Prevalence of Obesity
in
American Samoan Schoolchildren

(2008/2009 School Year)

Report to the Directors

Department of Health
Department of Education

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ABSTRACT

The prevalence of obesity among children and adolescents in American Samoa is much higher than in the United States, where recent evidence suggests that it may have reached a plateau. We attempted to investigate if the prevalence of obesity in the Territory might be following a similar trend. We compared the prevalence of overweight and of obesity for students aged 6-11 and 12-19 using cross-sectional data taken over the past three years. We also measured changes in the body mass index (BMI) percentile in a cohort of schoolchildren over a two-year span who were now in grades 2, 5, 8, and 11 in all public schools of the Territory. We also questioned students concerning behavioral and social practices known to contribute to obesity. Overall, 55.6% of students were either overweight or obese, though the prevalence was lower for younger students and increased considerably with age. We discovered tentative evidence that the prevalence of obesity of schoolchildren in American Samoa may have stabilized. From our questions we found that students may be getting less than the optimal amount of sleep: many overweight and obese students reported being sleepy in class. In getting to and from school, most elementary school students rode the school bus, but high school juniors, particularly girls, depended more upon cars. The majority of students lived in two-parent households and reported dining at home with their family every evening around seven o'clock. Nearly half, though, reported dining out at least once a week. Dining habits were independent of BMI category. Eighty percent of high school juniors who were at a healthy weight, 74% who were overweight, and 48% who were obese regarded themselves as at an ideal weight. Students from all four grades believed they got an ample amount of exercise daily. Inadequate sleep, reliance on vehicles rather than walking to school, and social norms that are skewed toward accepting obesity may be major contributing factors toward the high prevalence of obesity in the Territory's schoolchildren.

Obesity Study Committee

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For the past three years we attempted to accurately determine the prevalence of obesity among the Territory's schoolchildren. Prior to 2009, the Centers for Disease Control and Prevention, or CDC, did not use these two terms for categorizing children and adolescents. Consequently, our first two reports[1, 2] used the CDC-recommended terms "at risk of overweight" and "overweight" for overweight and obese, respectively. Now that the CDC has adopted these latter two terms[3], reference herein to our two earlier reports will be adjusted to the new terms.

During the 2006/2007 school year, we measured the body mass index, or BMI, and the waist circumference of 2,795 boys and 2,621 girls[1]. The children were in grades kindergarten (K5), 3, 6, 9, and 12 at all public and private schools in the Territory. According to the CDC's age– and sex-specific cutoffs for BMI, about 20% of students were overweight and 34% were obese. These exceeded the 15.6% prevalence of overweight and 16.3% prevalence of obesity in US children in 2003-2006[4]. We found that 40% of students had waist circumferences indicative of high abdominal fat[1]. The prevalence of overweight, obesity, and high abdominal fat all increased with age[1].

During the 2007/2008 school year, we measured the BMI of 2,107 boys and 2,107 girls[2]. Students were from kindergarten (K-5) to grade 12 at eight public elementary schools and three public high schools. We again found a high prevalence of overweight and of obesity that increased with age. While only 17.5% of children aged 5 and 6 were obese, about 42% of adolescents 14- to 18-years old were obese. Reported food choices suggested that diets were not particularly high in fatty foods and junk foods. While only 5% of students participated in an after-school sport, about half the students reported performing a chore that required some level of physical activity.

This report addresses the results of the 2008/2009 school year survey. We revisited students measured two years earlier and who were now in grades 2, 5, 8, and 11 at all 23 public elementary schools and all six public high schools. Our goal was to determine how these students had changed in height and weight over the past 24 months. We used the BMI percentile to assess the size and growth of individual stu-

dents. The BMI percentile was used because children and adolescents naturally grow taller and heavier with age. This changes their BMI, which is an *absolute* value. But their BMI percentile may remain unchanged throughout their developmental years because it is a *relative* value, that is, relative to changes in the BMI of others of the same age and sex.

Although the CDC BMI charts were derived from cross-sectional samples of children and do not directly represent the longitudinal growth trajectory of the same set of children, this use of the BMI percentile to track the same set of our students offered an unbiased means to compare their growth changes over two years.

MATERIALS AND METHODS

As before, we conducted our survey under the auspices of the American Samoa Department of Health with the approval of its Institutional Review Board. We also were in compliance with the Family Educational Rights and Privacy Act, administered by the American Samoa Department of Education (ASDOE). Through student identification numbers provided by the ASDOE Chancery Office, we were able to match BMI percentiles of individual students surveyed two years earlier with their current BMI percentiles. Of the 3,478 students surveyed during the current period, nearly 75% could be matched to their earlier records. The few matched records that did not differ by 24 months were adjusted to reflect a 24-month difference.

Measuring height and weight, and their conversion to BMI and BMI percentile, are detailed elsewhere[1]. We asked students about the amount of sleep they got; how they traveled between home and school; whether they lived with both, one, or neither parent; what hour they ate supper, how often they ate supper as a family, and how often they ate out for supper. We also asked if they thought they got enough exercise each day, and asked high school juniors to rate their body image.

We surveyed students in grades 2, 5, and 8 from each of the Territory's 23 public elementary schools and juniors from each of the six public high schools (Table 1). Owing to the small number of underweight students, this BMI category

was omitted in most analyses. Unless otherwise noted, inferential statistical analyses were performed using the chi-square goodness-of-fit test.

Table 1. ASDOE Elementary and High Schools with the Number of Students in Grades 2, 5, 8, and 11 in each BMI Category* as defined by the Centers for Disease Control and Prevention[3]

School	Boys					Girls				
	UW	HW	OW	OB	Total	UW	HW	OW	OB	Total
A.P Lutali	0	9	3	2	14	0	10	3	1	14
Afonotele	0	9	0	6	15	0	6	1	7	14
Alataua-Lua	0	34	7	15	56	0	17	10	13	40
Alofau	0	7	7	6	20	0	14	3	4	21
Aua	0	25	11	24	60	0	29	20	17	66
Faga'itua HS	0	13	8	22	43	0	16	15	24	55
Faleasao	0	9	3	2	14	0	8	3	3	14
Fitiuta	0	7	3	3	13	0	11	0	2	13
Lauli'i	0	24	2	13	39	0	16	3	12	31
Le'atele	0	12	4	6	22	0	12	8	9	29
Leone HS	0	24	18	35	77	0	16	25	35	76
Leone Midkiff	0	80	41	42	163	0	74	36	47	157
Lupelele	0	58	26	59	143	1	52	33	42	128
Manu'a HS	0	1	3	3	7	0	3	1	6	10
Manulele	0	89	27	55	171	0	68	37	49	154
Manulele Jr. High	0	69	32	44	145	1	68	32	40	141
Masefau	0	10	3	4	17	0	7	8	5	20
Matafao	0	36	14	40	90	0	38	21	34	93
Matatula	2	11	6	14	33	0	23	3	13	39
Mt. Alava	0	4	5	3	12	0	3	4	5	12
Olomoana	0	14	6	6	26	0	6	3	7	16
Olosega	0	6	2	6	14	0	2	2	2	6
Pavaiai	0	114	49	57	220	0	82	39	45	166
Peter Coleman	2	68	19	40	129	0	53	22	44	119
Poly Tech HS	0	14	8	16	38	0	3	3	7	13
Samoana HS	2	19	16	26	63	0	28	13	27	68
Siliaga	0	19	8	7	34	0	11	6	3	20
Tafuna HS	1	40	24	44	109	1	26	37	68	132
Taputapu	0	6	5	5	16	0	2	2	4	8
Total	**7**	**831**	**360**	**605**	**1803**	**3**	**704**	**393**	**575**	**1675**
Percent	**0.4**	**46.1**	**20.0**	**33.6**	**100**	**0.2**	**42.0**	**23.5**	**34.3**	**100**

* BMI categories are underweight (UW) if less than the 5th BMI percentile; healthy weight (HW) if between the 5th but less than 85th BMI percentile; overweight (OW) if between the 85th but less than 95th BMI percentile, and obese (OB) if equal to or greater than the 95th BMI percentile.

