Prevalence of Overweight
in
American Samoan Schoolchildren

(2007/2008 School Year)

Report to the Directors

Department of Health
Department of Education

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ABSTRACT

This large-scale survey complements our earlier work to determine the prevalence of overweight in American Samoan children and adolescents. Last school year we determined the prevalence of overweight as about 34% for students in grades K, 3, 6, 9, and 12 in all schools of the Territory. The current study included students in all grades, K through 12, from eight elementary schools and three high schools. In addition to measuring students for their body mass index and categorizing them as either underweight, at a healthy weight, at-risk-of-overweight, or overweight according to criteria established by the Centers for Disease Control and Prevention, we also asked them questions concerning diet and physical activity. We again found that the overall prevalence of overweight was about 35%. We found that only about half the students engaged in any type of physical activity after school on a typical day. A larger proportion of students on Manu'a had after-school chores, compared with students on Tutuila/Aunu'u, and a lower proportion of Manu'a girls were categorized as overweight compared with girls on Tutuila/Aunu'u. Even so, the prevalence of overweight children and adolescents on both Manu'a and Tutuila/Aunu'u is more than twice that of youngsters in the United States. The health implications for them as they enter adulthood and for the Territory's healthcare system are grim.

In August 2007, we presented the results of our first large-scale study of overweight in American Samoan schoolchildren[1]. It detailed our survey of 2,795 boys and 2,621 girls attending kindergarten (K-5) and grades 3, 6, 9, and 12 at all public and private schools throughout the Territory during the 2006/2007 school year. We determined each student's body mass index, or BMI, which noted whether the student was underweight, at a healthy weight, at-risk-of-overweight, or overweight according to age- and gender-specific growth charts[2]. We also measured each student's waist circumference and compared it against age- and gender-specific cutoffs for children and adolescents[3]. The results indicated that less than half the students were at a healthy weight, about 21% were at risk of becoming overweight, and an alarming 34% were already overweight. This was far greater than the 16% of 6-to-19-year-olds found to be overweight in the United States from 1999 to 2002[4]. It was also substantially greater than the highest US ethnic group rate of 23.6% for 12- to 19-year-old non-Hispanic Blacks and the 27.9% reported in Polynesian children aged six to 12 from 13 Pacific countries surveyed in 2002[5].

One objection to using the Centers for Disease Control and Prevention (CDC) BMI growth charts on children of Samoan ancestry is that the charts are based on a reference population that comprised less than 4% of Asians and Pacific Islanders. We therefore examined subsets of our data using cutoffs developed by the International Obesity Task Force (IOTF). While slightly more than half of the 6-to-8-year-olds had healthy weights, most students 9 to 11, 12 to 14, and 15 to 17 years old were either overweight or obese. [Note: CDC and IOTF definitions for unhealthy weight differ in a confusing way. The IOFT defines "at-risk-of-overweight" as "overweight" and "overweight" as "obese." IOTF definitions are used internationally and by the CDC for categorizing adults. In July 2007, an expert panel representing the American Academy of

Pediatrics, the American Dietetic Association, the American Academy of Child and Adolescent Psychiatry, and the American College of Preventive Medicine all recommended that the CDC adopt these definitions for children as well[6]. Until/unless the CDC does so, we continue to use the standing definitions of *at-risk-of-overweight* and *overweight*.]

Another objection to using BMI standards in assessing Pacific Islanders for overweight is that greater weight for height among Pacific Islanders may be due to heavier bones, more muscle mass, or wider frame rather than to excess fat. We circumvented this objection by also measuring each student's waist circumference. Intra-abdominal fat is the most clinically relevant type of fat. Using waist circumference as a surrogate measure of intra-abdominal fat and applying age- and gender-specific cutoff points for children and adolescents[3], we found that about 40% of both boys and girls had a high level of abdominal fat.

While it may be desirable and practical to eventually tailor an obesity screening tool specifically for Samoans, the ramifications of unchecked obesity make it imperative that the problem be addressed now based on the best available evidence rather than wait for the best possible evidence.

This year we determined the BMIs of 4,214 students in grades K through 12 and confirmed that American Samoan youth face a serious obesity problem. We also asked students about their food choices and level of physical activity outside of school. Though we did not enquire about the amount of food eaten, most students reported that foods representing the greatest part of their diets were low in fat. Their responses suggested that low levels of physical activity may be the more important factor accounting for overweight in our schoolchildren. We discovered two possible critical intervals when the transition from healthy weight to either at-risk-of-overweight or overweight was particularly evident: between ages six and

seven and between ages 13 and 14. Interventions might be most effective during these intervals.

Materials and Methods

We again conducted our survey under the auspices of the American Samoa Department of Health with the approval of its Institutional Review Board and in compliance with the Family Educational Rights and Privacy Act administered by the American Samoa Department of Education (ASDOE). We surveyed students in all grades from eight elementary schools and three high schools (HS) (Table 1).

Table 1. Schools, survey date(s), and numbers of students measured for height and weight, and interviewed for diet choices and physical activities during the 2007/2008 school year.

