution Range (AMDR)

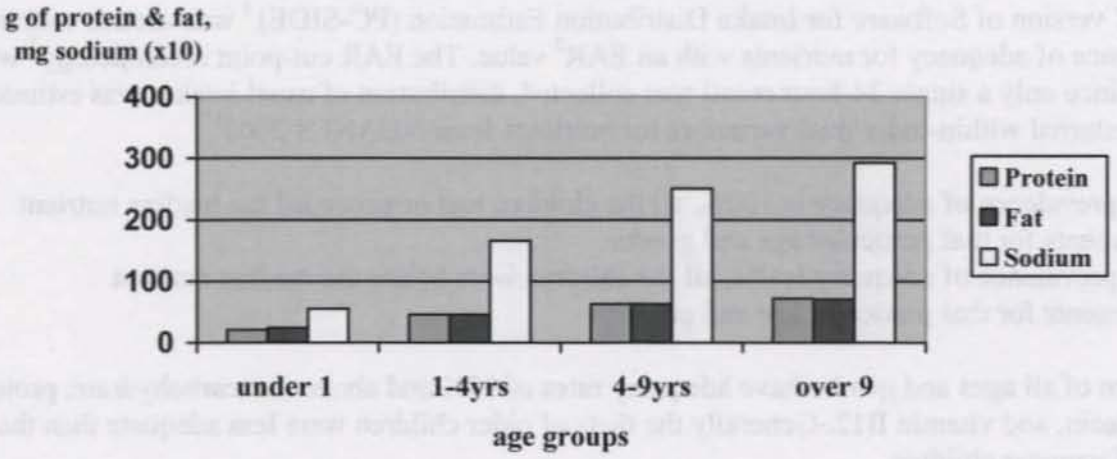
§ Daily Value (DV)

†† Average Intake (AI)

ψ Dietary Reference Intake (DRI)

For all age groups the increased consumption of protein is closely associated with increases in fat and sodium (see Figure 4.). This is indicative of the high intake of processed meats which contain high protein, fat and sodium levels.

Figure 4. Increasing protein, fat and sodium intakes by age

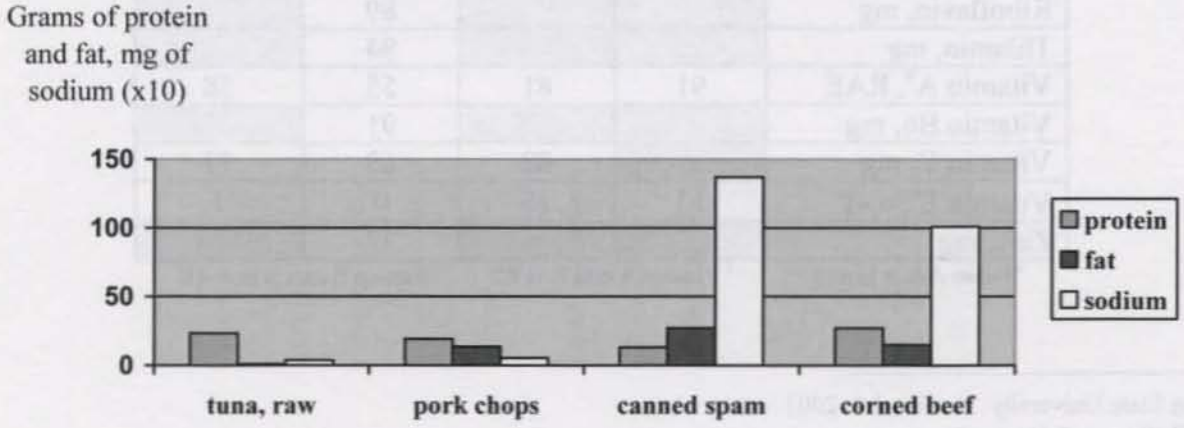


A more traditional diet with fresh fish as a protein source, or fresh meat with no added fat or sodium, would not result in such a large increase in fat and sodium intakes with the increased protein intake (see Table 23 & Figure 5).

Table 23. Protein, fat and sodium content of meat sources (per 100g)
(USDA National Nutrient Database for Standard Reference, Release 19)

Meat source (per 100g)	Protein (g)	Total fat (g)	Sodium (mg)
Tuna, raw	23.4	1	37
Pork chops, raw, sirloin	26.5	8.4	46
Canned Spam	13.2	27.2	1369
Corned beef, canned	27.1	14.9	1006

Figure 5. Protein, fat and sodium content of meat sources (per 100g)
(USDA National Nutrient Database for Standard Reference, Release 19)



DIETARY ADEQUACY

Although the average intakes for many of the micronutrients (vitamins and minerals) appear to be adequate for the population, further analysis indicates that a portion of the population (individuals) had intakes below the recommended levels on the day of the survey.

The PC version of Software for Intake Distribution Estimation (PC-SIDE) [1] was used to estimate prevalence of adequacy for nutrients with an EAR[2] value. The EAR cut-point methodology[3] was used. Since only a single 24-hour recall was collected, distribution of usual intakes was estimated using external within-individual variances for nutrients from NHANES 2002[15].

Where prevalence of adequacy is 100%, all the children met or exceeded the median nutrient requirements for that particular age and gender.
Where prevalence of adequacy is 0%, all the children were below the median nutrient requirements for that particular age and gender.

Children of all ages and gender have adequacy rates of 95% and above for: carbohydrate, protein, iron, niacin, and vitamin B12. Generally the diets of older children were less adequate than the diets of younger children.

Table 24 shows the prevalence of adequacy for a range of other nutrients by age and gender. Shading indicates that the prevalence of adequacy was 95% or more for that age, gender and nutrient.

Table 24. Prevalence of adequacy of nutrient intake among children in CNMI.

	1-3 years *n=131* *(%)*	4-8 years *n=199* *(%)*	9-10 years, females *n=31* *(%)*	9-10 years, males *n=34* *(%)*
Folate[a], DFE	66	73	32	42
Magnesium, mg		88	18	55
Phosphorus, mg	94		11	36
Riboflavin, mg			89	
Thiamin, mg			94	
Vitamin A[b], RAE	91	81	55	58
Vitamin B6, mg			91	
Vitamin C, mg		88	63	77
Vitamin E[c], ∝-T	15	16	0	1
Zinc, mg			77	

[a] Folate data is in mcg [b] Vitamin A data is in RE [c] Vitamin E data is in ∝-TE

[1] Iowa State University. Version 1.0, 2003.
[2] EAR, Estimated Average Requirements
[3] Dietary Reference Intakes. Applications in Dietary Assessment. Institiute of Medicine, 2003.

This analysis indicates that girls 9-10 years old are most at risk of nutrient inadequacy, with some rates of prevalence of adequacy as low as 0% (vitamin E), 11% for phosphorus, 18% (magnesium) and 32% for folate.

Across all age groups vitamin E intakes were low with only 15-16% of the younger children receiving adequate vitamin E and the 9-10 year olds receiving little (1%) or no (0%) vitamin E.

Vitamin E rich foods include green leafy vegetables, carrots, nuts, olive oil, corn oil, canola oil, safflower oil, sunflower oil, wheat germ, whole grains, and margarines made from plant oils. Meats, fruits, and milk have little vitamin E.

Healthy People 2010 Objectives for Dietary Intake

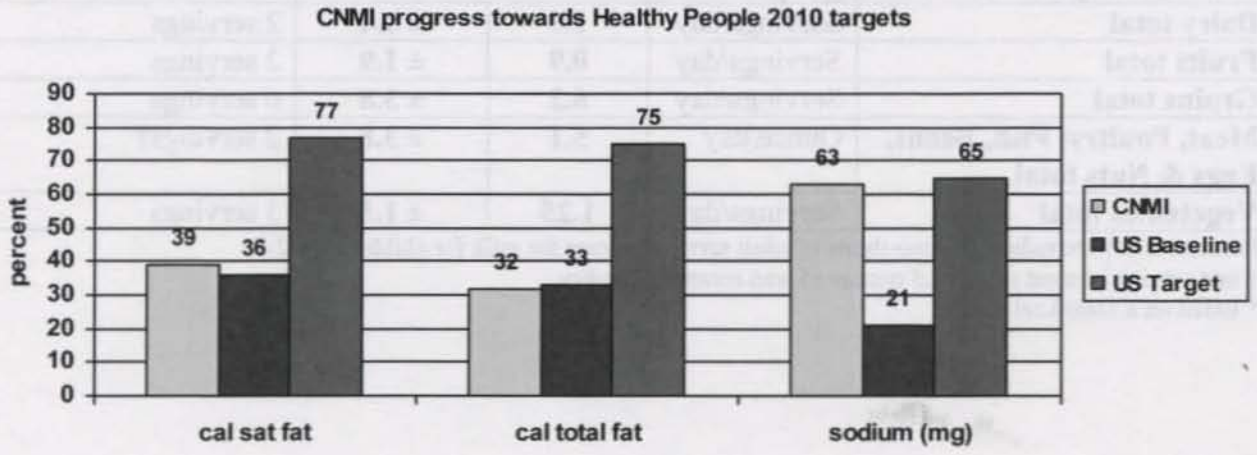
Table 25 and Figure 6 show how CNMI compares to the U.S. baseline and Healthy People 2010 targets for dietary intake for children. The CNMI intake is comparable to baseline US levels, although is closer to targets than the US in sodium levels.

Table 25. CNMI and the Healthy People 2010 Objectives for Dietary Intake (Percent Meeting Level)

Objective	Objective Level	CNMI	Baseline (U.S.)	Target (U.S.)
% calories from saturated fat	less than 10%	39%	36%	**75%**
% calories from total fat	less or equal to 30%	32%	33%	**75%**
Sodium *	less or equal to 2400 mg	63%	21%	**65%**

* (from foods, dietary supplements, tap water, and salt use at the table)

Figure 6. CNMI progress towards Healthy People 2010 targets for children's diets



4:2 FOOD GROUPS

Because the software used to analyze the diets in this study uses the 1996 Food Guide Pyramid[16] (FGP) servings, the recommendations below for Food Group Intakes are also based on the 1996 FGP and may therefore differ from the current Dietary Guidelines for Americans issued by the US Department of Agriculture[11].

Discretionary fat is defined as fat in excess of the small amounts of fat that people would consume if their food choices were among the lowest in fat in each food group

Food Group Intakes of children under 2 year of age

No recommendations for food group intake or discretionary fat exist for children under 2 years of age (Table 26).

Table 26. Food Group Intake of children < 2yr (n = 71)

Food Group	Unit	Mean	Standard deviation	Recommendations (daily)
Discretionary fat	g/day	**21.9**	**± 20.8**	N/A
Dairy total	Servings/day	**1.0**	**± 1.4**	N/A
Fruits total	Servings/day	**0.5**	**± 1.1**	N/A
Grains total	Servings/day	**2.8**	**± 2.2**	N/A
Meat, Poultry, Fish, Beans, Eggs & Nuts total	Ounce/day	**2.6**	**± 2.5**	N/A
Vegetables total	Servings/day	**0.4**	**± 0.8**	N/A

Food Group Intakes of children 2-3 years of age

Table 27. Food Group Intake of children 2yr – 3 yrs (≥ 2yr - < 4 yrs) (n=85)

Food Group	Unit	Mean	Standard deviation	Recommendations (daily) *
Discretionary fat	g/day	**52.2**	**± 29.7**	Choose lower fat options
Dairy total	Servings/day	**1.3**	**± 1.4**	2 servings
Fruits total	Servings/day	**0.9**	**± 1.9**	2 servings
Grains total	Servings/day	**6.2**	**± 3.8**	6 servings
Meat, Poultry, Fish, Beans, Eggs & Nuts total	Ounce/day	**5.1**	**± 3.8**	2 servings†
Vegetables total	Servings/day	**1.25**	**± 1.5**	3 servings

Portion sizes were reduced to two-thirds of adult servings except for milk for children age 2-3.
† one serving of meat equals 2.5 ounces of lean meat/fish/poultry
* based on a 1600 kcal diet

Results for this age group (Table 27) are consistent with the macro/micronutrient dietary analysis – higher than recommended protein intake in the meats & other protein food group (5.1 servings consumed vs. 2 servings recommended).