RESULTS AND DISCUSSION

BMI—Overall

The overall prevalence of obesity was about 34%. Another 20% of boys and 23% of girls were overweight (Table 1). These results were consistent with what we found in our earlier two studies[1,2]. For comparison, the prevalence of obesity of children and adolescents in the United States surveyed between 2003-2006 was 16.3% with another 15.6% categorized as overweight[4].

Assigning children and adolescents to one of the four CDC BMI categories uses the same CDC BMI charts[3] whether for American Samoa or the United States. These charts are based on pooled growth parameters of children and adolescents sampled in the United States from 1963 to 1994. That data gave a bell-shaped distribution curve for each sex over a range of ages from 2 to 20 years. These curves were then mathematically smoothed to yield age– and sex-specific BMI growth charts[3]. From these a BMI percentile can be obtained based on a child's BMI, age, and sex.

A BMI percentile of, say, 85, means that 84% of the children of the same age and sex in the CDC's sample had a BMI lower than the child being measured, and 14% of the children in the CDC's sample had a higher BMI. A BMI percentile of 85 or more but less than 95 places the child in the overweight category. A BMI percentile of 95 or more categorizes the child as obese.

A z-score is an alternate way of expressing a BMI percentile. The ideal bell-shape curve of the CDC sample has a z-score of zero at the 50th BMI percentile, or central peak. For reasons best left to statisticians, a z-score equal to 1 is equivalent to the 84th percentile. By grouping our students' z-scores into equal intervals and counting how many students fell into each interval, we made a bar chart called a *histogram*. We then applied an equation to give the best bell-shaped curve to fit the histogram. This allowed us to compare our students' bell-shaped curves against the ideal bell-shaped curves used for the CDC BMI charts growth charts[3] (Fig. 1).

The average z-score for our students shifted by about 1.15 units (the x values, Fig. 1) relative to the CDC growth curves[3] (not shown). This corresponds to an average BMI percentile of 87, which is just above the CDC's 85th percentile cutoff for overweight, meaning that the average American Samoan student is overweight.

BMI—Matched pairs over two years

Of 1,803 boys and 1,675 girls surveyed this school year, we matched 1,324 (73.4%) of the boys and 1,239 (74.0%) of the girls to their BMI data taken 24 months earlier[1]. Table 2 gives the age of students for the various grades and the number of students for each matched grade pair.

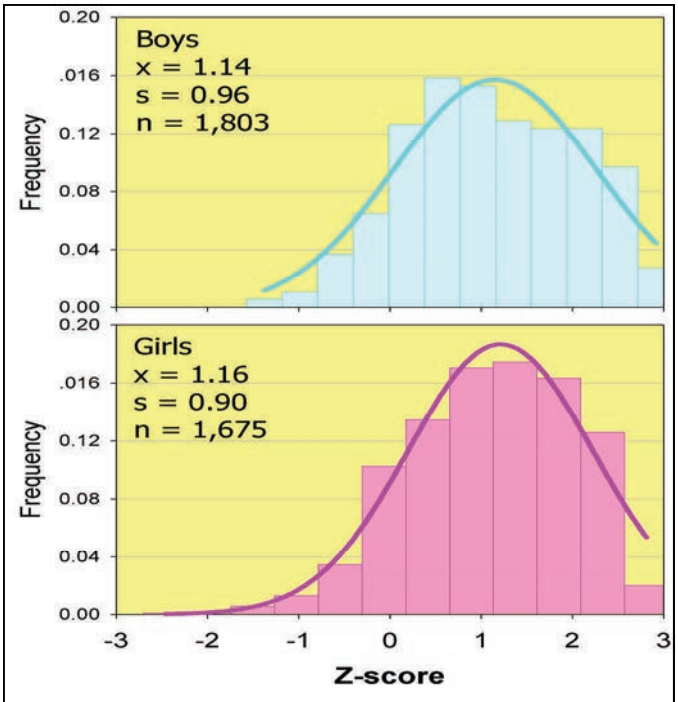

Figure 1. Bell-shaped, or Gaussian distribution curves of z-scores for American Samoan boys (top panel) and girls (bottom panel) during the 2008/2009 school year.

The percentage of healthy weight students in grades 5, 8, and 11 progressively declined over the two-year period (Fig. 2). This trend was consistent with what we found during the previous two years[1, 2], that is, the percentage of healthy weight students declined as grade level increased, with two exceptions: during the 2006/2007 school year, K-5 and grade 3 had similar percentages of healthy weight boys, and boys aged 12 to 14 had a higher percentage of healthy weight individuals than did boys aged 9 to 11[1]. These exceptions do not undermine the prevailing evidence that as students age they tend toward overweight and obesity.

The majority of students remained in the same BMI category over the two year period (Table 3). Even so, their average BMI percentiles increased, reflecting an average overall gain in weight that exceeded their gain in height for age.

Ignoring the seven students in the underweight BMI category, overweight students constituted the most dynamic BMI category. Fifty-six percent of boys and 58% of girls who were overweight during 2006/2007 were overweight during 2008/2009. Most of the others moved into the obese rather than into the healthy weight category. In contrast, 81% of healthy weight students remained in this BMI category after two years, but their average BMIP increased by 1.14 for boys and 4.52 for girls. And while 90% of obese students remained obese, their average BMIP increased by only 0.08 and 0.05 for boys and girls, respectively. The large decreases in BMIP for students who were obese during 2006/2007 but were now at a healthy weight were due to growth spurts rather than to weight loss.

Table 2. Age for Grade for Matched Data

Grade	Age (years) $x \pm s$	Grade	Age (years) $x \pm s$	n
K	5.4 ± 0.3	2	7.4 ± 0.3	571
3	8.4 ± 0.4	5	10.4 ± 0.4	728
6	11.5 ± 0.5	8	13.5 ± 0.5	775
9	14.5 ± 0.5	11	16.5 ± 0.5	489

The mean (x) and standard deviation (s) for age did not differ between boys and girls in the same grade. The sum of the number of boys and girls (n) is given for each matched pair of grades.