Dates	School	Boys	Girls	Totals
10/16/2007 to 10/19/2007	Taputapu	44	49	93
10/29/2007 to 11/16/2007	Tafuna HS	447	486	933
11/27/2007 to 12/18/2007	Manulele Tausala	477	445	922
1/22/2008 to 2/14/2008	Samoana HS	391	391	782
2/26/2008 to 3/14/2008	Pago Pago	392	376	768
3/15/2008	Manu'a HS	28	33	61
3/26/2008	Faleasao	36	40	76
4/1/2008	Olosega	45	43	88
4/9/2008 to 4/14/2008	Tula	110	111	221
4/23/2008 to 4/24/2008	Lauli'i	95	93	188
4/25/2008	Aunu'u	42	40	82
	Totals	2107	2107	4214

We selected schools of various sizes and locations to provide a representative sample of students throughout the Territory. With the cooperation of principals and teachers, we surveyed all students in attendance in pairs, usually within the time span of a single classroom period. We measured height ($\pm$ 1 mm) and weight ($\pm$ 0.1 kg) as detailed elsewhere[1]. From information provided by the ASDOE chancery, we recorded each student's date of birth. Using these data, together with the student's gender, we calculated the BMI and BMI percentile (BMIP) using the NutriSts subroutine from the CDC software program, EpiInfo.

We next asked the student three diet-related questions and one question about physical activity. Interviews were in either Samoan or English, whichever language the student was more comfortable speaking. Given the time constraint and reliability of student recall, the questions were necessarily short and simple: *What did you eat this morning before school? What did you eat for supper last night? What fruits and vegetables do you eat?* and *What did you do, or plan to do, after school yesterday or today?* Because our food- and physical activity-related questions were open-ended, we received a variety of answers. We report here only those answers given by 1% or more of students. Students 13 years and older were further asked that, if they knew how to read a food label, to select which of three food labels (Table 2) represented the best choice for avoiding excess weight.

Separate operators entered data into two Microsoft Access 97 databases and checked them against each other for discrepancies. Inputting errors were resolved by referring to the field notes. We used Microsoft Visual Basic 6 to query the data and SigmaStat 3.10 to analyze them. Statistically significant results are expressed with a probability, *P,* that the difference between two groups might be due to chance. A value for *P* at 0.05 or less is customarily used to indicate a statistically significant difference. The lower the value of *P,* the greater the confidence we may have that the groups in fact differ in the criterion being tested.

We reported one boy and three girls who were one month away from their fifth birthday as 5-year-olds, although we calculated BMIs and BMIPs for their true ages. Likewise, we reported eight boys and five girls who were 19 years old as 18-year-olds. We did this in order to include them in statistical analyses by age, since they would have been excluded otherwise owing to their small sample size. Likewise, we excluded the *underweight* category from BMI category comparisons since it comprised only 28 students.

Table 2. Contrived food labels for testing student knowledge of nutrition facts. The labels are based on those currently required by the Food and Drug Administration on prepared foods sold in the United States.

Label A

Nutrition Facts	
Serving Size 1	
Amount Per Serving	
Calories 170 Calories from Fat 110	
	%Daily Value*
Total Fat 11g	17%
Saturated Fat 1.5g	8%
Cholesterol 0mg	0%
Sodium 250mg	10%
Total Carbohydrate 26g	9%
Dietary Fiber 3g	12%
Sugars 3g	
Protein 4g	
Vitamin A 0% * Vitamin C 45%	
Calcium 2% * Iron 6%	
Vitamin E 6% * Thiamin 4%	
Riboflavin 2% * Niacin 4%	
Vitamin B6 2% * Phosphorus 2%	
*Percent Daily Values based on a 2,000 calorie diet.	

Label B

Nutrition Facts	
Serving Size 1	
Amount Per Serving	
Calories 120 Calories from Fat 30	
	%Daily Value*
Total Fat 3.5g	5%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 95mg	4%
Potassium 300mg	8%
Total Carbohydrate 16g	5%
Dietary Fiber 3g	12%
Sugars 12g	
Protein 6g	
Vitamin A 10% * Vitamin C 0%	
Calcium 30% * Iron 6%	
Vitamin D 30% * Riboflavin 30%	
Vitamin B12 50% * Folate 6%	
Zinc 4%	
*Percent Daily Values based on a 2,000 calorie diet.	

Label C

Nutrition Facts	
Serving Size 1	
Amount Per Serving	
Calories 100 Calories from Fat 0	
	%Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 0mg	0%
Potassium 720mg	21%
Total Carbohydrate 26g	9%
Dietary Fiber less than 3g	12%
Sugars 3g	
Protein 4g	
Vitamin A 0% * Vitamin C 45%	
Calcium 2% * Iron 6%	
Thiamin 8% * Riboflavin 2%	
Niacin 8% * Vitamin B6 10%	
Folate 6% * Phosphorous 6%	
Zinc 2% * Magnesium 6%	
*Percent Daily Values based on a 2,000 calorie diet.	

A   B   C

Results and Discussion

Body Mass Index: Overall

We found that 34.4% of boys and 36.3% of girls were overweight (Table 3), similar to the 34.9% of boys and 33.6% of girls who were categorized as overweight during the first year of the study[1]. Likewise, about 20% of students were again at-risk-of-overweight. Average overall BMIPs were near the CDC 85th percentile cutoff separating healthy weight from at-risk-of-overweight individuals. High BMIPs of about 75 were seen even in the youngest students. This was far above the average BMIP of 50 for all ages in the CDC reference population. The weight of one 18-year-old girl exceeded the 200-kg capacity of our balance, giving her a BMI greater than 73 kilograms per meter square, nearly three times the BMI cutoff for overweight in adults.

Chi-square analyses comparing the proportions of healthy weight, at-risk-of-overweight, and overweight boys and girls of the same age revealed differences at ages 14 ($P = 0.050$) and 16 ($P = 0.011$). Significantly more boys had healthy weights at these ages. Otherwise, before age 14 and after age 16, the distribution of students among the healthy weight, at-risk-of-overweight, and overweight categories were about the same for both sexes.