The low dairy food group intake is reflected in the low calcium intakes previously reported.

The children's intake of fruits and vegetables are also well below recommended intakes, with children consuming less than one serving of fruit daily, compared to the recommended two servings and only one of the three recommended vegetable servings. This trend continues as the children get older.

Food Group Intakes of children 4-6 years of age

Table 28. Food Group Intake of children 4 yr - 6 yr (≥ 4yr - <7 yr) (n=128)

Food Group	Unit	Mean	Standard deviation	Recommendations (daily)
Discretionary fat	g/day	**45**	**± 27**	Choose lower fat options
Dairy total	Servings/day	**0.8**	**± 1.0**	2 servings
Fruits total	Servings/day	**0.6**	**± 1.7**	2.3 servings
Grains total	Servings/day	**5.2**	**± 2.5**	7 servings
Meat, Poultry, Fish, Beans, Eggs & Nuts total	Ounce/day	**5.5**	**± 2.9**	2.1 servings†
Vegetables total	Servings/day	**1.0**	**± 1.2**	3.3 servings

* for children 4-6 years, based on a recommended energy intake of 1800 kcal

† one serving of meat equals 2.5 ounces of lean meat/fish/poultry

Again the high meat and other protein servings intake confirms the previous analysis showing a high protein intake (5.5 servings actual vs. 2.1 servings recommended) (Table 28).

Dairy, fruits and vegetable servings are all well below recommended levels. The intake of 0.8 servings of dairy is below the recommended 2 servings. Likewise the fruit and vegetable intakes of 0.6 and 1.0 respectively are well below the recommended 2.3 and 3.3 recommended serving

Food Group Intakes of children over 7 years of age

Table 29. Food Group Intake of children 7 yrs and over (≥ 7yr) (n=136)

Food Group	Unit	Mean	Standard deviation	Recommendations (daily)
Discretionary fat	g/day	**49**	**± 35**	Choose lower fat options
Dairy total	Servings/day	**0.7**	**± 0.8**	2 servings
Fruits total	Servings/day	**0.9**	**± 1.9**	2.7 servings
Grains total	Servings/day	**7.1**	**± 4.3**	7.8 servings
Meat, Poultry, Fish total	Ounce/day	**6.4**	**± 4.0**	2.3 servings†
Vegetables total	Servings/day	**1.0**	**± 1.3**	3.7 servings

* for children 7-10 years, based on a recommended energy intake of 2000 kcal
† one serving of meat equals 2.5 ounces of lean meat/fish/poultry

Again the high number of meat and other protein servings intake confirms the previous analysis showing a high protein intake (6.4 servings actual vs. 2.3 servings recommended).

Dairy, fruits and vegetable servings are all well below recommended levels. The intake of 0.7 servings of dairy is below the recommended 2 servings. Likewise the fruit and vegetable intakes of 0.9 and 1.0 respectively are well below the recommended 2.7 and 3.7 recommended serving (Table 29).

While the results for meat and dairy servings reinforce the conclusions of the nutrient analysis, the Food Group Intake analysis points to an additional indicator for improving the health of CNMI children. Making efforts to increase consumption of fruits, vegetables and dairy foods can be expected to provide both short-term and long term health benefits, by providing the important micronutrients children need for healthy growth and by protecting against some of the chronic diseases in later life.

Fruits and vegetables offer an array of valuable vitamins and minerals, so that eating plenty of fruits and vegetables protects against deficiencies and diseases. Increasing the consumption of fruits and vegetables, is a practical strategy for consumers to optimize their health and to reduce the risk of chronic diseases. Greater consumption of fruits and vegetables is associated with a reduced risk of stroke and perhaps other cardio-vascular diseases, with a reduced risk of cancers in certain sites (oral cavity and pharynx, larynx, lung, esophagus, stomach, and colon-rectum), and with a reduced risk of type 2 diabetes (vegetables more than fruit). Moreover, increased consumption of fruits and vegetables may be a useful component of programs designed to achieve and sustain weight loss.

Low fat dairy foods provide calcium, magnesium, phosphorus and other important minerals for bone health and may help control body fat[17].

4:3 HEALTHY EATING INDEX

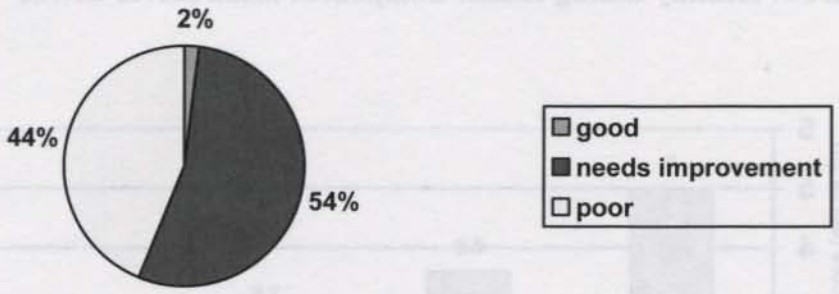
To assess and monitor the dietary status of Americans, the U.S. Department of Agriculture's Center for Nutrition Policy and Promotion (CNPP) developed the Healthy Eating Index (HEI)[18] The HEI consists of 10 components, each representing different aspects of a healthful diet: Components 1-5 measure the degree to which a person's diet conforms to serving recommendations for the five major food groups of the Food Guide Pyramid (grains, vegetables, fruits, milk, and meat); Components 6 and 7 measure total fat and saturated fat consumption, respectively, as a percentage of total food energy intake; Components 8 and 9 measure total cholesterol and sodium intake; and Component 10 examines variety in a person's diet. The original HEI was created by the U.S. Department of Agriculture in 1995. The HEI was revised in 2006 to reflect the 2005 Dietary Guidelines for Americans. However, the analysis of the CNMI diets was done using the older 1995 HEI score, as updated software used to analyze the diets with the 2006 HEI was not yet available. For more details on HEI criteria see Appendix 2.

The maximum overall score for the 10 components combined is 100. An HEI score over 80 implies a "good" diet, an HEI score between 51 and 80 implies a diet that "needs improvement," and an HEI score less than 51 implies a "poor" diet. The Healthy Eating Index measures overall diet quality but does not necessarily reflect over consumption.

Results from analysis of diets of children in CNMI between 2 years and 10 years old shows that, 2% of the children had diets classified as "Good" (HEI score greater than 80), 54% had diets that were classified as "Needs Improvement" (HEI score between 51 & 80) and 44% of the children had diets that were classified as "Poor" (HEI score less than 51) (Figure 7).

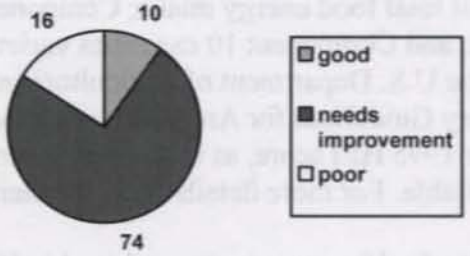
The mean overall (total) HEI score was 56.4 and the median HEI score was 57.6, which indicates that on average, diets of children in the CNMI need improvement, and many diets are poor.

Figure. 7 Healthy Eating Index Rating for CNMI Children, 2005



The following is the Healthy Eating Index rating for the U.S. population in 1999-2000 (Figure 8). Compared to children in the CNMI, more people in U.S. are eating a 'good' diet, a larger proportion of the U.S. population has diets that 'need improvement' but fewer have a 'poor' diet compared to children in the CNMI.

Figure. 8: Healthy Eating Index rating, U.S. population, 1999-2000
Taken from The Healthy Eating Index: 1999-2000 CNPP-12

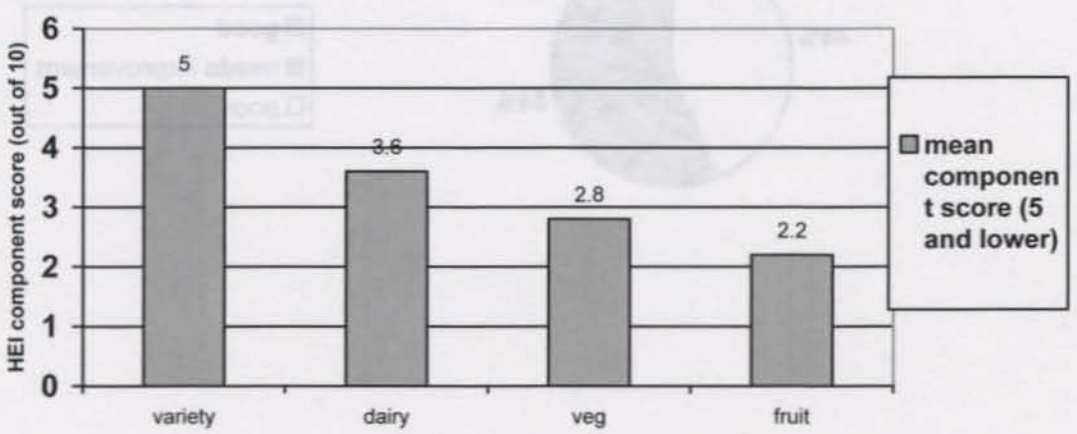


Each component of the Healthy Eating Index has a maximum score of 10 and a minimum score of zero. High component scores indicate intakes close to recommended ranges or amounts; low component scores indicate less compliance with recommended ranges or amounts. Those components with scores below 5 ('poor') are shown in Figure 9 below.

The fruit component of the HEI had the lowest mean score for CNMI children (2.2); the vegetable score the second lowest (2.8) and the dairy component the third lowest (3.6). This confirms the previous food group analysis indicating that intakes of these foods were below recommended levels.

The percentage of children scoring an ideal 10 for fruit and vegetable components was a low 12% and 8% respectively.

Figure 9. Healthy Eating Index: Component mean scores CNMI



Age and HEI score

Children in CNMI age 2-4 years had the highest mean HEI score (60.5), or best diet, among all children surveyed (Table 30).