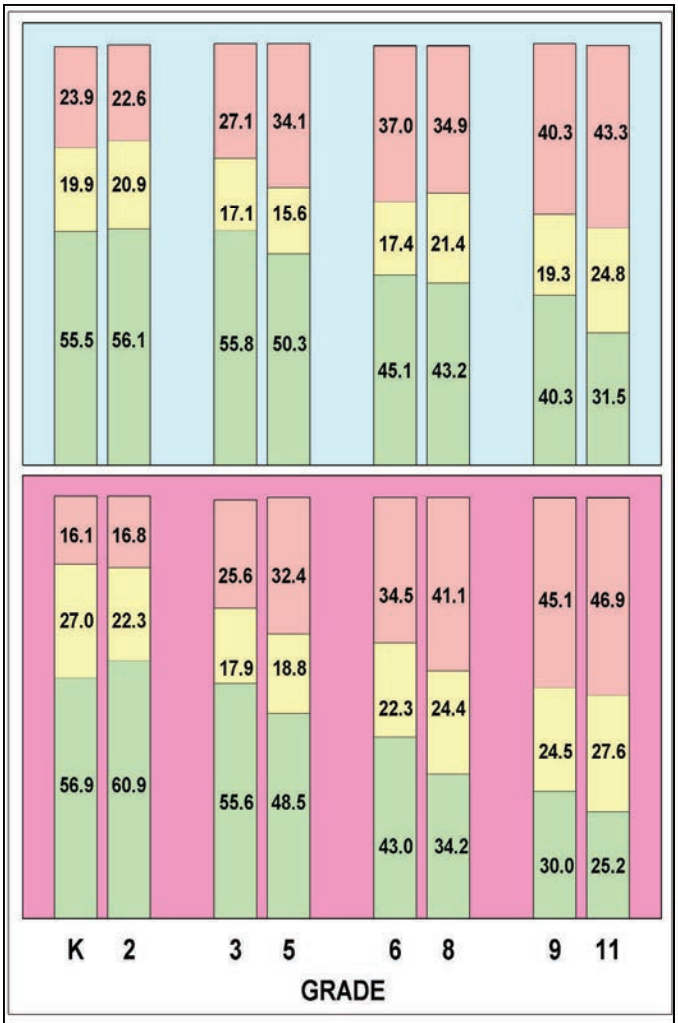

Figure 2. Percentages of obese (red), overweight (yellow) and healthy weight (green) for 1,324 boys (top panel) and 1,239 girls (bottom panel) by grade. Data for grades K, 3, 6, and 9 are from the 2006/2007 school year; data for grades 2, 5, 8, and 11 are from the 2008/2009 school year. Some percentages sum to slightly less than 100% owing to the exclusion of the underweight category.

Table 3. The BMI Category and Change in BMI Percentile (BMIP) of 1,324 Boys and 1,239 Girls measured during the 2006/2007 and 2008/2009 School Years, by Gender

BMI Status		Change in BMIP (x ± s, n)	
2006/2007	2008/2009	Boys	Girls
Underweight	Underweight	1.26 ± 0.98, 3	1.26 ± 0.96, 2
Underweight	Healthy Weight	13.85, 1	3.79 ± 2.29, 3
Underweight	Overweight	NA	NA
Underweight	Obese	NA	NA
Healthy Weight	Underweight	-1.42, 1	-16.13, 1
Healthy Weight	Healthy Weight	1.19 ± 12.14, 562	4.52 ± 13.80, 474
Healthy Weight	Overweight	12.23 ± 9.81, 78	12.62 ± 8.79, 94
Healthy Weight	Obese	22.44 ± 15.53, 19	22.77 ± 12.61, 15
Overweight	Underweight	NA	NA
Overweight	Healthy Weight	-9.15 ± 5.84, 44	-9.17 ± 5.45, 40
Overweight	Overweight	0.32 ± 3.18, 136	0.88 ± 3.48, 164
Overweight	Obese	4.41 ± 2.64, 62	4.48 ± 2.90, 77
Obese	Underweight	NA	NA
Obese	Healthy Weight	-30.86 ± 10.79, 5	-28.51 ± 14.28, 8
Obese	Overweight	-4.73 ± 2.71, 54	-3.37 ± 2.21, 30
Obese	Obese	0.08 ± 1.04, 362	0.05 ± 0.90, 337

Change in BMIP is given by the average BMI percentile change (x), its standard deviation (s), and the number of students (n). NA means "Not Applicable," that is, no student met the BMI Category pairing.

Only 11 elementary school students lost a pound or two of weight during two years, but 17 of 238 boys and 30 of 254 girls in the eleventh-grade reduced their weight.

Applying the Wilcoxon matched-pairs signed-ranks test, we found significant differences in the median BMI percentiles for boys who transitioned from grade 3 to 5 (median BMI percentiles of 81.5 and 84.9, respectively; $P < 0.001$), and who transitioned from grade 9 to 11 (90.6 and 92.7; $P < 0.001$). For girls, significant differences in median BMI percentiles occurred between grades 3 and 5 (median BMI percentiles of 78.7 and 85.7, respectively; $P < 0.001$), grades 6 and 8 (89.2 and 92.1; $P < 0.001$), and grades 9 and 11 (93.8 and 94.1; $P = 0.028$). On the other hand, neither boys nor girls gained significantly more weight than height between

kindergarten and grade 2, nor did boys who went from grade 6 to grade 8. In the case of kindergarten to grade 2, average student ages increased from 5.4 to 7.4 years (Table 2). During last year's survey[2] on a smaller sample size, we found a significant difference in the proportions of healthy weight to overweight to obese children between ages 6 and 7. But our current data revealed no significant difference in the proportional distribution among BMI categories in children between the ages of 5 and 7.

Despite the fact that American Samoan youngsters have a prevalence of overweight and of obesity exceeding that of children and adolescents in the United States[1, 2], and the fact that our students gained more weight than height during the past two years relative to the CDC's growth charts[3], the childhood obesity epidemic in American Samoa may have reached a plateau and, in some cases, may even be in decline.

Such guarded optimism was also recently expressed for the childhood obesity epidemic in the United States[4]. Researchers there concluded that the prevalence of high BMI showed no significant changes between 2003-2004 and 2005-2006 and no significant trends between 1999 and 2006[4]. We reevaluated data from our previous two studies[1, 2] along with data from this current study in order to make a comparison with data describing US children surveyed between 2003 and 2006 (Table 4).

The US survey[4] divided children by gender and ethnicity into age groups of 2- to 5-year-olds, 6– to 11-year olds, and 12– to 19-years olds. The US survey[4] examined the prevalence of children who were at or exceeded the CDC BMI percentiles of 85 (that is, overweight), 95 (obese), and 97 (an undefined category that might be equivalent to the adult designation of "morbidly obese.") We examined data for boys and girls aged 6 to 11 and 12 to 19 during the past three school years by partitioning BMI percentiles among the three categories used in the US survey[4] (Table 4).

The prevalence of boys and girls aged 6 to 11 who were at or above the 85th BMI percentile declined slightly but steadily from 2006/2007 to 2008/2009. This trend was also apparent for students in this age group whose BMI percentiles were 95 or more and 97 or more.