Similar chi-square comparisons of adjacent ages for boys and girls separately gave significant differences between ages six and seven ($P = 0.058$ for boys, $P < 0.001$ for girls) and between ages 12 and 13 for boys ($P = 0.023$) and ages 13 and 14 for girls ($P = 0.036$). For boys, the percentage at a healthy weight between ages six and seven decreased from 60.9% to 48.9%, or 12.0 points, while the percentage who were overweight increased 12.3 points to 32.6%. Those who were at-risk-of-overweight remained constant at about 18.3%, that is, an equal percentage of healthy weight boys moved into the at-risk-of-overweight category as

Table 3. Percentages of students who were underweight (UW), at a healthy weight (HW), at risk of overweight (AR), and overweight (OW) by gender and age; their average body mass index (BMI) with standard deviation (StDev); their average body mass index percentile (BMIP) with standard deviation; and the number of students (N).

Boys		Percent				BMI (kg/m*m)		BMIP (%-tile)		N
		UW	HW	AR	OW	Average	StDev	Average	StDev	
Overall		0.2	45.9	19.5	34.4	23.92	7.14	80.39	20.94	2107
AGE (years)	5	0.0	64.0	21.1	14.9	17.20	2.75	74.24	20.26	114
	6	0.7	60.9	18.1	20.3	17.80	3.59	75.43	21.60	138
	7	0.0	48.9	18.5	32.6	20.91	8.13	78.88	21.20	135
	8	0.0	50.0	19.1	30.9	19.96	4.62	78.45	22.03	136
	9	0.0	57.7	16.2	26.1	19.96	4.45	75.63	21.53	142
	10	0.0	45.8	16.1	38.1	21.92	4.73	80.90	19.98	118
	11	0.0	43.4	22.0	34.6	22.81	5.11	82.28	18.83	127
	12	0.7	47.7	12.4	39.2	24.17	6.70	78.18	23.78	153
	13	1.4	47.6	23.0	28.0	24.18	5.98	78.03	23.47	143
	14	0.0	38.9	23.4	37.7	26.05	6.20	82.43	20.40	257
	15	0.0	39.4	20.8	39.8	27.54	7.22	83.31	19.81	216
	16	0.0	37.2	18.3	44.5	28.42	6.73	84.48	19.22	191
	17	0.0	35.6	19.7	44.7	29.06	6.68	85.34	18.45	188
	18	0.0	47.0	22.4	30.6	29.39	8.71	81.02	19.06	49

| Girls		Percent				BMI (kg/m*m)		BMIP (%-tile)		N
		UW	HW	AR	OW	Average	StDev	Average	StDev	
Overall		0.3	40.6	22.8	36.3	24.85	7.52	81.56	20.58	2107
AGE (years)	5	0.0	58.6	18.2	23.2	17.22	2.51	75.26	20.94	99
	6	0.8	64.3	22.2	12.7	17.22	2.98	71.26	22.12	126
	7	0.0	52.4	14.8	32.8	20.25	7.25	76.45	23.66	128
	8	0.8	60.0	15.8	23.4	19.43	4.99	73.99	22.45	120
	9	0.7	47.9	15.5	35.9	20.94	4.88	76.66	24.60	142
	10	0.0	45.3	25.0	29.7	21.49	4.51	76.62	24.50	128
	11	0.0	45.4	24.1	30.5	22.85	4.85	79.62	21.98	141
	12	0.0	38.1	20.1	41.8	25.55	6.46	82.81	20.31	134
	13	1.2	40.1	21.6	37.1	26.06	6.74	83.06	20.47	167
	14	0.0	29.0	29.0	42.0	27.58	6.15	86.83	15.60	272
	15	0.0	29.3	22.3	48.4	29.29	6.79	87.82	15.13	215
	16	0.0	27.0	30.7	42.3	29.68	7.12	87.75	14.53	189
	17	0.0	30.0	24.0	46.0	30.31	7.68	85.00	18.59	200
	18	0.0	37.0	28.2	34.8	29.57	7.51	82.49	20.42	46

moved out and into the overweight category.

For 6- and 7-year-old girls, the 11.9-point decrease in healthy weight from 64.3% to 52.4% was similar to the rate seen for boys. However, the increase in the percentage who were overweight—from 12.7% for 6-year-olds to 32.8% for 7-year-olds—was much greater than the increase in percentage for boys. Although both boys and girls showed an equal decline in the percentage of healthy weight individuals between ages six and seven, our results indicated that girls may be more susceptible to greater weight gain then.

For 13- and 14-year-old girls, the percentage at a healthy weight decreased from 40.1% to 29.0%, or 11.1 points, while the at-risk-of-overweight and the overweight percentages increased by 7.4 and 4.9 points, respectively. Girls may be particularly susceptible to weight gain at this age. A study by the National Heart, Lung, and Blood Institute found that girls between ages nine and 12 were especially at risk of becoming overweight[7]. The study, however, did not address why, nor did it examine boys to see whether they faced a similar risk. Samoan girls may lag a year behind the study group of 2,300 black and white girls for several reasons. Perhaps they remain more physically active doing chores or playing sports. They might also be less exposed to sedentary lifestyle influences such as hours on the phone and similar distractions. Alternatively, Samoan girls may take more meals at home than in a fast-food setting.