Table 30. Mean overall HEI score by age group

Age	Mean HEI Score	Min-Max range	Median HEI score
2-3.9 years	60.5	29.5 – 84.8	60.8
4-8.9 years	56.8	21.2 – 91.5	56.4
9 years and older	57.9	23.4- 82.9	58.3

Children age 2-4 years also scored higher than other age groups on a number of HEI component scores (Table 31):

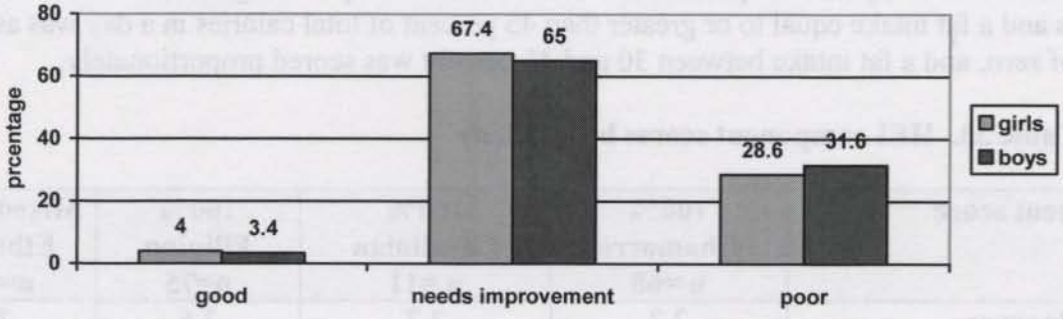
Table 31. Mean component HEI scores by age

Age	Dairy score	Vegetable score	Fruit score
2 - 3.9 years	4.9	3.6	2.7
4 - 8.9 years	3.3	2.7	1.8
9 years and older	3.1	2.5	2.3

Gender and HEI score

There was little difference by gender in HEI score (Figure 10). Only 3- 4% of girls and boys had an HEI score in the 'good' range. 65% -67% of children needed improvement and 29-30% had poor HEI scores (29-32%) (Figure 10).

Figure 10. HEI score and category by gender



Average HEI scores for boys and girls (all ages) were similar – 56.3 (girls) and 56.5 (boys), although there were some differences in the scores for individual HEI components.

Fruit component scores for both groups were the lowest among all components. Boys scored about one unit higher on the component grain score than did girls – 7.8 vs. 6.7.

Socio-economics and HEI score

HEI scores of those receiving economic assistance were slightly lower (56) than those not receiving economic assistance programs (58). However, this difference is not statistically significant.

A similar result is seen for income levels, with those earning over $577 biweekly showing slightly higher scores (95) than those earning less than $577 biweekly (55):

Ethnicity

When HEI scores were calculated for those of 100% Carolinian, Chamorro, and Filipino ancestry vs. those of mixed or other ethnicity, the only group apparently different in total HEI score was the Carolinian group that had an average score of 48.36 compared to score of 55.6 – 56.9 for the other groups (Table 32). However, this difference is not statistically significant.

Table 32. HEI score by ethnicity

	100% Chamorro n =68	100% Carolinian n =11	100% Filipino n=75	Mixed/Other Ethnicity n=266
Total HEI score	56.9	48.4	55.6	56.9

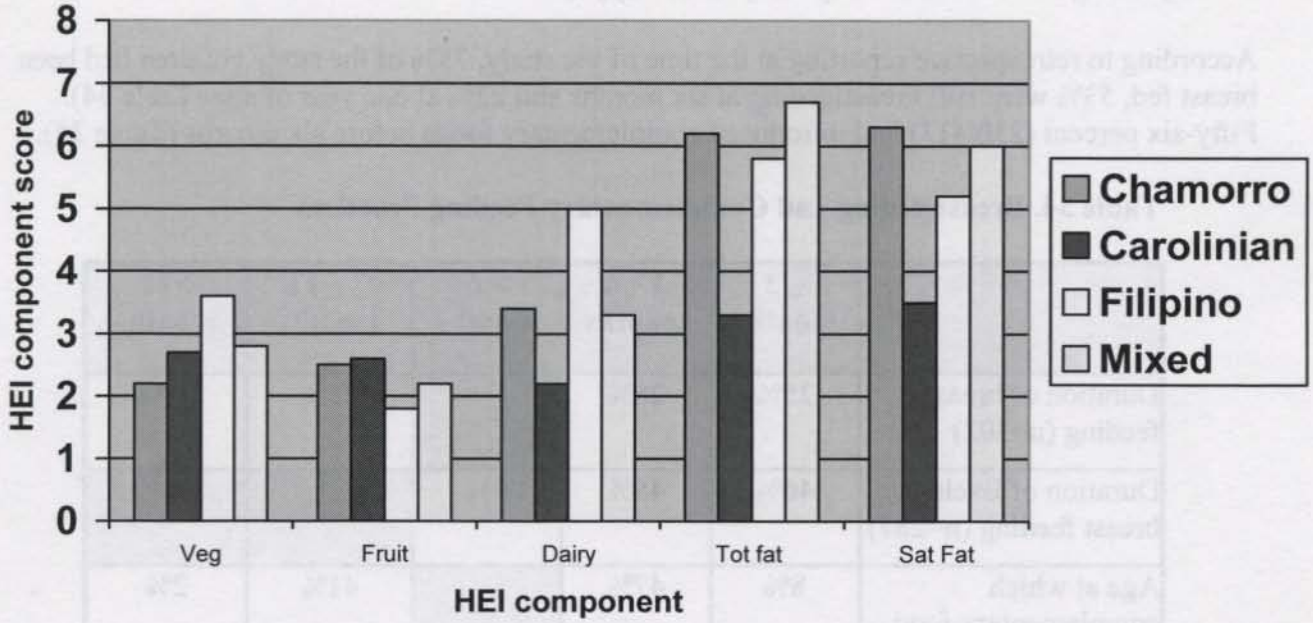
Fruit and vegetable component scores were the lowest of all HEI component scores across all ethnicities, with Filipinos showing slightly higher vegetable and dairy scores and slightly lower fruit scores compared to other ethnicities.

Carolinians had lower HEI scores for total fat and saturated fat (Table 33 and Figure 11). Still their fat intakes came close to exceeding the recommended daily allowance for fat, since a total fat intake of less than or equal to 30 percent of total calories in a day is assigned a maximum score of 10 points and a fat intake equal to or greater than 45 percent of total calories in a day was assigned a score of zero, and a fat intake between 30 and 45 percent was scored proportionately.

Table 33. HEI component scores by ethnicity

Component score	100% Chamorro n =68	100% Carolinian n =11	100% Filipino n=75	Mixed/Other Ethnicity n=266
Vegetable score	2.2	2.7	3.6	2.8
Fruit score	2.5	2.6	1.8	2.2
Dairy score	3.4	2.2	5.0	3.3
Total Fat	6.2	3.3	5.8	6.7
Saturated Fat	6.3	3.5	5.2	6.0

Figure 11. Selected HEI component scores by ethnicity



CHAPTER 5. INFANT FEEDING PRACTICES

Breast feeding and introduction of complementary food

According to retrospective reporting at the time of the study, 75% of the study children had been breast fed, 53% were still breastfeeding at six months and 22% at one year of age (Table 34). Fifty-six percent (230/413) had introduced complementary foods before six months (Table 35).

Table 34. Breastfeeding and Complementary Feeding Practices

	≤ 2 months	3 – 6 months	> 6 months	7 – 12 months	>12 months
Duration of breast feeding (n=302)	25%	28%		25%	22%
Duration of Exclusive breast feeding (n=287)	46%	45%	9%		
Age at which complementary food was introduced (n=413)	8%	47%		41%	2%

Table 35: Children in CNMI who meet child feeding recommendations (WHO and AAP)

Breastfeeding Guideline (WHO & AAP)	CNMI%
Breastfeed (at any time/duration)	73%
Exclusive breast feeding until 6 months	6%
Continue Breast feeding until at least one year	16%
Introduce complementary food > 6mo	44%

Breast feeding rates found from this survey are higher than those reported by the Maternal and Child Health Program for Breastfeeding Rate at Hospital Discharge for 2004 (67%)[19]. The trend in recent years, as reported by MCH, is a decline in breastfeeding rates from 95% in 2001. This might be due to the changing demographics of the CNMI population, including the high number of foreign workers.

Breastfeeding was negatively associated with child BMI (p=0.043) (Table 36) (i.e. protective against higher weight) controlling for birth weight and years of mother's education[20].

Table 36: Variables associated with Body Mass Index

Multiple Regression (n=370*)

	Slope	S.E	P
Intercept	13.317	1.464	-
Age, yr	0.380	0.063	<.0001
Sex, 1=male 0=female	0.739	0.357	0.039
Ever Breastfed, 1=yes 0=no	-0.799	0.406	0.050
Birth weight, kg	0.124	0.068	0.068
Mother education, yr	0.082	0.078	0.295

R^2 = 10% *Multiple regression model includes only the cases that have values for all the variables. Birth weight missing n=42, Mothers education missing variable n = 7, height n=4 missing

CHAPTER 6: HEIGHT AND WEIGHT

Birth weight (lbs)

The mean reported birth weight of children was 7.0 ± 1.1 lbs (Table 76). Low birth weight is defined as a weight of less than 5 pounds, 8 ounces (2,500 grams) at birth. Very low birth weight is a weight of less than 3 pounds, 5 ounces (1,500 grams). LBW infants die at rates of up to 40 times those of infants of normal weight, and LBW infants are many times more likely to end up with long-term handicapping conditions[21]. Recent evidence suggests that both low birth weight, as well as high birth weight babies, are at increased risk of later overweight and chronic disease [22 23]. Birth weights were normally distributed in the CNMI population.

Table 37. Reported Birth weight by category [12]

Birth weight (lbs)	n	%
< 5.5	26	7
5.5 - 8.8	337	89
8.8	14	4

(83 missing data)

Mid Upper Arm Circumference (MUAC)

A mid upper arm circumference below 12.5cm on a child below 5 years of age, is used as an indicator for under nutrition. Only 2% of the population was below 12.5cm, a proportion considered within an expected normal population distribution (Table 38).

Table 38. Mid Upper Arm Circumference by WHO cut point

MUAC	n	%
< 12.5 cm	5	2
≥ 12.5 cm	207	98

(Medecins Sans Frontieres. Nutrition Guidelines. 1st edition 1995)[24]

Table 39: Mean Weight, height and weight-for-length percentiles for children under 2 years old.

	N	Mean	S.D.
Length-for-age	70	39.9	± 25.5
Weight-for-age	71	48.7	± 31.9
Weight-for-length	70	67.6	± 27.9

Based on data in tables 39 & 40, we see a somewhat higher than expected prevalence of stunting (<5th percentile length-for-age) at 10%. This would be worthy of exploration and may relate to short gestation, low pregnancy weight gain or teenage pregnancy. The low weight for age is due to the low length-for-age. A high weight-for-length is evident at 15% (>95th percentile) and a Z score >2 of 11%. Causes of this can be high pregnancy weight gain, high pre-pregnant weight and/or gestational diabetes.

A child with a Weight-for-Length under the 5th percentile is considered underweight.

Table 40: Weight-for-Age, Height-for-Age and Weight-for-Length Percentiles* and Z- scores for children under 2 years old.

	Length-for-age	Weight-for-age	Weight-for-length
< 5th	**7(10%)**	8 (11%)	2 (3%)
5th - 85th	59 (83%)	52 (73%)	44 (62%)
> 85th - 95th	2 (3%)	4 (6%)	14 (20%)
> 95th	3 (4%)	7 (9%)	11 (15%)
Z score < -2	3 (4%)	6 (8%)	2 (3%)
Z score ≥ -2 to ≤ 2	67 (94%)	60 (85%)	61 (86%)
Z score > 2	1 (1%)	5 (7%)	8 (11%)

*based on CDC (2000) reference data[29]

BMI for Age Percentile (2 yr and above)

Using CDC cut off points, 34% of the children in the survey were found to be at risk for overweight (>85th - 95th percentile) or overweight (>95th percentile). Five percent of children were underweight (< 5th percentile). (Table 41).