Table 4. Prevalence of High BMI for Age Among American Samoa's Students for the 2006/2007, 2007/2007, and 2008/2009 School Years in Comparison with US Children Surveyed between 2003 and 2006

BMI => Percentile	Sex	Age	American Samoa			US
			2006/2007	2007/2008	2008/2009	2003-2006
97th	Boys	6 to 11	24.8	24.6	23.0	11.7
		12 to 19	34.0	31.5	29.9	13.9
	Girls	6 to 11	23.8	20.9	18.1	11.1
		12 to 19	29.5	32.1	31.5	11.1
95th	Boys	6 to 11	33.5	30.2	29.2	18.0
		12 to 19	41.1	39.1	38.2	18.2
	Girls	6 to 11	31.3	27.8	25.1	15.8
		12 to 19	41.8	42.8	43.9	16.8
85th	Boys	6 to 11	52.4	48.5	47.7	33.9
		12 to 19	61.6	59.1	59.9	34.9
	Girls	6 to 11	50.1	47.4	46.8	32.6
		12 to 19	69.6	68.1	69.2	33.3
Sample size		6 to 11	1,200	796	948	1,013
		12 to 19	1,116	1,197	855	2,229
		6 to 11	1,108	785	857	1,082
		12 to 19	1,051	1,223	818	2,071

American Samoa data for 2006/2007 and 2007/2008 are from references 1 and 2, respectively. Data on US children are from Reference 4 and represent the average for non-Hispanic Whites, non-Hispanic Blacks, and Mexican-Americans collectively.

Results were mixed for students in the 12 to 19 age group. The prevalence steadily declined for boys whose BMI percentiles were 95 or more and 97 or more. But for girls at or above the 95th percentile, the prevalence steadily increased. No trend was evident for girls in either the 85th or 97th percentile cutoffs.

One striking feature was the large difference in prevalence values between the 6-11 and the 12-19 age groups in American Samoa relative to the US. For example, American Samoan girls 6-11 years of age whose BMI percentile was equal to or greater than 97 had a prevalence of 18.1, but girls 12-19 years of age had a prevalence of 31.5 (Table 4). Yet both age groups in the US had a prevalence of only 11.1. A similar pattern was seen for each combination of sex and BMI percentile category, suggesting an accelerated gain in weight

for American Samoan adolescents between ages 12 and 19 in addition to an already high prevalence of obesity during their pre-teens.

Sleep habits

We asked students at what hours they usually went to sleep and awoke during school days. From the difference we determined their maximum hours of sleep.

Using a Mann-Whitney rank sum test, we found that girls slept longer than boys ($P = 0.019$) by an average of about six minutes. A Kruskal-Wallis one way ANOVA on ranks found that healthy weight students slept nearly 12 minutes longer than overweight and obese students ($P < 0.001$). A similar ANOVA found that students slept less as they aged ($P < 0.001$). The decline was about 7 minutes for boys and 9 minutes for girls for each year of age (Fig. 3).

According to the National Sleep Foundation[5], children aged 5 to 12 years should get between 10 and 11 hours of sleep each night, while teenagers should get at least 9.25 hours of sleep. When children routinely do not get enough sleep or when the sleep they get is disrupted, they are at a higher risk for obesity, learning difficulties, and behavioral problems such as attention-deficit/hyperactivity disorder[6,7].

Several factors have been identified that influence a child's sleep habits. These include, but are not limited to, distance

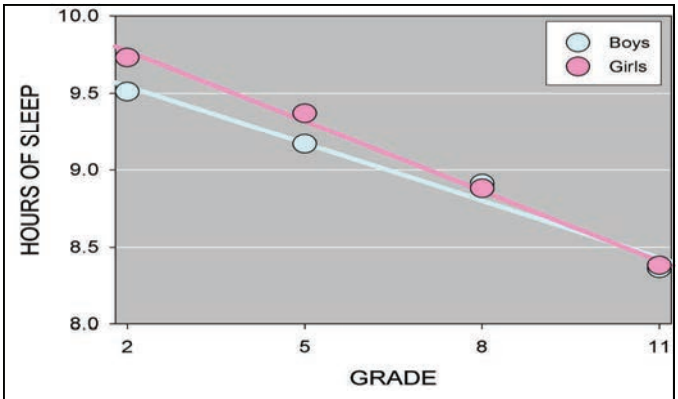

Figure 3. Number of hours of sleep by sex and grade.

between home and school, time of work onset of parents, age of parents, birth order of the child, the duration of school, time when school ends, age at which homework begins, and the amount of required homework, as all of these factors affect bedtime, wake-up time, and duration of total sleep[8]. Sleep habits are very much influenced by culture[8].

Students in grade 2 (7-year-olds) and grade 5 (10-year-olds) fell short of the recommended number of hours of sleep by between 0.5 and 1.5 hours. Students in grade 8 (13-year-olds) and grade 11 (16-year-olds) were also short of the recommended number of hours, but by less than an hour.

ASDOE tried to address this problem by beginning classes 30 minutes later during the 2008/2009 school year[9]. Elementary schools previously started at 7:30 am while secondary schools began at 8:00 am. Under the new schedule, both elementary and secondary schools started and ended 30 minutes later. Because we did not collect data on sleep habits during the two prior years of our survey, we cannot determine whether students had responded by getting more sleep this school year.

Table 5. Responses to "Are you sleepy most mornings?" by Gender, Grade, and BMI Category

Sex	Grade	BMI Status	Never		Sometimes		Often		Always		Totals	
Boys	2	Obese	449	104	17	6	0	0	5	2	471	112
		OverWgt		99		2		0		2		103
		Healthy		246		9		0		1		256
	5	Obese	455	156	24	9	0	0	0	0	479	165
		OverWgt		67		6		0		0		73
		Healthy		232		9		0		0		241
	8	Obese	426	153	81	29	1	0	4	0	512	182
		OverWgt		85		20		0		2		107
		Healthy		188		32		1		2		223
	11	Obese	235	104	91	37	1	0	7	5	334	146
		OverWgt		52		24		0		1		77
		Healthy		79		30		1		1		111
	All	Obese	1565	517	213	81	2	0	16	7	1796	605
		OverWgt		303		52		0		5		360
		Healthy		745		80		2		4		831
Girls	2	Obese	365	66	41	8	1	0	9	1	416	75
		OverWgt		82		9		0		3		94
		Healthy		217		24		1		5		247
	5	Obese	416	131	29	10	0	0	2	0	447	141
		OverWgt		87		4		0		0		91
		Healthy		198		15		0		2		215
	8	Obese	362	152	88	36	1	1	5	3	456	192
		OverWgt		85		28		0		1		114
		Healthy		125		24		0		1		150
	11	Obese	194	98	152	67	2	1	5	1	353	167
		OverWgt		51		41		1		1		94
		Healthy		45		44		0		3		92
	All	Obese	1337	447	310	121	4	2	21	5	1672	575
		OverWgt		305		82		1		5		393
		Healthy		585		107		1		11		704
Both		Obese	2902	964	523	202	6	2	37	12	3468	1180
		OverWgt		608		134		1		10		753
		Healthy		1330		187		3		15		1535