While the percent of healthy weight 12- and 13-year-old boys remained unchanged at about 47.6%, the percent at-risk-of-overweight increased by 10.6 points, while the percent who were overweight decreased by 11.2 points. This anomalous decrease in the percentage of overweight boys at age 13 was reversed at age 14 along with an 8.7-point decline in the percentage of healthy weight boys. This later transition between 13- and 14-year-old boys corresponded to the same age transition period for girls. We used

this transition period, along with the 6- to 7-year-old transition, as the basis for dividing our sample into three age groups: 5- and 6-year-olds, 7- to 13-year-olds, and 14- to 18-year-olds (Fig. 1). Children within each age group were homogenous in the proportions of healthy weight, at-risk-of-overweight, and over-weight individuals. The difference between these divisions were highly significant ($P < 0.001$) for both sexes.
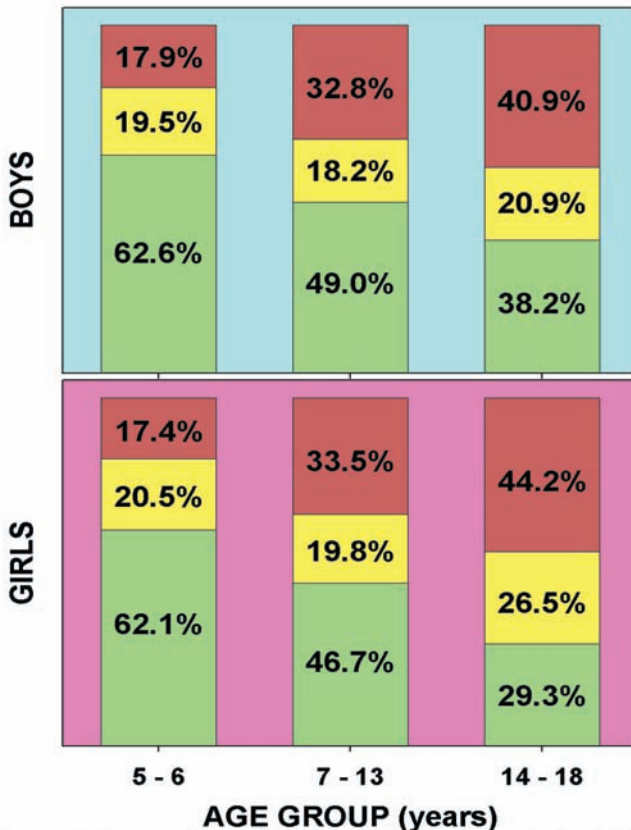
Figure 1. Proportions of Healthy Weight (green), At-Risk-of-Overweight (yellow), and Overweight (red) students by Gender and Age Group.

Because the CDC BMI growth charts[2] take into account the changing physiology of children and adolescents as they grow, the abrupt changes in the proportions of students distributed among the CDC BMI categories during these age transitions must be due to one or more other factors. Ms. Maggie Keane, CEO of Ina'ilau a Tama'itai'i, Inc., pointed out that benefits from the US Department of Agriculture Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) expire when the child reaches age five. Benefits include nutritious foods to supplement the diet, information on healthy eating, and referrals to health care. Loss of these benefits might contribute to a change from a relatively healthy diet to one with increased proportions of less expensive, less nutritious, energy-dense foods. A survey by researchers at the University of Washington found that energy-dense foods, such as sweets and snacks, cost an average of $1.76 per 1,000 calories compared with $18.16 per 1,000 calories for low-energy but nutrient-dense foods such as fruits and vegetables[8]. Switching from low-energy to high-energy foods owing to loss of WIC supplemental income might then result in children—girls especially—gaining excessive weight over the following year or two. This likelihood must be taken seriously in American Samoa, where two of three children live in poor families[9].

Dr. Stacey Wiles, a pediatrician at LBJ Tropical Medical Center, suggested that the spike between six and seven years of age might be due to the school environment. Children transition from kindergarten to full school days, resulting in fewer parent-supervised meals. Lack of close supervision and encouragement might also lead children to skip vegetables but to eat dessert. And as children sit in classes for more hours, their total caloric expenditure tends to decrease.

However, a study of 5,380 kindergartners and first-graders by researchers from Indiana and Ohio State Universities found that the youngsters' BMIs in-

creased on average more than twice as much during summer break compared with the school year[10]. The increase was even greater for children who were already overweight at the start of kindergarten. They concluded that the 5- and 6-year-olds experienced a more structured routine with school activities as opposed to plenty of free time eating snacks and watching television when at home.

Age 13 was when the highest percentage of underweight was evident for either sex (Table 3). Percentages for healthy weight were relatively high and percentages for overweight low, particularly for boys, at this age too. The second spike in overweight between ages 13 and 14 might be attributed to the physiological effects of puberty having a greater impact on ethnic Samoan adolescents than on the CDC reference population. Factors fueling obesity in American Samoa might be more pronounced or less avoidable as well for adolescents in their early teens.

Body Mass Index: Manu'a vs. Tutuila Islands

Last year we surveyed only 117 students from Manu'a Island schools. This proved to be too small a sample for comparative tests. This year we surveyed 225 students from Olosega and Faleasao Elementary Schools and Manu'a High School, allowing us to perform chi-square analyses.

Although we reported that the prevalence of overweight among American Samoan girls in this current survey was 36.3%, a chi-square comparison between girls from Manu'a and Tutuila found a significant difference ($P = 0.010$). The percentage of overweight girls from Manu'a was only 23.3% compared with 37.2% of overweight girls from Tutuila and Aunu'u. The prevalence of normal weight for Manu'a girls, 48.3%, was also greater than the 40.3% prevalence for Tutuila girls. We found no prevalence differences between Manu'a and Tutuila Island boys.