Table 41. BMI for Age Percentile (2 yrs and above)

	n	%
< 5th percentile underweight	16	5
5th – 85th normal weight	214	62
85th – 95th at risk of overweight	51	15
> 95th overweight	65	19

based on CDC (2000) reference data[29]

BMI status by IOTF cutoffs

In the United States, the 85th and 95th centiles of body mass index for age and sex based on nationally representative survey data have been recommended as cut off points to identify overweight and obesity [25]. A workshop organized by the International Obesity Task Force (IOTF) proposed that the adult cut off points be linked to body mass index centiles for children to provide child cut off points [26,27,28]. These recommendations use the same cut off points for body mass index in childhood, based on international data and linked to the widely accepted adult cut off points of a body mass index of 25 and 30 kg/m^2. (Figures 12 & 13)

Figure 12: Boys BMI status by IOTF cutoffs[27] (n=171)

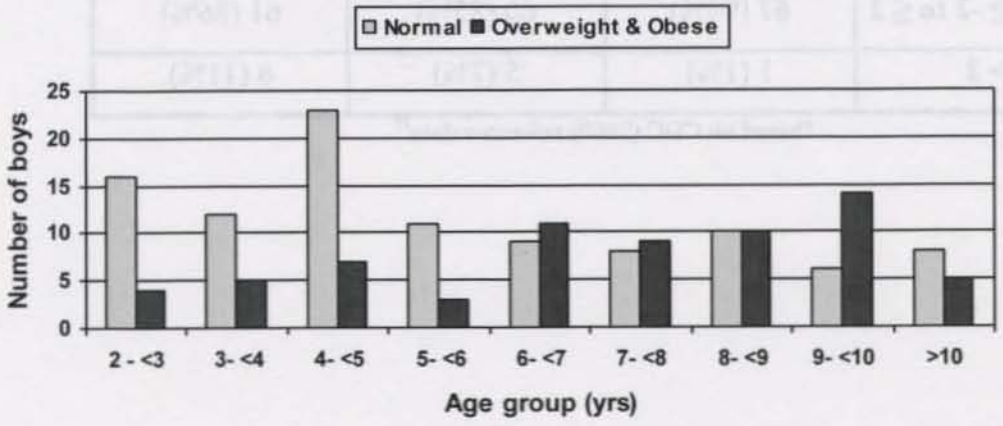


Figure 13: Girls BMI status by IOTF cutoff[27] (n=164)

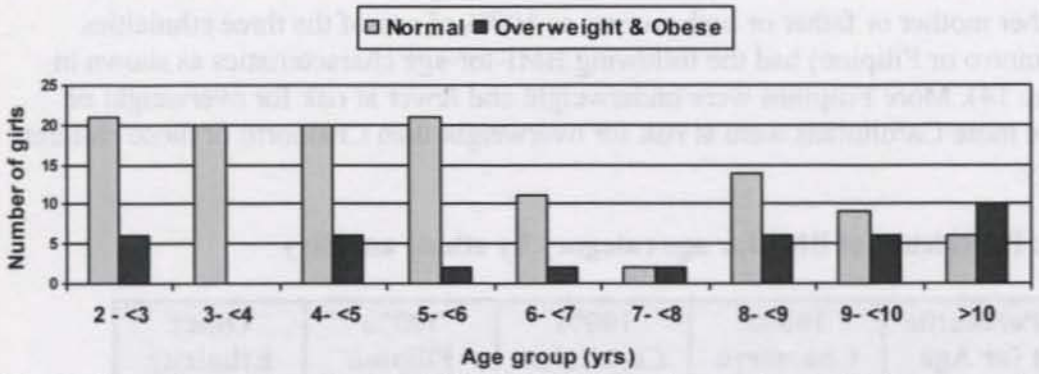


Table 42 shows how using the two different classifications and cutoffs for overweight and obesity, result in slightly different percentages of children assigned to each group.

The IOTF cut offs result in fewer children being classified as obese, but a greater percentage classified as overweight. Overall the CDC cutoffs result in a total of 34% of children being classified as overweight or obese and the IOTF cutoffs a total of 32% of children as overweight or obese. Both classification systems show increasing rates of overweight and obesity with age.

Table 42: Summary of BMI according to both CDC and WHO-IOTF cutoffs

	BMI for age based on CDC cutoffs	BMI for age based on IOTF cutoffs
Overweight	15%	18%
Obese	19%	14%

The U.S. National data provides for comparisons with the Asian Pacific Islander populations in the U.S. and another reference point for making public health policy decisions.

U.S. National data that utilize the CDC cut-offs, show that the percentage of Asian Pacific Islander children ages 2-5 years who have BMI-for-age >95th is 12.3% (overweight), and 85th-<95th percentile of 14.1% (at risk of overweight). None of the children 2-5 years of age were in the in CNMI BMI-for-age >95th percentile category (overweight), but 4.3% were at risk of overweight (85th-<95th percentile)

These figures indicate that the problems of overweight in the CNMI are developing later in childhood. Fewer young children (under 5's) are overweight, but as a child grows towards puberty (5-10 years) there is a greater risk of excess weight gain resulting in overweight and obesity. And although the use of the IOTF cut-offs result in slightly different figures, a similar trend of increased occurrence of overweight in children 5 years and older can also be seen. This suggests that the older age group may benefit from messages and programs which target environment and behavioral therapy to help maintain healthy weight, eating patterns and physical activity choices.

BMI for Age by Ethnicity

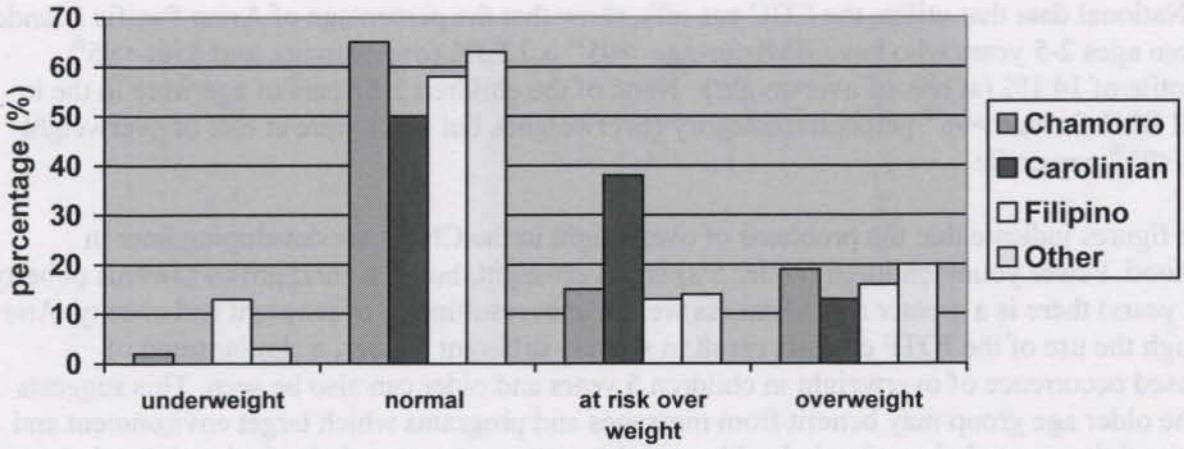
Children with either mother or father or both parents as 100% of one of the three ethnicities (Carolinian, Chamorro or Filipino) had the following BMI-for-age characteristics as shown in Table 43 & Figure 14). More Filipinos were underweight and fewer at risk for overweight or overweight, while more Carolinians were at risk for overweight than Chamorro or those children of mixed ethnicity.

Table 43: Prevalence of BMI for age category by ethnic ancestry

CDC Percentile* BMI for Age	100% Chamorro	100% Carolinian	100% Filipino	Other Ethnicity
< 5th underweight	1 (2%)	0 (0%)	9 (13%)	6 (3%)
5th – 85th normal weight	35 (65%)	4 (50%)	40 (58%)	135 (63%)
85th – 95th at risk of overweight	8 (15%)	3 (38%)	9 (13%)	31 (14%)
> 95th overweight	10 (19%)	1 (13%)	11 (16%)	43 (20%)
Total n	54	8	69	215

BMI-for-age based on CDC cutoffs [28]

Figure 14. BMI for Age category by ethnicity



BMI for Age and Physical Activity

Figure 15: Children's physical activity by BMI for age (physical activity in both school and sports outside of school)

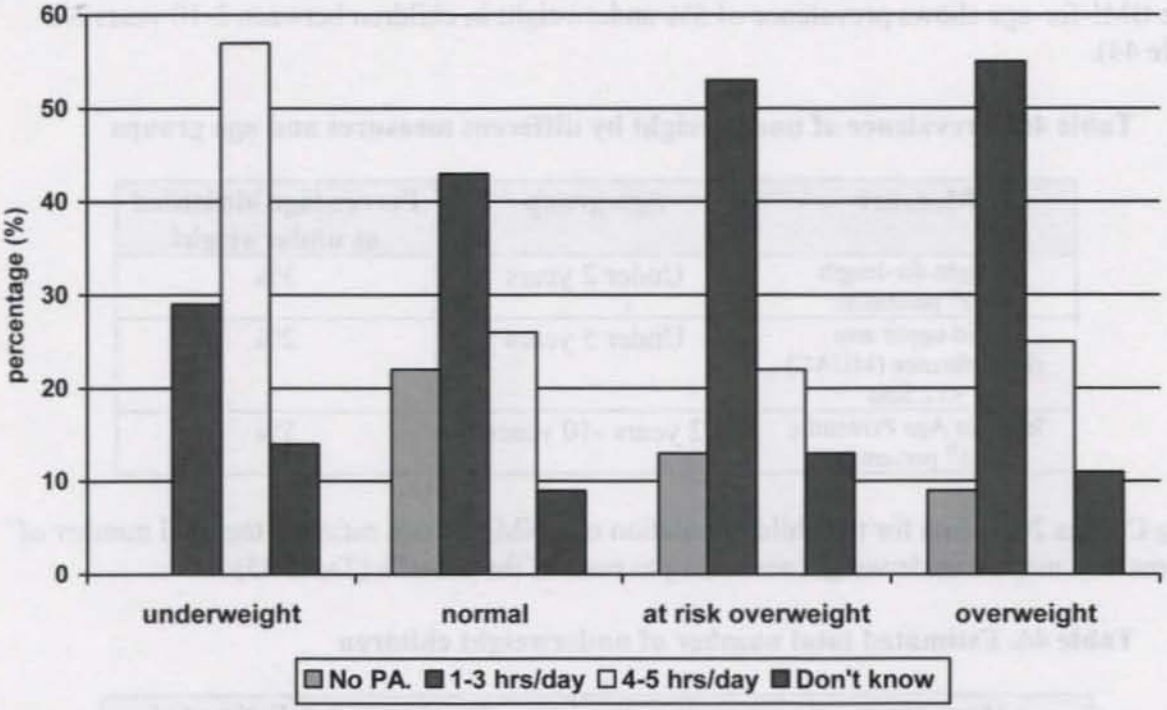


Table 44: Children's physical activity level by BMI for age category

BMI for Age category		No P.A	1-3 hrs	4-5 hours	Don't know	Total
Category 1 < 5th percentile	Underweight	0 (0%)	2 (29%)	4 (57%)	1 (14%)	7
Category 2 5th – 85th percentile	Normal	26 (22%)	52 (43%)	31 (26%)	11 (9%)	120
Category 3 85th – 95th percentile	At risk of overweight	4 (13%)	17 (53%)	7 (22%)	4 (13%)	32
Category 4 > 95th percentile	Overweight	4 (9%)	24 (55%)	11 (25%)	5 (11%)	44
Total n		34 (17%)	95 (47%)	53 (26%)	21 (10%)	203

Missing = 5

Underweight

A number of different measures can be used to identify the prevalence of underweight, depending on age. Three percent of children under 2 were found to be underweight using weight-for-length cut offs. MUAC measurements indicate a prevalence of 2% underweight in children under 5 years, while BMI-for-age shows prevalence of 5% underweight in children between 2-10 years old (Table 44).