Table 6. Responses to "Are you sleepy most afternoons?" by Gender, Grade, and BMI Category

Sex	Grade	BMI Status	Never		Sometimes		Often		Always		Totals	
Boys	2	Obese	456	110	15	2	0	0	0	0	471	112
		OverWgt		99		4		0		0		103
		Healthy		247		9		0		0		256
	5	Obese	470	163	9	2	0	0	0	0	479	165
		OverWgt		71		2		0		0		73
		Healthy		236		5		0		0		241
	8	Obese	467	166	44	16	0	0	1	0	512	182
		OverWgt		93		14		0		0		107
		Healthy		208		14		0		1		223
	11	Obese	279	124	48	18	2	1	5	3	334	146
		OverWgt		65		10		1		1		77
		Healthy		90		20		0		1		111
	All	Obese	1672	563	116	38	2	1	6	3	1796	605
		OverWgt		328		30		1		1		360
		Healthy		781		48		0		2		831
Girls	2	Obese	392	70	21	5	1	0	2	0	416	75
		OverWgt		90		3		1		0		94
		Healthy		232		13		0		2		247
	5	Obese	426	136	19	5	0	0	2	0	447	141
		OverWgt		84		7		0		0		91
		Healthy		206		7		0		2		215
	8	Obese	413	176	42	15	0	0	1	1	456	192
		OverWgt		100		14		0		0		114
		Healthy		137		13		0		0		150
	11	Obese	289	137	58	29	3	1	3	0	353	167
		OverWgt		73		18		2		1		94
		Healthy		79		11		0		2		92
	All	Obese	1520	519	140	54	4	1	8	1	1672	575
		OverWgt		347		42		3		1		393
		Healthy		654		44		0		6		704
Both		Obese	3192	1082	256	92	6	2	14	4	3468	1180
		OverWgt		675		72		4		2		753
		Healthy		1435		92		0		8		1535

Usual bedtimes for elementary school students were between 8:30 and 9:00 pm. High school juniors reported staying up until 10:00 pm. Students in all grades reported awakening between 6:00 and 6:30 am.

An often overlooked problem with overweight and obese children is sleep apnea[5]. Sleep apnea is characterized by brief but numerous involuntary breathing pauses during sleep. These interruptions awaken the sleeper, making it impossible to get a deep, restorative night of sleep. Consequently, children feel sleepy during the day and their concentration and performance suffer.

To determine if sleep deprivation was a problem with students, we asked if they felt sleepy in class during mornings and afternoons. Response choices were: never, sometimes, often, or always. Tables 5, 6, and 7 summarize responses to the questions referring to mornings, afternoons, and both mornings and afternoons, respectively.

A significantly greater proportion of overweight and obese students were sometimes, often, or always sleepy in the

morning ($P < 0.001$, Table 5) or in the afternoon ($P = 0.008$, Table 6). However, we found no significant difference between BMI categories for students who reported being sleepy both mornings and afternoons (Table 7).

A greater proportion of second– and eleventh-grade girls reported being sleepy in the morning ($P < 0.001$ for both

Table 7. Combined Responses* to "Are you sleepy most mornings?" and "Are you sleepy most afternoons?" by Gender, Grade, and BMI Category

Sex	Grade	BMI Status	Never		Not Never		Totals	
Boys	2	Obese	470	111	1	1	471	112
		OverWgt		103		0		103
		Healthy		256		0		256
	5	Obese	477	165	2	0	479	165
		OverWgt		72		1		73
		Healthy		240		1		241
	8	Obese	504	177	8	5	512	182
		OverWgt		107		0		107
		Healthy		220		3		223
	11	Obese	312	136	22	10	334	146
		OverWgt		72		5		77
		Healthy		104		7		111
	All	Obese	1763	589	33	16	1796	605
		OverWgt		354		6		360
		Healthy		820		11		831
Girls	2	Obese	409	74	7	1	416	75
		OverWgt		94		0		94
		Healthy		241		6		247
	5	Obese	438	138	9	3	447	141
		OverWgt		90		1		91
		Healthy		210		5		215
	8	Obese	440	185	16	7	456	192
		OverWgt		108		6		114
		Healthy		147		3		150
	11	Obese	307	148	46	19	353	167
		OverWgt		80		14		94
		Healthy		79		13		92
	All	Obese	1594	545	78	30	1672	575
		OverWgt		372		21		393
		Healthy		677		27		704
Both		Obese	3357	1134	111	46	3468	1180
		OverWgt		726		27		753
		Healthy		1497		38		1535

* "Never" indicates the number of respondents who answered Never to both questions; "Not Never" indicates the number of respondents who answered some combination of Sometimes, Often, or Always to both questions.

grades). Sleepiness affected only fifth-grade girls in the afternoon ($P = 0.024$), while both fifth– ($P = 0.051$) and eleventh-grade ($P = 0.004$) girls reported being sleepy both mornings and afternoons.

School transportation

We asked students what means of transportation they used to get to school. Although the question was open-ended, four answers constituted just about all the responses: school bus, aiga bus (i.e., privately owned bus), car, and walking.

Because students attending A. P. Lutali Elementary School on Aunu'u Island did not have access to either an aiga bus or a private vehicle, and students on the Manu'a Group of islands lacked access to an aiga bus, their responses were treated separately from students attending school on Tutuila Island. Student responses from Tutuila Island are summarized in Table 8 and plotted by gender, BMI category, and grade in Fig. 4.

Table 8. Means of Transportation to School for Students of Tutuila Island by Gender, Grade and BMI Category

Sex	Grade	BMI Status	School Bus		Aiga Bus		Car		Walk		Totals	
Boys	2	Obese	213	54	5	4	130	34	109	18	457	110
		OverWgt		41		0		29		29		99
		Healthy		118		1		67		62		248
	5	Obese	183	59	10	5	130	55	141	43	464	162
		OverWgt		30		3		20		20		73
		Healthy		94		2		55		78		229
	8	Obese	183	72	15	5	126	46	162	51	486	174
		OverWgt		30		2		25		43		100
		Healthy		81		8		55		68		212
	11	Obese	95	41	72	24	119	57	41	21	327	143
		OverWgt		24		17		27		6		74
		Healthy		30		31		35		14		110
	All	Obese	674	226	102	38	505	192	453	133	1734	589
		OverWgt		125		22		101		98		346
		Healthy		323		42		212		222		799
Girls	2	Obese	161	28	6	3	143	27	92	16	402	74
		OverWgt		33		1		36		23		93
		Healthy		100		2		80		53		235
	5	Obese	163	42	11	3	144	58	108	35	426	138
		OverWgt		33		2		34		18		87
		Healthy		88		6		52		55		201
	8	Obese	166	64	21	3	139	71	118	50	444	188
		OverWgt		45		6		32		28		111
		Healthy		57		12		36		40		145
	11	Obese	99	54	62	22	159	74	23	11	343	161
		OverWgt		26		19		41		7		93
		Healthy		19		21		44		5		89
	All	Obese	589	188	100	31	585	230	341	112	1615	561
		OverWgt		137		28		143		76		384
		Healthy		264		41		212		153		670
Both		Obese	1263	414	202	69	1090	422	794	245	3349	1150
		OverWgt		262		50		244		174		730
		Healthy		587		83		424		375		1469

On Tutuila Island, the school bus, car, and walking were the chief modes of transportation for elementary school children, while high school juniors relied mainly upon the car, school bus, and aiga bus for getting to and from school ($P < 0.001$). One in four juniors rode the aiga bus, while less than 3% of elementary school students did so. Proportionately more girls than boys rode to school by car than walked ($P < 0.001$). The largest proportion of walkers were students in grades 5 (27%) and 8 (30%), while only 10% of high school juniors walked to school. Car use rose and walking declined as BMI category changed from healthy weight to overweight to obese ($P < 0.001$).