Diet

About one in four students reported having eaten prior to attending school. Bread/bun, usually as a meat sandwich, was the most frequently eaten item. Three more carbohydrates followed it: cereal/oatmeal, juice/soda, and sweets/sugar (Fig. 2). Slightly more than one hundred students had a breakfast that included high-fat items such as bacon/spam/sausage (ranked sixth), and about two dozen students stopped at a fast-food restaurant on their way to school.
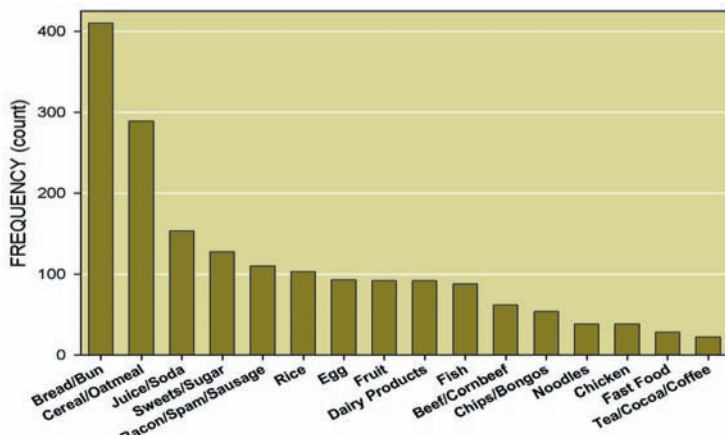

Figure 2. Foods eaten for breakfast by 550 boys and 566 girls prior to attending school.

Carbohydrates, that is, sugars and starches, may behave quite differently in our bodies by their effect on blood glucose levels. The glycemic index (GI) describes this difference. Low GI carbohydrates (GI less than 56) produce only small fluctuations in blood glucose and insulin levels, thus helping to control appetite and delay hunger. High GI carbohydrates (GI 70 or greater), on the other hand, quickly raise blood glucose levels and may promote heart disease and diabetes[11].

We examined the GI of the most frequently eaten breakfast carbohydrates. White bread and cereals

(Cheerios™, corn flakes) had high GIs of 70 and 75, respectively[12]. Other favorite breakfast choices had low to moderate GIs. Oatmeal had a GI of 48, unsweetened apple juice (the base in Just Juice™) was 40, while Coca-Cola™ was 63[12]. Both juice and soda have been implicated in contributing to overweight[13], even if the latter were sugar-free[14]. Sweets, the fifth-ranked choice, probably have a GI of 58, similar to that of sugar[12].

High school students were more likely to eat breakfast prior to attending school (Fig. 3). Reasons generally centered around heartier morning appetites, a reluctance to wait in line for school breakfast, or a dislike of school breakfast menus.
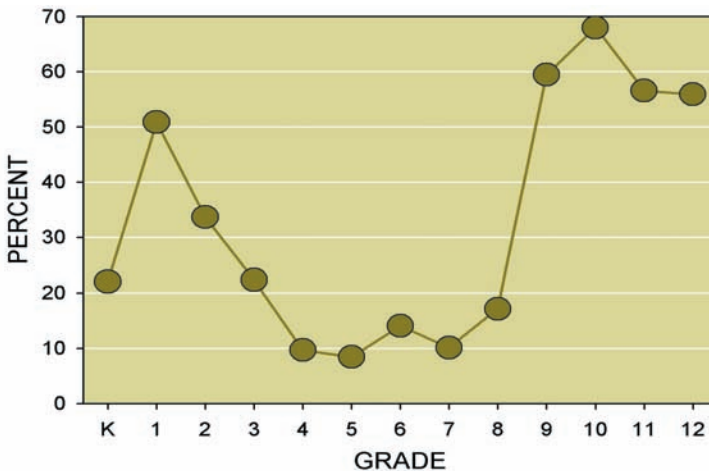
Figure 3. Percent of students in each grade who reported eating prior to attending school.

Between five and 15% of students of all ages reported eating no supper the previous evening. Of those who did eat, rice was by far the most popular carbohydrate, while chicken and fish were the chief sources of protein (Fig. 4). Fast food, sweets/sugar, juice/soda, and chips/Bongos ranked low in frequency eaten.
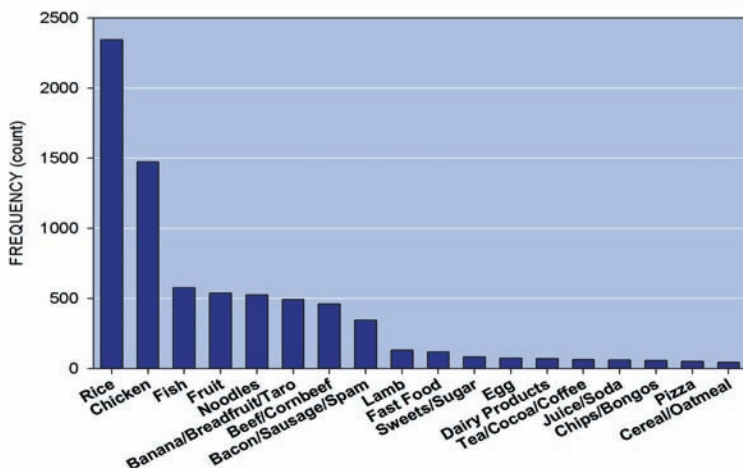
Figure 4. Foods eaten for supper the previous evening by 1,875 boys and 1,890 girls.