Table 45: Prevalence of underweight by different measures and age groups

Measure	Age group	Percentage identified as underweight
Weight-for-length < 5th percentile	Under 2 years	3%
Mid-upper arm circumference (MUAC) <12.5cm	Under 5 years	2%
BMI for Age Percentile < 5th percentile	2 years -10 years	5%

Using Census 2000 data for the child population of CNMI we can estimate the total number of children that may be underweight according to each of the cut-offs (Table 45).

Table 46. Estimated total number of underweight children

Measure	Age group	Total population in age group	Estimated total number of underweight children
Weight-for-length < 5th percentile	< 2 years	2,471	75
Mid-upper arm circumference (MUAC) < 12.5cm	<5 years	5,792	116
BMI for Age Percentile < 5th percentile	2 -10 years	9,663	483

Census age categories used:
< 2 years: < 1 year and 1 year old
<5 years: < 1 year, 1 year - 4 years
2 –10 years: 2 years - 10 years

The rates of undernutrition compare favorably with regional rates of 15% in the Asia-Pacific Region (UNICEF, 1996-2005), and reflect a normal population distribution.

It also compares to U.S. National data for Asian/Pacific Islanders who have an prevalence of underweight of 6.6%.[4]

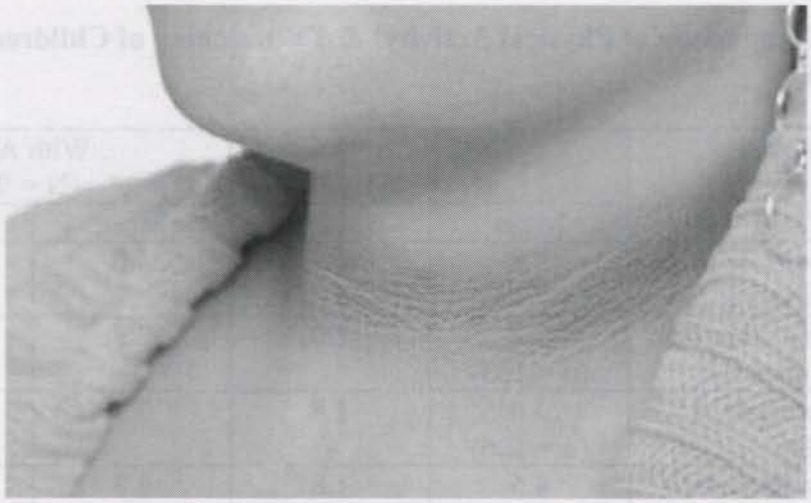
4 Based on 2000 CDC growth chart percentiles for weight-for-length for children under 2 years of age and BMI-for-age for children 2 years of age and older. 2005 Pediatric Nutrition Surveillance.

CHAPTER 7. ACANTHOSIS NIGRICANS (AN)

Background

Acanthosis nigricans (acantho means thorn; nigricans means black) is a reactive skin pattern seen in association with obesity, cancer, and other systemic disorders. Lesions are gray-brown to black, rough, have thickened plaques and prominent skin lines, and occur most commonly in the armpits, back & sides of neck, groin (inguinal creases),and underneath the breast, but can occur elsewhere (e.g. back of fingers or mouth). The texture of lesions may be velvety because of small skin elevations. AN is usually associated with obesity. When malignancy is NOT involved insulin resistance is involved. The development of *Acanthosis nigricans* in children may be a predictor of later development of type 2 diabetes [30]. The mechanism of development of cancer & hyperinsulinemia is not clear, but may be related to growth factors.

Figure 16. Skin pattern typical of Acanthosis nigricans



Children were examined in light clothing (shorts/T-shirt) and no attempt was made to observe the skin lesions in the groin and breast regions. Observations were made primarily from the back & sides of neck or armpits (during the measurement for the MUAC). Thus our estimates are expected tobe conservative, likely underestimating true prevalence. From the 420 children seen during the study, 9 cases of *Acanthosis nigricans* were observed (4%).

Descriptive correlates of AN

- 7 children from Saipan and one on each of Rota & Tinian
- Ethnicities of those with AN were Chamorro, Carolinian, Pohnpeian, Palauan, Filipino & Japanese (some were of mixed ethnicity)
- Children were all 8-10 yrs old
- 7 were boys and 2 girls
- All 9 children were in the overweight category (significantly more likely to be overweight (P <.0001) (Table 47)
- 6 children had high blood pressure (and were significantly more likely to have high blood pressure)

- 2 had signs of puberty (the 2 girls, and were significantly more likely to have begun puberty)
- 3 had cholesterol levels above 200 mg/dl

Table 47: Factors associated with Acanthosis Nigricans

Logistic Regression (N=346[†])

	Slope	S.E.	P
Intercept	-18.452	4.712	<.0001
Age, years	0.342	0.291	0.240
Sex, 1=M 0=F	1.015	1.1.47	0.376
BMI (kg/m^2)[†]	0.500	0.143	0.0005

Odds Ratio for BMI = 1.65 (CI = 1.24-2.18)

[†]Based on CDC BMI not calculated for below 2yr old

Table 48: Comparison of Physical Activity[‡] & TV watching of Children with and without AN

Physical Activity	Without AN (N = 127)		With AN (N = 9)	
	Mean	Std Dev	Mean	Std Dev
Physical Exercise in school, days/wk	3.8 (n = 125)	1.7	4.0	1.9
Physical activity other than in school, days/wk	2.2 (n = 123)	2.0	2.6	2.4
TV during weekdays, hrs/day	3.0 (n = 126)	1.8	3.3	2.1
TV during weekends, hrs/day	4.5 (n = 126)	1.8	3.8	1.6

[‡]Youth Risk Behavior Surveillance Survey (YRBSS)

Children with AN consumed more protein (Table 49) and more processed meat (Table 50)

Table 49: Daily Dietary Nutrient and Food Intake of Children with and without AN‡

Nutrient and food intake	Recommendations	Without AN (n=127)		With AN (n=9)	
		Mean	*SD*	*Mean*	*SD*
Calories, kcal	1770¥	1800	789	2299	1087
Protein, g	19-34 (RDA)†	68.5	31.0	**92.5***	67.2
Carbohydrate, g	130g (RDA)†	228.7	112.7	279.8	115.0
Fat, g (% kcal)	25% - 35% total calories§	66.6 (33%)	NA	88.2 (35%)	NA
Cholesterol, mg	< 300mg/day§	283.9	187.3	361.9	284.9
Fiber, g	25-31g§	6.7	4.7	6.5	3.0
Calcium, mg	800mg: 7 & 8 yr olds, male and female 1300mg: 9 & 10 yr old, male and female (AI)†	411.3	307.4	454.3	330.1
Iron, mg	10mg: 7 & 8 yr olds, male and female 8 mg: 9 & 10 yr old, male and female (RDA)†	10.0	5.6	11.2	5.1
Sodium, mg	1200mg: 7 & 8 yr olds, male and female 1500mg: 9 & 10 yr old, male and female (AI)†	2775.4	1544.0	3726.9	2187.0
Added Sugars, tsp	use sparingly⌀	11.4	10.3	17.9	14.2

‡7-10 year olds
*Significant at $p < 0.05$
§American Heart Association
¥Report of a Joint FAO/WHO/UNU Expert Consultation, 2004
†Dietary Reference Intake, based on reference BMI of 17.2 to 20.5
⌀Food Guide Pyramid, 1996. USDA

Table 50. Daily Food Guide Pyramid Servings¥ and Healthy Eating Index (HEI) of Children with and without AN**

Food Guide Pyramid serving or HEI score	Recommendation	Without AN (n=127)	With AN (n=9)
Grains, serving/day	6-11	7.1	7.5
***Processed Meats (fried hot dog, corned beef & spam), ounces/day	2-3Ψ	1.6	3.2*
Dairy, servings/day	2-3	0.7	0.4
Vegetables, servings/day	3-5	1.0	1.2
Fruits, servings/day	2-4	0.9	1.4
Healthy Eating Index, 1-100	> 80 is 'good'	56.2	55.3

¥ Food Guide Pyramid, 1996. USDA
** 7 – 10 year old children
Ψ Recommendation is for "Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts"
* Significant at $p \leq 0.1$ level
*** Processed meats are high in fat and sodium

Findings

The presence of Acanthosis Nigricans (AN) is an indicator of insulin resistance and a troubling finding in children. Transient insulin resistance has been associated with growth hormone and rapid pubertal growth[31]

Overall, dietary intakes were high in macronutrients. Protein intake was significantly higher in the children with Acanthosis nigricans than children without AN, as was the intake of processed meats. Sodium and added sugar were also high. The diet was low in fiber and calcium. (Tables 49 & 50)

Children presenting with AN had BMI's that were 11.4 units greater than those without AN, on average (adjusting for age and sex). Extreme overweight is the primary risk factor for AN.

Conclusion

These results are the first known documentation of AN among Pacific Islander children. Further study of the causes and consequences of AN in childhood will be important for prevention, treatment, and understanding the development of metabolic syndrome, cancer and diabetes and other chronic diseases in Pacific Island populations.

These data were presented at the Experimental Biology Conference April 28- May 2, 2007 Washington, DC.: **Acanthosis nigricans among Pacific Islander children in the Commonwealth of the Northern Marianas** Rachel Novotny, Patricia Coleman, Lynn Tenorio, Nicola Davison, Tayna Camacho, Vickie Ramirez. *FASEB J.* 2007 21:532.7 Accessed July 24th 2007. http://www.fasebj.org/cgi/content/meeting_abstract/21/5/A313-c?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&author1=Novotny&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=relevance&resourcetype=HWCIT

CHAPTER 8: VITAMIN A

Vitamin A

Introduction

Parents/caregivers were asked questions about common symptoms of vitamin A deficiency and whether their child had received treatment for vitamin A deficiency. Although to date there are no clinically confirmed cases of vitamin A deficiency in CNMI, vitamin A deficiency has been documented in other parts of Micronesia. Vitamin A capsule distribution occurs in parts of Micronesia, so it is possible that some children received vitamin A supplements, although probably not in CNMI.

Parents reported that:

- 1% (6) of the children were diagnosed/treated for vitamin A deficiency in the past 6 months
- 2% (7) had problems seeing in the daytime
- 1% (4) had night blindness (problems seeing at night)
- 4% of children (15) received a vitamin A supplement in the past 6 months
- 2% (7) of mothers reported having problems seeing in the daytime
- and 2% (7) of mothers reported having problems seeing at night when they were pregnant with this (participating) child.

Indicators for assessing Vitamin A Deficiency (VAD)

Although biological indicators are widely used to assess the prevalence and severity of VAD there are a series of 'ecological' and related indicators that have been associated with the incidence of VAD. These help to identify areas or populations where VAD is likely to be prevalent.