Other interesting results were that 22 of 24 students of Mt. Alava Elementary School walked and the other two rode by car. Most students at Afonotele, Olomoana, and Le'atele Elementary Schools walked (86.2%, 78.6%, and 78.4%, respectively), while the others rode by car.

Over half the students attending five elementary schools depended upon school buses: Alofau (78.0%), Alataua-Lua (70.8%), Taputapu (66.7%), Matatula (55.6%), and Pavaiai (50.5%).

Faga'itua High School juniors were the most dependent upon school buses and cars (52.0% and 27.6%, respectively), Samoana HS students upon aiga buses and cars (45.8% and 33.6%), Tafuna HS juniors upon cars and school buses (60.6% and 18.3%), and Leone HS students on walking (24.2%), school buses (41.2%) and cars (26.2%).

On Aunu'u Island, 22 of 27 students (81.5%) rode the school bus, while the remainder walked to A.P. Lutali Elementary School.

The Manu'a Island Group comprised students from Faleasao, Fitiuta, and Olosega Elementary Schools and Manu'a High School. Their transportation results are summarized in Table 9.

More than half of the Manu'a Islands students rode the school bus, while a handful of elementary school students were driven to school by car. Only two high school students walked to school, but nearly as many elementary school students walked (34) as rode the school bus (35).

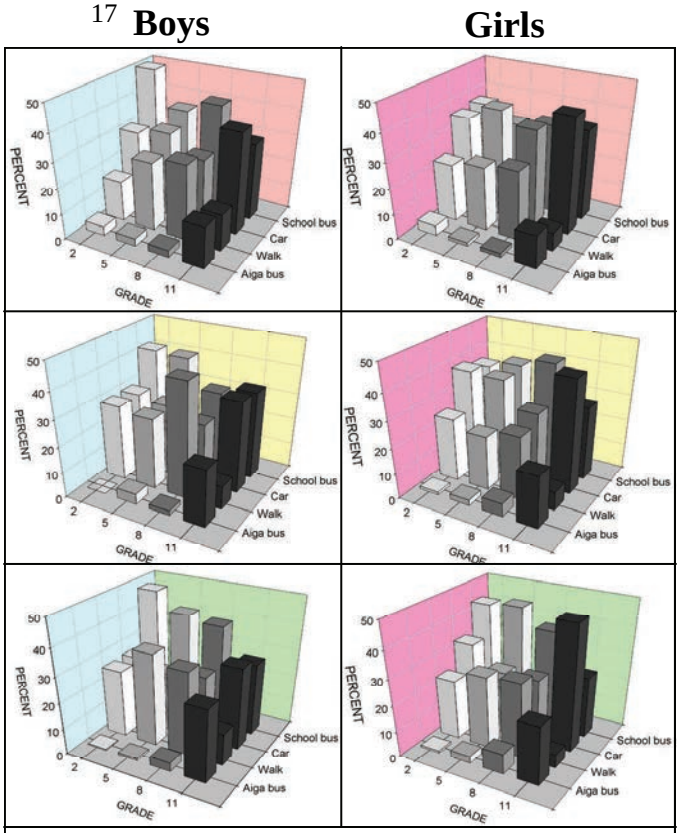

Figure 4. Responses to the means of transportation to school for students of Tutuila Island by gender, BMI category, and grade.

One boy was the only student attending Fitiuta Elementary School to ride the school bus. Two boys and two girls got to school by a car, while the remaining 21 students walked.

Olosega Elementary School, which serves students on both Ologesa Island and Ofu Island, had seven students who walked and 13 who rode the school bus, probably reflecting the number of students from each island, respectively.

Likewise, Faleasao Elementary School on Ta'u Island serves students from the villages of Faleasao and Ta'u. Six students walked to school while 21 rode the school bus and one boy rode by car.

Summarizing for the Territory, significantly more girls than boys rode to school by car than walked ($P < 0.001$). The car was also favored by a significantly higher proportion of obese students than students of healthy weight ($P < 0.001$) and was the means of school transportation for a quarter of students from all four grades. A quarter of high school juniors on Tutuila Island relied upon aiga buses for getting them to and from school ($P < 0.001$) while, with the exception of Leone HS, relatively few of them walked.

Table 9. Means of Transportation to School for Students from the Manu'a Island Group by Gender, Grade, and BMI Category

Sex	Grade	BMI Status	School Bus		Car		Walk		Totals	
Boys	2	Obese	4	2	1	0	4	0	9	2
		OverWgt		1		1		1		3
		Healthy		1		0		3		4
	5	Obese	4	1	0	0	7	1	11	2
		OverWgt		0		0		0		0
		Healthy		3		0		6		9
	8	Obese	10	3	2	2	9	2	21	7
		OverWgt		1		0		4		5
		Healthy		6		0		3		9
	11	Obese	6	3	0	0	1	0	7	3
		OverWgt		2		0		1		3
		Healthy		1		0		0		1
	All	Obese	24	9	3	2	21	3	48	14
		OverWgt		4		1		6		11
		Healthy		11		0		12		23
Girls	2	Obese	4	0	0	0	5	1	9	1
		OverWgt		0		0		0		0
		Healthy		4		0		4		8
	5	Obese	7	2	1	0	5	0	13	2
		OverWgt		1		0		1		2
		Healthy		4		1		4		9
	8	Obese	6	2	1	0	4	2	11	4
		OverWgt		3		0		0		3
		Healthy		1		1		2		4
	11	Obese	9	5	0	0	1	1	10	6
		OverWgt		1		0		0		1
		Healthy		3		0		0		3
	All	Obese	26	9	2	0	15	4	43	13
		OverWgt		5		0		1		6
		Healthy		12		2		10		24
Both		Obese	50	18	5	2	36	7	91	27
		OverWgt		9		1		7		17
		Healthy		23		2		22		47

Parental presence

We wished to explore whether parental presence had an effect on students' BMI category. Our assumption was that two-parent households would provide the economic resources and stability for purchasing healthy foods and preparing healthy meals. On the other hand, students who did not live with their parents or whose parents were separated or divorced might be either emotionally vulnerable and seek solace in food or lack the supervision to check their impulse to eat unhealthy foods and spend more time watching TV or playing video games rather than engaging in an active outdoor pursuit. The results are summarized in Table 10.