Imported apples, oranges, and carrots were the fruits and vegetable of choice (Fig. 5). Even in Manu'a, which lies about 75 mi (120 km) east of Tutuila with limited air and sea transportation, students reported apples and oranges as their first and second fruit choices and carrots fourth, after cabbage. Students selected locally grown fruits such as mango, papaya, and breadfruit far less frequently. In the case of mango and papaya, limited availability rather than actual preference may account for their low rankings.
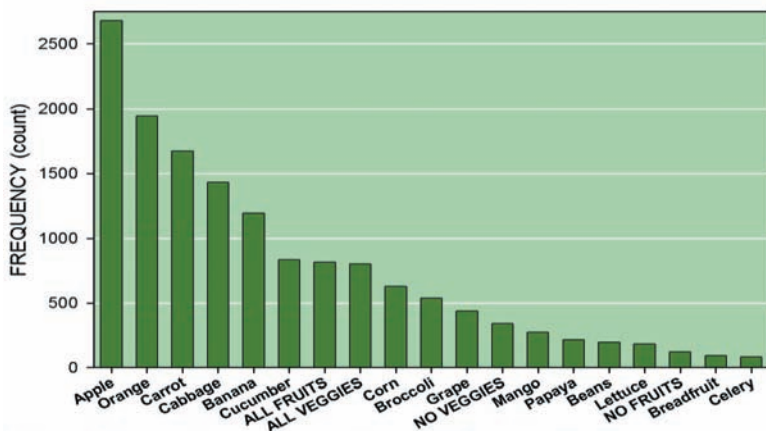
Figure 5. Popular fruits and vegetables of 2,078 boys and 2,080 girls.

Whether boy or girl (n = 2,107 each), elementary (n = 2,438) or high school (n = 1,776) student, answers to diet-related questions were remarkably similar. The only significant difference (Wilcoxon Signed Rank Test on paired replicates, $P = 0.006$) that we discovered was in breakfast choices between students from Tutuila and students from Manu'a. While about 10% of students from Tutuila selected bread/bun as the most frequently eaten breakfast item, only 2.7% of students from Manu'a did so. Instead, cereal/oatmeal (5.3%) was their first choice followed by sweets/sugar and dairy products (3.1% each). Other less striking differences in home breakfast choices between Tutuila and Manu'a students, respectively, were juice/soda (3.8% vs. 0.4%), beef/corn beef (1.6% vs. none), and chips/Bongos (1.4% vs. none).

Slightly more than half the students correctly selected label C of Table 2 as the food choice lowest in calories and fat (Table 4). Overweight students were the most knowledgeable (65.5%), followed by at-risk-of-overweight students (56.8%) and normal weight students (46.7%). Many snacks and dairy products sold in American Samoa are labeled according to the Food Standards Australia New Zealand (FSANZ), which uses the metric energy unit, the *joule*, in place of the calorie. The students' level of knowledge in reading FSANZ labels may be even lower.

Table 4. Number of students, N, by age who selected a label from Table 2, and the percent who correctly selected label C. *P* is the cumulative binomial distribution probability for the percent correct.

Age	N	Percent	P
13	47	46.8	0.019
14	267	57.7	< 0.001
15	254	56.7	< 0.001
16	215	56.7	< 0.001
17	207	62.8	< 0.001
18	44	54.5	0.001

Physical Activity

In order to gain an understanding of how students used their time when not in school, we asked what they did the previous day or what they planned to do that afternoon or evening. If their response was a sedentary activity such as "homework" or "nap," we prompted them in order to find if they also intended to play outside, do chores, or engage in some other physical activity.
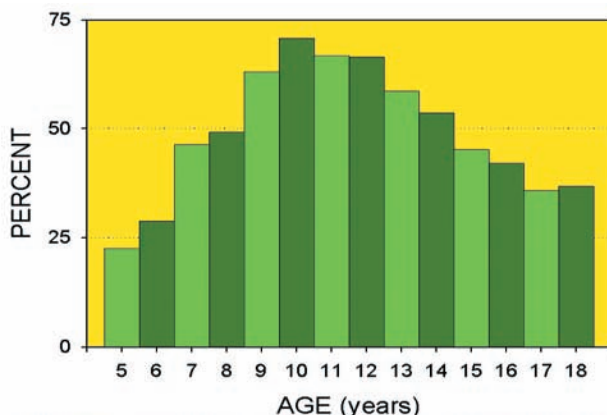
Figure 6. Percentages of students, by age, who reported having chores either the previous day or after school on the current day. The total included 970 boys and 1,120 girls.