- Nutritional status
- Food availability
- Food security
- Illness related indicators
- Socioeconomic indicators

These indirect indicators do not replace biological indicators and cannot be used alone for determining the vitamin A status of the population, or to define whether a population has a VAD problem of public health significance. However, a composite based on these criteria can be used to corroborate biological criteria to determine if there is a public health problem (Table 51).

Table 51. Ecological indicators for Vitamin A deficiency

Ecological Indicators	Influencing Factors	CNMI level (from survey)
Food availability Indicators		
Breastfeeding	Breast feeding to 18 months & Vitamin A containing complementary foods from 6 months is protective against VAD	22% breastfeeding at 12mths and over
Growth indicators	Stunting (<-2Z scores for ht/age) and wasting (<-2 Z score wt/age) associated with increase VAD risk	4% children in survey under 2 yrs stunting 8% children in survey under 2 yrs wasting

Low birth weight (LBW)	High prevalence LBW indicates maternal undernutrition and increases risk of child VAD	7% children in survey were reported by parent as LBW (<5.5 lbs)
Food availability	If vulnerable groups have access to Vit A rich foods less than 3+ times per week, risk for VAD increases	42% of households report growing their own food 17% of households report owning livestock
Food security	If vulnerable groups have access to Vit A rich foods less than 3+ times per week, risk for VAD increases	65% of households with children received some form of assistance (Food Stamps, free school breakfast/lunch, FEMA) in past 12 months. This would increase potential availability of Vit A rich food
Dietary consumption	Risk of VAD is greater when consumption of foods of animal origin does not occur regularly	Children had high average HEI component score for meat (9.4) indicating relatively good access to food of animal origin
Illness related Indicators		
Diarrhea episodes	Prevalence of diarrhea in >20% of children in a 2 week period may be an indicator of VAD risk	Three out of 420 children in the study had utilized medical services in the last week because of having diarrhea (0.7%)
Fever & helminthic infection rate	Both depress appetite and nutrient absorption efficiency. When rates are high the risk of VAD increases	2% of children were reported to have received treatment for helminth infection in the past 6 months Nine out of 420 children in the study had utilized medical services in the last week because of having a fever (2.1%)
Socioeconomic Indicators		
Income/employment	In many places VAD prevalence is closely related to poverty. High risk is suggested as households with no regular employment and >70% of income spent on food	9% of the survey population reported incomes below $96 biweekly
Education	No schooling or illiteracy in >50% of women 15-44 yrs is associated with a high vulnerability to VAD	Maternal literacy was reported as 99% Mean maternal education was 11.9 yrs
Water supply and sanitation	There is a high probability of VAD if <50% households have a safe water supply (in addition to risk based on diet and illness-related).	95% of households have accessed to piped water 86% of households have flush toilets

Table adapted from WHO Pub WHO/NUT/96.10 (Table 15, page 57)

Relatively little research has been done to evaluate the relationship between ecological and demographic and related direct indicators and VAD. This composite of indictors of ecological factors can be used to evaluate whether biological testing is indicated and to corroborate biological criteria to determine if there is a public health problem. Based on these data the risk of Vitamin A deficiency appears low.

Analysis of dietary data from the 2005 survey indicates that although the vitamin A status of a large number of the under 10 year old population may not be notably deficient, there may be cause for concern among some populations.

Table 52. Mean and median dietary Vitamin A intake for children compared to Estimated Average Requirement (EAR)

	Unit	Mean	Standard deviation	Median	Estimated Average Requirement (EAR)
Children < 1yr (n = 25)					
VITAMIN A	RE	**290**	± 317	**203**	210µg
Children 1– 4 yr (n=131)					
VITAMIN A	RE	**502**	± 454	**405**	210 µg
Children 4 yr - 9 yr n=199					
VITAMIN A	RE	**556**	± 785	**381**	275µg
Children 9 yrs and over (n=65)					
VITAMIN A	RE	**555**	± 683	**279**	420-445µg

The mean Vitamin A intake for all age groups exceeds the recommended daily allowance. However, the median values for Vitamin A intake indicate that individuals in the older age group (children 9 years and older) may be at some risk of vitamin A deficiency since the median values are below the recommended daily value. This means that some children have individual intakes below the Estimated Average Requirement (EAR) (Table 52).

Although a single 24 hour dietary recall is considered a poor measure of an individual's diet, 12% of the children 1-4 years surveyed had vitamin A dietary intakes below recommended levels (210 µg) on the day of the survey. Of the 4-9 year olds group, 24% of children consumed diets that were below the Estimated Average Requirement (275 µg) on the day of their recalls.

Prevalence of dietary adequacy on p26 shows that as many as 45% of children have inadequate intakes of Vitamin A (females 9 years and older). Among the younger children, 9% of children 1-3 years and 19% of children 4-8 years have inadequate vitamin A intakes. A 1997 study that testing serum retinol in 200 children 3-5 years old found serum retinol concentrations of the children ranged from 13 to 58 µg/dl with mild vitamin A deficiency (retinol 10 to 30 µg/dl) identified in 61% of the children[32]

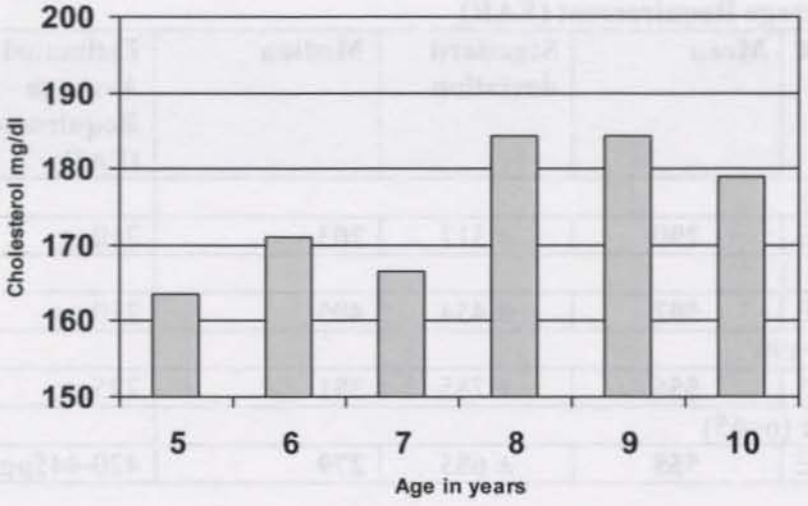
Since there are indications of low intake in some individuals, this may warrant further investigation to identify 'at risk' segments of the population.

CHAPTER 9. OTHER MEASURES

Cholesterol

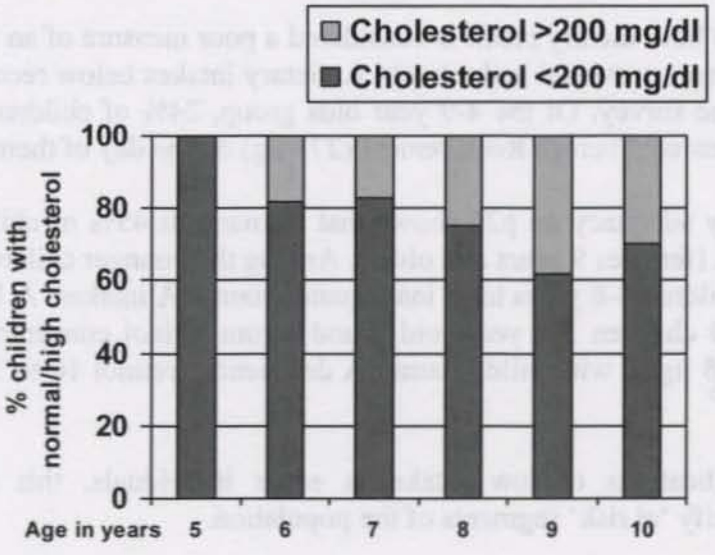
Cholesterol testing was done only on children 5 years and older. Data are presented by age group in Figures 17 & 18. Thirteen (13%) percent of males and 14% of females had a cholesterol level greater than 200 mg/dl which is the National Cholesterol Education Program cut-point for adverse levels [33]
There is no significant relationship between the cholesterol cut off and the age groups.

Figure 17. Mean cholesterol level by age group



Correlations between dietary characteristics and blood cholesterol levels were tested and none were found to be significant (dietary protein, total fat, saturated fat, discretionary fat and energy).

Figure 18. Percent of children in high and low cholesterol categories



Hemoglobin

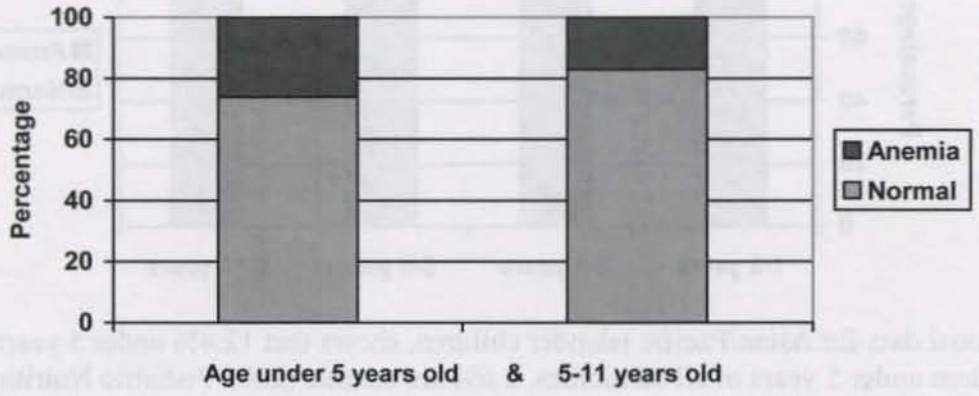
Based on WHO cutoffs [34] among children under five years old, 74% of children under 5yrs old had hemoglobin > 11 g/dl (normal) and 26% of children under 5yrs old had hemoglobin < 11 g/dl (anemia). Among children 5 – 11 years old, 83% of children 5 – 11yrs old had hemoglobin (normal) and 17% of children 5 – 11yrs old had hemoglobin < 11.5 g/dl (anemia). (Table 53 & Figure 19)

Dietary correlates of anemia were tested and none were found to be significant (energy, protein, vitamin C, riboflavin, folate, vitamin B12 and iron)

Table 53. Low and normal hemoglobin levels among children in CNMI (WHO cut offs)

Age (years)	Hemoglobin normal (g/dl)	Low Hemoglobin (anemia) (g/dl)
Under 5	74% ≥ 11 (n=156)	26% < 11 (n=56)
5-11	83% ≥ 11.5 (n=173)	17% < 11.5 (n=35)

Figure 19. Percentage of children with anemia (WHO cut offs)



The U.S. National health objective 19.12a & b for the year 2010 is to reduce iron deficiency among young children aged 1 to 2 years to less than 5%, and among children aged 3-4 to less than 1% (15).