We found no significant difference among the proportion of healthy weight, overweight, and obese students, whether boy or girl, based on parental presence. However, a higher proportion of second grade students lived with both parents than did fifth graders ($P < 0.001$), and a higher proportion of fifth graders lived with both parents than did eighth grade students and high school juniors ($P < 0.001$).

Table 10. Number of Students Who Live with Both Parents, in Single-parent Households, or with Neither Parent by Grade, BMI Category, and Gender

Grade	Both	Mom only	Dad only	Neither
2	871	4	4	9
5	868	24	9	27
8	835	50	17	69
11	570	39	15	67
BMI Status	**Both**	**Mom only**	**Dad only**	**Neither**
Healthy	1411	48	20	58
Overwgt	675	29	9	39
Obese	1050	38	16	75
Gender	**Both**	**Mom only**	**Dad only**	**Neither**
Boy	1622	58	27	96
Girl	1522	59	18	76

Supper questions

The home environment plays a major role in fostering a child's health and well-being, especially when parents encourage sensible eating habits and a physically active lifestyle. One shortcoming of our question on parental presence was whether both parents worked outside of the home. Working parents probably rely more heavily than non-working parents on prepared, processed, and fast foods, which generally have high calorie, high fat, and low nutritional content. Nor did we inquire about the level of parental education, income, and BMI, all of which may influence their own understanding and attitude toward making healthy choices for themselves and for their children.

From our survey last year, children reported that rice and chicken constituted the main supper choices, with many other sensible food items high on the menu[2]. Apples, oranges, carrots, cabbage, and banana were their most popular fruit and vegetable choices[2]. This time we asked how often they

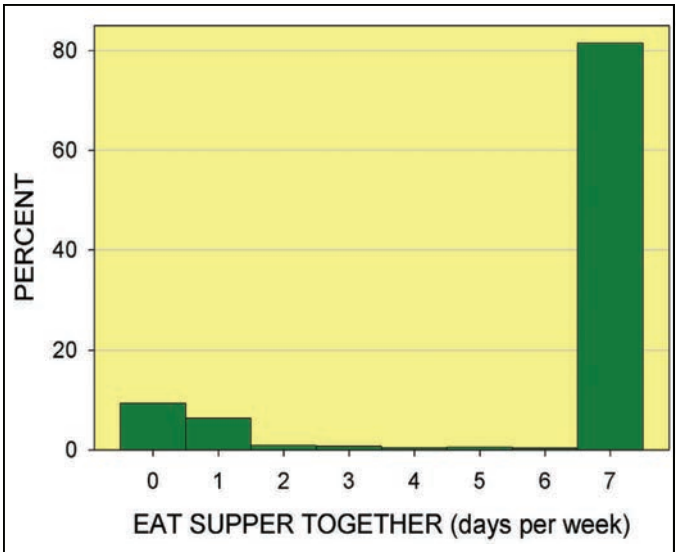

Figure 5. Frequencies at which students ate supper together with their family during a typical week. Sample size = 3,478.

ate supper together as a family, at what time they ate supper, and how often they ate out.

Over 81% of the students reported eating supper together every day of the week (Fig. 5). Proportionately more girls than boys ate supper every day with their family ($P = 0.018$).

The typical supper hour was between 6:00 pm and 8:00 pm, whether on Tutuila, Aunu'u, or Manu'a islands (Fig. 6).

Over 55% of students living on Tutuila Island reported that eating supper at a restaurant was unusual, meaning that about 45% reportedly ate out at least once during a typical week (Fig. 7). Of students who reported eating out more than once a week, only 9.8% were from the 5th-grade compared with 20.9% from grade 8 ($P < 0.001$), 18.3% from grade 2 ($P = 0.001$), and 13.9% of high school juniors ($P = 0.001$). Students who reported eating out more than once a week were more likely to be girls than boys ($P < 0.001$). BMI category had no influence on how often a student ate out for supper nor how often a student ate supper with the family.

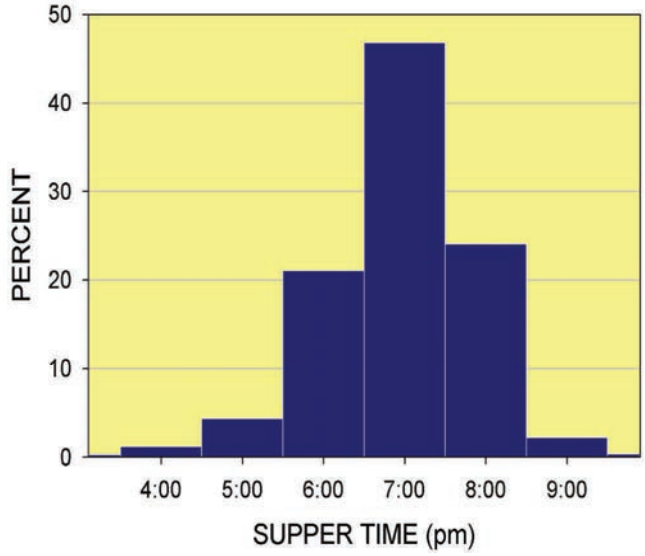

Figure 6. Frequencies of typical weekday supper times for students. Sample size = 3,478.

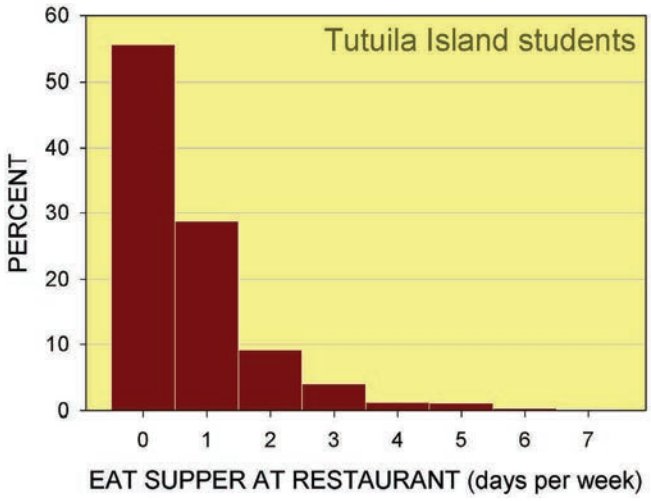

Figure 7. Frequencies at which students on Tutuila Island ate out for supper during a typical week. Sample size = 2,563.

Self-assessment of body image by high school juniors

In order to determine how students rated their own weight, we asked high school juniors to rank themselves on a scale of 0 to 10, with 5 being "ideal." Progressively lower values were to indicate the degree away from ideal toward being underweight. Likewise, progressively higher values above 5 were to indicate the degree toward being overweight. Their ranking was then multiplied by 10 to yield an approximate perceived BMI percentile.