We found that nearly half of all students, regardless of gender or CDC BMI category, had an after school chore ranging from babysitting to picking up litter (Fig. 6). The percentage engaged in chores rose with age, peaked at age 10 and then steadily declined. However, a significantly greater percentage of students on Manu'a performed chores compared with students on Tutuila ($P < 0.001$). While less than half the boys on Tutuila (46.2%) reported having chores, two of every three (67.0%) boys on Manu'a did. For girls on Tutuila, slightly more than half (53.2%) reported having chores, while on Manu'a three of every four (75%) girls performed chores.
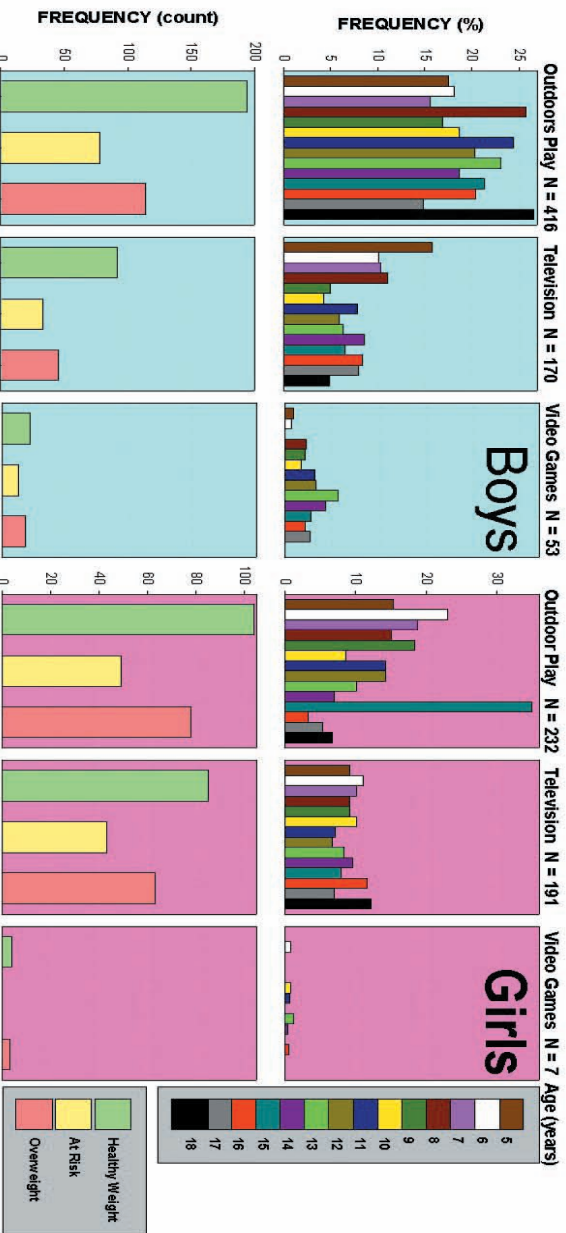
Figure 7. Numbers of students who played outdoors, watched television, or played video games after school by gender, age, and CDC BMI Category. Frequency in top row refers to the percent for each age by gender. Frequency in the bottom row refers to the number of students for each activity by gender.

Less than one in five boys and one in nine girls engaged in some type of outdoor play (Fig. 7). Outdoor games appealed to boys regardless of age but declined with age for girls, except for a spike for girls aged 15 years. About 5-10% of students reported watching television regardless of age or gender, with the exception of 5-year-old boys (16%). The most striking difference between boys and girls was the number who played video games. Although boys were seven times more likely than girls to engage in this pastime, less than 3% actually did so. For all three activities—outdoor play, television, and video games–most of the students had healthy weights.

No Manu'a student participated in a sport. On Tutuila, football was the most popular sport of boys while girls preferred dance (Fig. 8). Both boys and girls also enjoyed basketball, volleyball, and soccer followed to a lesser degree by Junior Reserve Officers' Training Corps, softball, jogging, weight lifting, and swimming. Taken together, only about 10% of boys and 5% of girls participated in some type of strenuous after-school sports activity. Football, dance, basketball, and volleyball were activities where overweight students outnumbered healthy weight individuals.

<u>Commentary</u>

Many of today's young and middle-aged adults were children or adolescents in 1978 and 1982 when University of Alabama Professor James Bindon visited American Samoa and collected BMI data on 130 boys and 138 girls between 11 and 18 years of age. Retroactively applying IOTF cutoffs, which were published in 2000, to Bindon's data revealed that the prevalence of obesity was 3.8% for boys and 8.0% for girls[15]. We may presume that these rates were even lower for older American Samoan adults who, as children, grew up in a more traditional, less commercialized society when ample time was allotted for vigorous recrea-
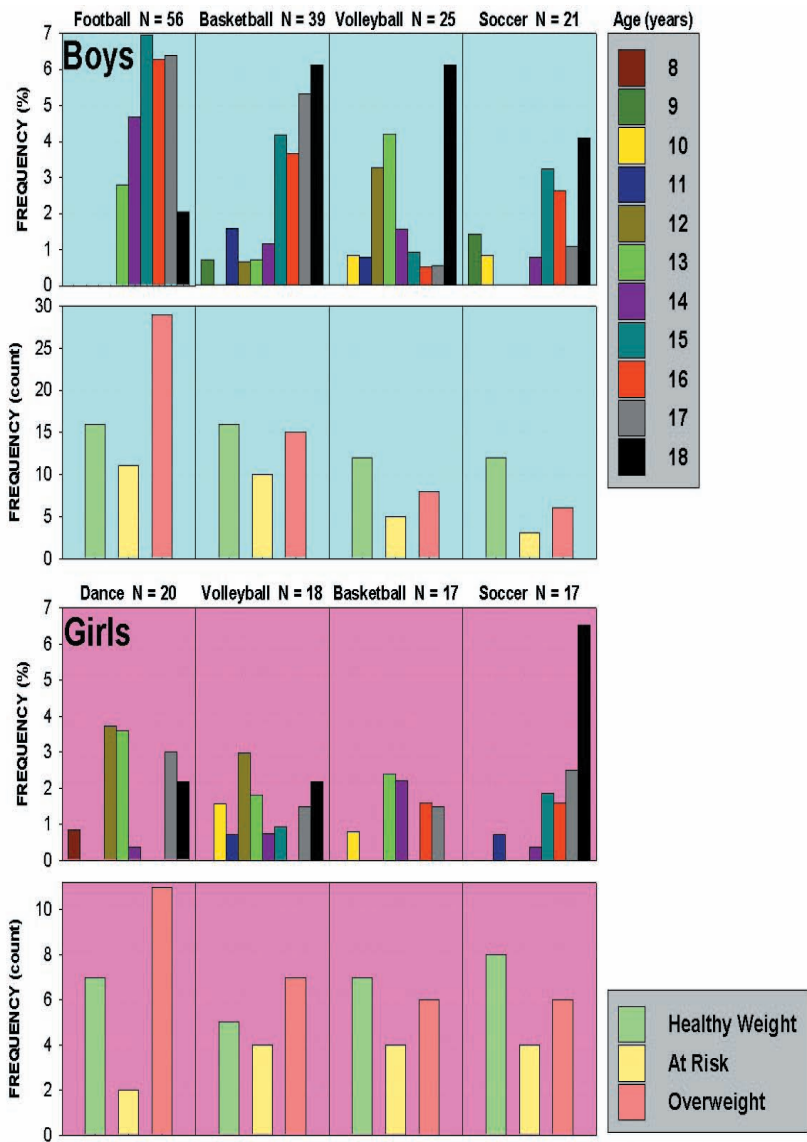
Figure 8. Numbers of students who participated in an after-school sport by gender, age, and CDC BMI category. Frequency (%) refers to the percent for each age by gender. Frequency (count) refers to the number of students for each sport by gender.