Using CDC cut offs:

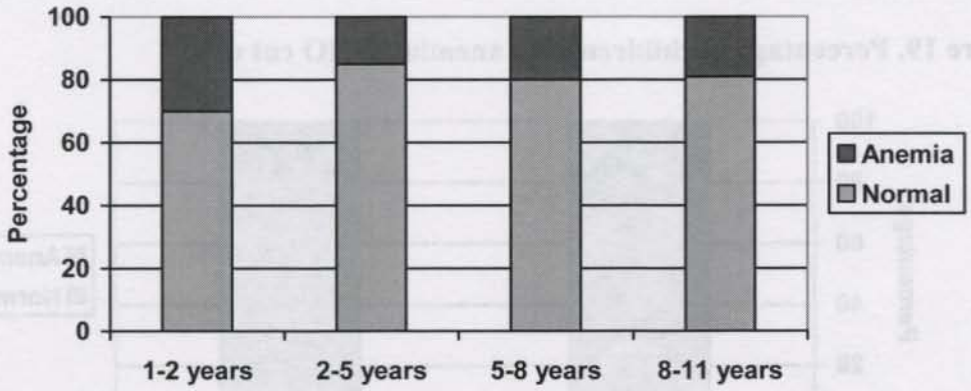
- children aged 1 to 2 years are considered anemic if their Hb concentration is less than 11.0 g/dL;
- children aged 2 to 5 years are considered anemic if their Hb concentration is less than 11.1 g/dL (CDC, 1998).
- children aged 5 to 8 years are considered anemic if their Hb concentration is less than 11.5 g/dL (CDC, 1998).
- children aged 8 to 11 years are considered anemic if their Hb concentration is less than 11.19 g/dL (CDC, 1998).

Using these CDC cut-offs the prevalence of anemia in CNMI children varies between 15% and 30%, with the youngest children (1-2 years) showing highest rates of anemia (30%) and 2-5 year olds showing the lowest rates (15%) (Table 54 and Figure 20)

Table 54. Low and normal hemoglobin levels among children in CNMI (CDC cut offs)

Age	Hemoglobin normal	Low Hemoglobin (anemia)
1 - <2 years old (n=93)	70% ≥ 11 g/dl	30% < 11 g/dl (n=26)
2 - <5 years (n=131)	85% ≥ 11.1 g/dl	15% < 11.1 g/dl (n=20)
5 -<8 years (n=106)	80% ≥ 11.5 g/dl	20% < 11.5 g/dl (n=21)
8- <11 years (n=65)	81% ≥ 11.9 g/dl	19% < 11.9 g/dl (n=12)

Figure 20. Percentage of children with anemia (CDC cut offs)



U.S national data for Asian/Pacific Islander children, shows that 12.4% under 5 years are anemic. For children under 5 years of all ethnicities, 3.6% are anemic (2005 Pediatric Nutrition Surveillance). CNMI therefore has much higher rate of anemia among young children under 5 years (21%) than U.S.

In infants (aged 0-12 months) and preschool children (aged 1-5 years), iron-deficiency anemia results in developmental delays and behavioral disturbances (e.g., decreased motor activity, social interaction, and attention to tasks). These developmental delays may persist past school age (i.e., 5 years) if the iron deficiency is not fully reversed.

Blood pressure

The blood pressure equipment used was validated for children 3 years and above. However, since reference data for the identification of high blood pressure are weight, height and gender specific, a simpler referral cut-off was used in the field after consultation with CNMI DPH.
Children ages 36-60 months with blood pressures over 105/65, and children ages 5-10 years with blood pressures over 110/70, were referred to the Department of Public Health for follow up. For both age groups (3-5yrs and 5-10 yrs) the incidence of high blood pressure using these cut-offs was 20%, although there are a number of factors, including stress, which may have resulted in a higher incidence of high blood pressure in this population (Table 55).

Care was taken to match cuff size to the arm circumference (utilizing the MUAC measurement on each child) and confirmatory repeat measures were taken for any readings found to be above the cut off levels.

Table 55. Blood pressure by DPH referral cutoff and age group

Age, yr	N	No.(%) Children Higher than CNMI DPH Cutoff *
≥ 3 to ≤ 5	94	20 (21%) *(≥105/65)
> 5 to 10	208	41 (20%) *(≥110/70)

systolic/diastolic (mm/Hg)

Currently the American Heart Association recommends that all children age 3 and older have yearly blood pressure measurements. Early detection of high blood pressure will improve health care of children. High blood pressure is a major risk factor for heart disease and stroke in adulthood.

The two cut-offs used during the survey were identified to simplify the screening process in the field. In childhood, blood pressure normally rises with age. For improved accuracy a child's sex, age and height should be used to determine age-, sex- and height-specific systolic and diastolic blood pressure percentiles. This approach provides information that lets researchers consider different levels of growth in evaluating blood pressure. It also demonstrates the blood pressure standards that are based on sex, age and height and allows a more precise classification of blood pressure according to body size. More importantly, the approach avoids misclassifying children at the extremes of normal growth (http://www.americanheart.org/presenter.jhtml?identifier=4609).

CHAPTER 10. DENTAL CHARACTERISTICS

Table 56 describes the decayed, filled and missing teeth by age group. For children 6 years of age and above the figures below for missing teeth do not distinguish between teeth lost naturally, teeth lost to decay and teeth extracted.

Table 56. Number of decayed, filled and missing teeth for each age group

Age group, yr	N	Decayed teeth Mean ± SD	Filled teeth Mean ± SD	Missing teeth Mean ± SD
≤1	25			0.4 ± 1.5
>2 to ≤3	43	0.6 ± 1.4		0.9 ± 2.9
>3 to ≤4	45	1.8 ± 3.2		
>4 to ≤5	37	5.9 ± 5.0		
>5 to ≤6	56	4.8 ± 5.1	0.3 ± 0.9	0.1 ± 0.3
>6 to ≤7	37	5.6 ± 4.6	0.7 ± 1.5	0.5 ± 1.2
>7 to ≤8	34	5.7 ± 4.5	1.3 ± 2.3	2.1 ± 2.8
>8 to ≤9	31	3.8 ± 3.4	0.5 ± 1.3	6.7 ± 3.7
>9 to ≤10	40	4.2 ± 3.3	0.9 ± 1.8	7.2 ± 4.4
>10	64	2.0 ± 2.4	0.5 ± 1.2	9.2 ± 7.1

The reduction in number of decayed teeth after age 6-7 years is probably due to the loss of decayed baby teeth that are then replaced by sound permanent teeth. Primary teeth typically begin to appear when a baby is between age six months and one year. Primary teeth help children chew and speak. They also hold space in the jaws for permanent teeth that are developing under the gums.

Figure 21. Number of decayed teeth for each age group 2-10 yr

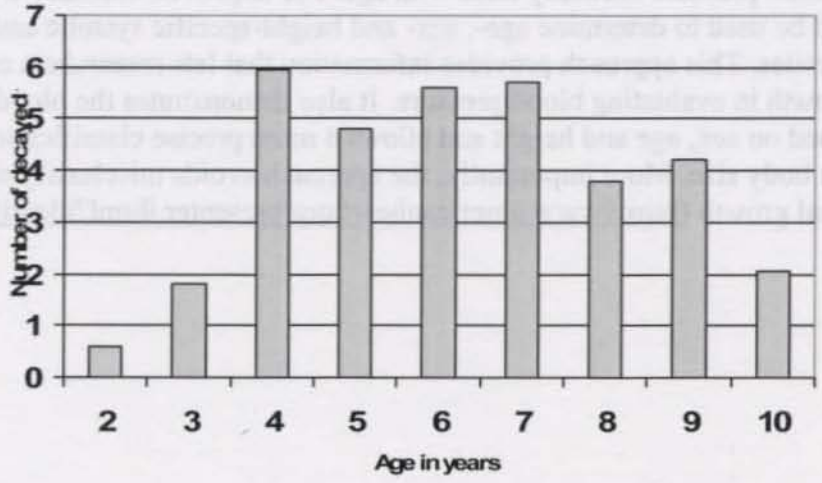


Table 57. Average number of teeth decayed, missing and filled per child

	< 5 yr	5 & 6 yr	> 6 yr
Decayed teeth	1.8 (n=198)	2.54 (n=37)	1.95 (n=169)
Filled teeth	1.02 (n=198)	1.14 (n=37)	1.16 (n=167)
Missing teeth*	1.07 (n=197)	1.08 (n=37)	2.96 (n=170)

* For children over 6yr and over: This figure does not distinguish between teeth lost naturally, teeth lost to decay and teeth extracted.

A total of 26 children were reported as having inflamed or bleeding gums (6.2%).

No dietary variables were associated with dental health. (37 dietary components were examined, including added sugars, beverages, dairy, and calcium).

Differences in tooth decay by gender were not statistically significant (Table 58).

Table 58. Decayed and Filled teeth by gender

	Male	Female
Decayed teeth*	31.4% (n=132)	28.6% (n=120)
Filled teeth*	7.4% (n= 31)	6.4% (n=27)

* Odds ratio indicates not significant (OR = 2.0)

Tooth decay and filling were associated with parental education (Table 59). There was a greater percentage of tooth decay and fewer filled teeth among children whose parents had les than 12 years of schooling.

Table 59. Decayed and filled teeth by parental education

	Under 12 years of school	Over 12 years school
Decayed teeth*	60% (n=251)	<1% (n=1)
Filled teeth*	13.6% (n=57)	<1% (n=1)

* Odds ratio significant (OR=18.9)

Tables 60 and 61 indicate possible differences in rates of decayed and filled teeth between islands and within different ethnic groups. However, the sample sizes for Rota and Tinian islands and for Carolinians are small and therefore may not be representative.

Table 60. Decayed or filled teeth by location

	Rota & Tinian	Saipan
Decayed teeth	2.9% n=12	56% n=235
Filled teeth	1% n=3	11% n=46

* Chi sq 6.1 (p=0.05) not significant for location

Table 61. Decayed or filled teeth by ethnicity

	Filipino	Chamorro	Carolinian	Other
Decayed teeth (n = 168)*	11% (n=46)	10% (n=40)	1% (n=6)	38% (n=160)
Filled teeth (n = 58)**	2% (n=8)	4% (n=18)	N/A (n=0)	8% (n=32)

N/A none in sample

* Chi sq 0.23 (p=0.97) not significant

** Chi sq 12.25 (p=0.01) significant, but n=0 for Carolinian and other sample sizes low

CHAPTER 11. SUMMARY AND RECOMMENDATIONS

Breastfeeding

- with the approval of a new first time Supplemental Feeding Program for Women, Infants and Children (WIC) in the Commonwealth of the Northern Marianas Islands, there is an enormous opportunity to enhance and protect breastfeeding as primary prevention for obesity and related chronic diseases, which was protective for overweight.

Diet

- improvements in children's diets could be improved by strategies that result in a decrease in dietary fat and protein intake, and an increase in calcium, fruit and vegetable intakes.
- one way to decrease dietary protein and fat could involve reducing intake of processed meats (to lower fat, protein and calories) and increasing intake of low fat dairy products and fish, especially eaten with bones to increase calcium.
- the message that 'more is better' for fruit and vegetable servings provides a simple guideline without requiring knowledge of servings and quantities. http://www.fruitsandveggiesmorematters.org/

Physical Activity

- to keep children more active they should be encouraged to participate in activities that involve movement and reduce the amount of time spent watching TV, especially on the weekend.

Acanthosis nigricans

- lower processed meats intake to achieve weight maintenance

Vitamin A

- increase fruit and vegetable intake, especially those that are yellow/orange color, to increase vitamin A intake
- possibly limited serological testing for serum retinol levels in selected populations

Anemia

- increase consumption of iron rich foods such as organ meats, dark green leafy vegetables, whole grains, beans, fish
- improve iron absorption by consuming foods containing ascorbic acid (Vitamin C) at the same meal as the iron rich foods. E.g. fruits and vegetables

Cholesterol

- reduce intake of processed meats (to lower fat)
- choosing lower fat options when available

Blood Pressure

- maintain a healthy weight
- regular physical activity, eating a healthy diet low in saturated fat, cholesterol and salt, and be more physically active

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APPENDIX 1: Questionnaire

Pacific Islands- HEALTH/NUTRITION QUESTIONNAIRE (2005)
Name of participant will not be recorded on survey, but a referral form will be given if individual is identified as being at nutritional risk.

i) Interviewer Initials: _____ ii) Assigned subject number:_____

iii) Date of interview: Month_____Day_____ 2005 vi) Island of residence _____

vi) Town/village of residence:_____ iv) Language interview is administered in: _____

SECTION I. HOUSEHOLD DEMOGRAPHICS
I would first like to ask you some questions about your household:

1) How many individuals live in your household? (circle one)

1 2 3 4 5 6 7 8 9 10 or more

2) How many children live in your household?

1 2 3 4 5 6 7 8 or more

3) Do you grow or gather any of your own foods **to eat**? Yes No

4) Do you keep any livestock which you eat in your household? Yes No

5) a. □ Do you own the land you live on?
b. □ Do you rent the land you live on?
c. □ Do you occupy without rent the land you live on?
d. □ Other

6) Does your household have the following (check all that apply):
a. □ Sink with piped water
b. □ Inside toilet
c. □ Outside toilet

7) Has your household received any assistance in the past 12 months? (circle all that apply)

Food Stamps	Yes	No
FEMA	Yes	No
Free school breakfast or lunch	Yes	No
LIHEAP (Low Income Home Energy Assistance Program)	Yes	No

Other (specify) _____
None (circle if applicable)

8) Of the following income groups, which best represents your total household income, for one biweekly pay period? (*Use flashcard so people don't have to say the number – they can identify a letter instead*):

a. □ under $96
b. □ $96-$192
c. □ $193 - $384
a. □ $385-$576
b. □ $577- $961
f. □ $962-$1,346
g. □ $1,347-$1,923
h. □ $1,924- $2,885
i. □ more than $2,885

9) Can the father read? (English and/or local language) Yes No

10) How many years of schooling has the father completed, starting from grade 1? _____ years (write in number)

11) Can the mother read? (English and/or local language) Yes No

12) How many years of schooling has the mother completed, starting from grade 1? _____ years (write in number)

13) How many individuals in this household:

a. smoke	0	1	2	3	4	5+
b. chew tobacco	0	1	2	3	4	5+

14) Which of the following best describes the food situation in your household?

a. Always enough food to eat b. Sometimes not enough food to eat

SECTION II. CHILD PHYSICAL FINDINGS AND ANTHROPOMETRICS

Now I would like to ask you some questions about your child {name}

Child specific survey number:_____

(designator = A if child is 6-59 months and = B if child is 5 to 10 years)

15) The child is between the ages of: a. □ 6 to 59 months (6 months up until day before 5th birthday)

b. □ 5 to 10 years (5th birthday up to one day before 11th birthday)

16) Child's date of birth: Month_____ Day_____ Year_____

17) Child's island/or town of birth:_____

18) Child's gender (circle): Male Female

19) Please identify the racial backgrounds of the child's biological parents (should add up to 100%). Fill in the percentage for each ethnicity. (Use the example on the flash card)

a. **Mother**	%	b. **Father**	%
Chamorro	____	Chamorro	____
Carolinian	____	Carolinian	____
Chuukese	____	Chuukese	____
Chuukese (outer island)	____	Chuukese (outer island)	____
Hawaiian	____	Hawaiian	____
Kosraen	____	Kosraen	____
Marshallese	____	Marshallese	____
Palauan	____	Palauan	____
Pohnpeian	____	Pohnpeian	____
Pohnpeian (outer island)	____	Pohnpeian (outer island)	____
Samoan	____	Samoan	____
Yapese	____	Yapese	____
Yapese (outer island)	____	Yapese (outer island)	____
Filipino	____	Filipino	____
Korean	____	Korean	____
Chinese	____	Chinese	____
Japanese	____	Japanese	____
Thai	____	Thai	____
Other Asian	____	Other Asian	____
White/Caucasian	____	White/Caucasian	____
Other (write in)	_____	Other (write in)	_____

20) Birth Weight (pounds): lbs_____ oz _____ Don't Know (use weight from Health Card)

21) Is this child adopted? Yes No

22) Has your child been to see a health care provider in the last week due to illness?
Yes No
(If No, **Go To Question 24**.)
Don't Know

23) If Yes to Question 22, what was the reason(s) for the child's visit to the health care provider? (check all that apply)
- ☐ Diarrhea (3+ loose/liquid stools/day)
- ☐ Vomiting
- ☐ Fever
- ☐ Other (specify) _____

24) Has your child been diagnosed or treated for vitamin A deficiency in the past 6 months?
Yes No Don't Know

25) Has your child ever had any problems seeing in the daytime? Yes No Don't Know

26) Has your child ever had night blindness/problems seeing at night?
Yes No Don't Know

27) Did this child's mother have any problem seeing in the daytime when pregnant with this child? Yes No Don't Know

28) Did this child's mother have any problem seeing at nighttime when pregnant with this child?
Yes No Don't Know

29) Has your child received a vitamin A supplement (capsule) in the past 6 months?
Yes No Don't Know
(check Health Card)

30) Has your child been diagnosed or treated for anemia in the past 6 months?
Yes No Don't Know

31) Has your child received medicine to treat worms (parasites) in the past 6 months?
Yes No Don't Know
(check Health Card)

32) Has your child been diagnosed or treated for dengue fever in the past 6 months?
Yes No Don't Know

SECTION III. DIETARY SURVEY COMPONENT

33) Did this child ever receive breastmilk? YES NO
(includes even single feeding)

If YES go to question 34. If NO go to question 36.

34) How long was this child exclusively breastfed? *(exclusive = no other liquid/solid)*

- ☐ 0-2 months
- ☐ 3-4 months
- ☐ 4-6 months
- ☐ More than 6 months

35) How long did this child receive breastmilk (*including with other liquids or solids*)?

- ☐ 0-2 months
- ☐ 3-4 months
- ☐ 4-6 months
- ☐ 6-9 months
- ☐ 9-12 months
- ☐ More than 12 months

36) At what age was the child first fed solid or complementary foods?

- ☐ 0-2 months
- ☐ 3-4 months
- ☐ 4-6 months
- ☐ 6-9 months
- ☐ 9-12 months
- ☐ More than 12 months

37) Does your child usually eat breakfast?

a. Yes c. Don't know
b. No d. NA

38) If Yes to Question 38, does your child eat breakfast at:

a. Home b. School c. Other (Please specify) _____

39) Does your child usually eat lunch?

a. Yes c. Don't know
b. No d. NA

40) If Yes to Question 40, does your child eat lunch at:

a. Home b. School c. Other (Please specify) _____

Supplements:

41) Does your child take any supplements (such as vitamins, minerals, herbs, and protein powder) on

a regular basis? (select all that apply) YES NO
If YES go to Question 42. If NO go to question 43.

42) Collect the information in the table below for each supplement taken:

#	Supplement Brand	Supplement Name	Location of Purchase	Pills per Dose	Number of mg, mcg or IU (single nutrients only)	Pills Taken	Per Day	Per Month
1.	Example: Nature Made	Calcium	Long's	1	500	1	x	

6 MONTH -5 YEAR OLD CHILDREN: GO TO QUESTIONS 45 &46
5-10 YEAR OLD CHILDREN: ANSWER QUESTIONS 43-46

43) In an average week when your child is in school, on how many days does he/she go to physical education (PE) classes?

a. None
b. 1 day
c. 2 days
d. 3 days
e. 4 days
f. 5 days
g. Don't Know

44) How many days per week does your child play sports outside of school?

a. None
b. 1 day
c. 2 days
d. 3 days
e. 4 days
f. 5 days
g. Don't Know

45) How much TV (or video/DVD games or movies) does your child usually watch (play) on a typical **school day**? (check one)

a. 1 hour or less
b. 2 hours
c. 3 hours
d. 4 hours
e. 5 hours
f. 6 hours or more
g. none

46) How much TV (or video/DVD games or movies) does your child usually watch (play) on a typical **weekend day**? (check one)

a. 1 hour or less
b. 2 hours
c. 3 hours
d. 4 hours
e. 5 hours
f. 6 hours or more
g. none

Child Specific Survey Number _____ **Date** _____

SECTION IV. CHILD ANTHROPOMETRICS

Mark An X In The Box If The Child Requires A Referral:

47. Height/Length (cm) __ __ __. __ __ __ __ __. __ __ avg= __ __ __. __ __
(Circle either height or length as appropriate)

48. Body Weight (kg): __ __ __. __ __ __ __ __. __ __ avg = __ __ __. __ __
☐ Referral for weight

49. MUAC (cms) __ __ __. __ __ __ __ __. __ __ avg =__ __ __. __ __
☐ Referral for MUAC/ Arm circumference

50. PHYSICAL EXAM (check all findings present):
☐ Acanthosis nigricans Neck Armpit *(circle site of skin discoloration)*
☐ Decayed teeth
☐ Filled teeth
☐ Inflamed or bleeding gums
☐ Skin rash
☐ Signs of puberty
☐ Other, please specify_____

51. Blood pressure systolic _____mm/Hg
diastolic _____mm/Hg ☐ Referral Blood pressure

52. Hgb/ Hemoglobin (gm/dL)_____ ☐ Referral for Hemoglobin

53. Cholesterol (mg/dL) _____ ☐ Referral Cholesterol

Interviewer's Comments and Notes:

TAKE THE AVERAGE OF 2 MEASUREMENTS WITHIN THE TOLERANCE LIMITS OF

WEIGHT	**0.2kg**
HEIGHT	**0.2 cm (2mm)**
MUAC	**0.2 cm (2mm)**

APPENDIX 2: HEI criteria

Food Group Components (grains, vegetables, fruits, milk & meat)

- A maximum score of 10 was assigned to each of the five food group components of the Index when a person's diet met or exceeded the recommended number of servings for a food group
- For each of the five major food groups, a score of zero was assigned to the respective components when a person did not consume any item from the food group.

Fat and Saturated Fat Components

- Total fat intake of less than or equal to 30 percent of total calories in a day was assigned a maximum score of 10 points
- Fat intake equal to or greater than 45 percent of total calories in a day was assigned a score of zero, and fat intake between 30 and 45 percent was scored proportionately.
- Saturated fat intake of less than 10 percent of total calories in a day was assigned a maximum score of 10 points
- When saturated fat intake was equal to or greater than 15 percent of total calories in a day, a score of zero was assigned, and intake of saturated fat between 10 and 15 percent was scored proportionately.

Cholesterol component

- A score of 10 points was assigned when daily cholesterol intake was 300 milligrams (mg) or less.
- When daily intake reached a level of 450 mg or more, a score of zero was assigned, and when intake was between 300 and 450 mg, a proportionate score was assigned.

Sodium Component

- A score of 10 points was assigned when daily sodium intake was 2,400 mg or less
- A daily intake of 4,800 mg or more received a score of zero, and intake between 2,400 and 4,800 mg received a proportionate score

Variety Component

- A maximum variety score of 10 points was assigned when a person consumed at least half a serving each of 8 or more different types of foods in a day.
- A score of zero was assigned if at least half a serving of 3 or fewer different foods was consumed in a day. Intermediate scores were computed proportionately.