tional activities[16]. Given these healthier starts in life, what is the health status of American Samoan adults 25 to 64 years of age now?

American Samoa has one of the highest rates of diabetes in the world at 47.3%[17]. LBJ Tropical Medical Center Board Chairman, Charles Warren, cited that it costs five times more for the hospital to care for diabetic patients than for non-diabetic patients, that is, $13,243 vs. $2,650 per year[18]. Almost all adults in American Samoa have one or more of the major risk factors for a noncommunicable disease: smoking, obesity, hypertension, low consumption of fruits and vegetables, and low level of physical activity[17]. With 93.5% of the adult population either overweight or obese[17], American Samoans are exceeded only by Nauruans (94.5%) as the most overweight people in the world[19]. And since our report last year[1], another fast-food restaurant has joined the five already operating here, offering the allure of a three-pound lunch.

What, then, are the health implications for today's youth, of whom more than one in three is already obese, as they enter adulthood? The physical and psychological effects of being overweight can last a lifetime[20]. Human beings develop their tastes at an early age and have difficulty changing them. The number of fat cells is set during childhood and adolescence, and the most important factor in determining fat mass in adults is linked to previously developed fat cells[21].

The *cause* of obesity is nothing more complicated than a habit of eating more calories than are used up while resting and moving. Eating excessive amounts of highly processed foods and foods high in sugar, saturated fats, or trans fats generally account for the first part of the cause. Using muscles for little more than demanded by a sedentary lifestyle accounts for the second part. However, this energy imbalance is not simply due to gluttony and sloth, as some critics charge. Efforts to make our lives more comfortable

contribute towards obesity. Our biology has not kept up with the pace of change in society. The result is that individuals—children especially–have much less choice regarding their weight than is generally assumed.

Surprising factors have recently been linked to childhood obesity, ranging from plasticizers and other hormone-mimicking contaminants leached from food and beverage containers[22] to poor nutrition during pregnancy[23] and insufficient sleep[24]. Such correlational observations cannot adequately account for all collateral influences, most of which may be unknown, that also affect obesity. These other influences, called *confounding variables*, limit the usefulness of such studies in determining a *cause* for obesity. This is why, too, no single intervention short of forced starvation will have much of an impact on reducing obesity.

Results presented here and in other obesity studies in American Samoa can serve as important evidence-based resources to help shape public policy. Yet change may come slowly. In addition to overcoming apathy and inertia, at least three other challenges must be confronted. First, understaffed government departments already struggle with multi-faceted problems; second, political lifetimes are short compared with the amount of time interventions may need to have an impact; and third, complex problems beset with uncertainty might be marginalized by policymakers who want simple and certain solutions.

Nevertheless, several efforts have already been initiated to address the problem. In July 2007, ASDOE contracted Sodexho School Services to conduct a system-wide needs assessment of the food services in each school participating in the federal School Lunch Program[25]. Pediatric nutritionist Dr. Keith-Thomas Ayoob cautions that following the Institute of Medicine's nutrition guidelines for foods served and sold in schools may not have a large impact on reducing childhood obesity[26]. Students spend only six hours in

school, five days a week. Once outside of school, they are again exposed to the lure of foods high in fat, sugar, and salt. However, a recent study in five Philadelphia elementary schools that replaced sodas with fruit juice, scaled back snacks, and banished candy reduced the obesity risk by half[27]. But students, along with parents and teachers, were also given hours of instruction about good nutrition. The take-home message: A multicomponent school-based intervention can be effective.

Other partnerships that are helping children combat weight gain are the American Samoa Nutrition Coalition, Ina'ilau a Tama'ita'i, Savali Mo Oe, Healthy Kids Summer Camp, and the ASCC/GEAR-UP Fitness Mini-camp to name a few. In addition to playgrounds at Pago Park, Lion's Park, McDonald's restaurant, and various schools, a village playground in Vailoatai offers an opportunity for children to burn calories while having safe fun.

As former Arkansas Governor and Presidential Candidate Mike Huckabee stated, "We don't have a health care crisis in this country. We have a health crisis." By working together and with parents, policy makers and community leaders, concerned people can bring about needed change. Otherwise, we bequeath our children a legacy of shortened lifetimes constrained by chronic illnesses and a bankrupt health care system to treat them.

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