Whether boy or girl or categorized as obese, overweight, or at a healthy weight, most ranked themselves at the 50th percentile (Fig. 8). That is, they saw themselves as being at the ideal weight for their gender, age, and height. About 80% of the students whose true BMI percentiles placed them in the healthy weight category viewed themselves as being at the ideal weight. So too did 80% of overweight boys and 68% of overweight girls. But only about half of obese students ranked themselves at the ideal BMI percentile. Moreover, obese students more often ranked themselves as being at

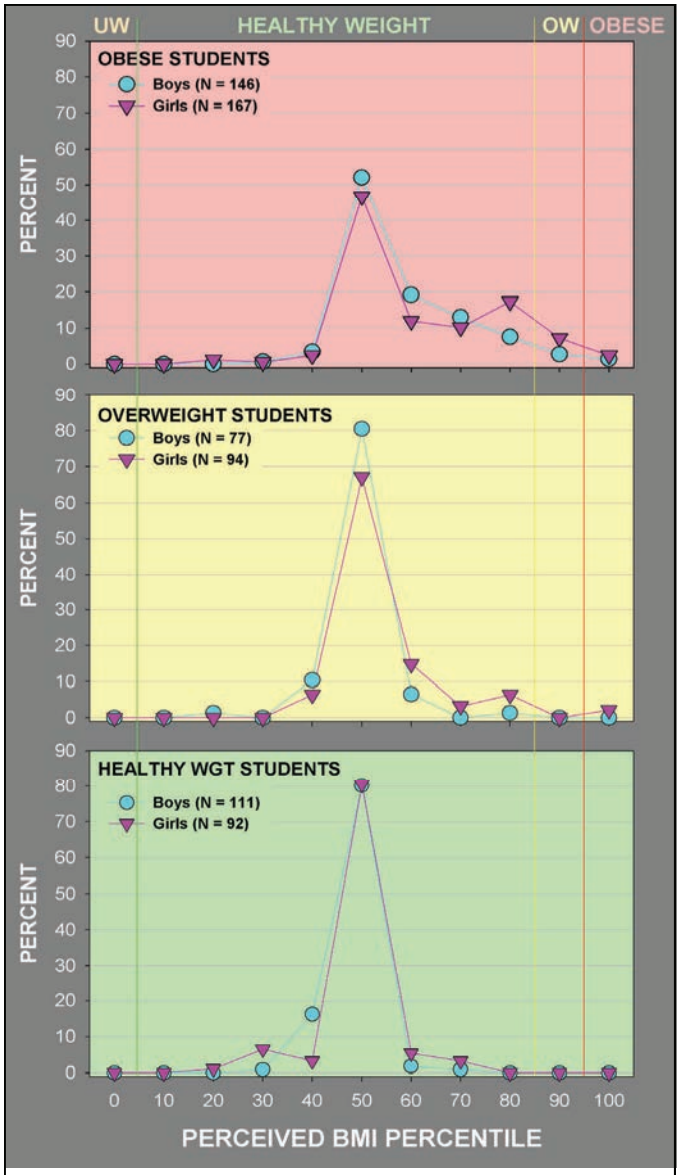

Figure 8. Perceived self-assessed BMI percentiles of high school juniors by gender and BMI category.

higher BMI percentiles, or too heavy. About 18% of healthy weight boys and 10% of overweight boys viewed themselves as being slightly underweight ("Too skinny," in their own words) at a perceived BMI percentile of 40.

Students' self-perceptions may be largely driven by a combination of creeping normalcy and social contagion. Creeping normalcy refers to the way a major change can be accepted as normality if it happens slowly, in unnoticed increments, when it would be regarded as objectionable if it took place in a single step or short period[10]. This appears to apply to the issue of childhood obesity in American Samoa when, around 1980, the prevalence of obesity was about 4% for boys and 8% for girls compared with 34% today[11].

The second factor, social contagion, refers to the influence of close friends and associates. One study suggested that obesity was socially contagious and could spread easily from person to person[12]. The researchers believed it was more than just people with similar eating and exercise habits associating together. Having family and friends who become obese changes one's idea of what is an acceptable weight[12].

This rating scale with 5 being ideal was confusing to many elementary school students. Some ranked themselves as 10, but when asked if they thought themselves as overweight responded "No." Therefore, we did not evaluate responses from elementary school students.

Self-assessment of physical activity level

Using the same rating scale as for perceived BMI percentile, we asked students to rate the level of physical activity they get on a typical day. Most believed they got an ideal amount of exercise (Fig. 9). Again, a large number of elementary school students did not understand the ranking scale, often selecting 10. Statistical analysis was, therefore, not performed on these data. However, the plots show that girls—particularly obese girls—were more likely to report getting less than the ideal amount of exercise daily. Also, a noticeable number of students—boys especially—of all three BMI categories rated themselves at 1.

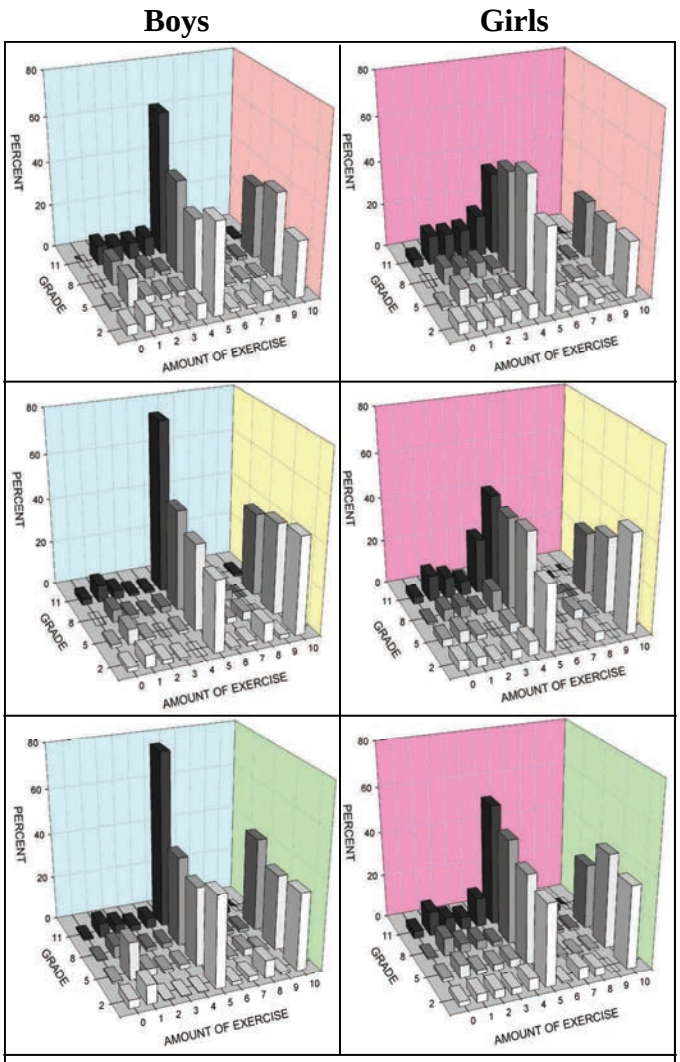

Figure 9. Perceived amounts of exercise students believe they get. Boys and girls responses by grade. Percent is by gender, BMI category, and grade. A response of 5 for AMOUNT OF EXERCISE means "ideal," with progressively less than ideal amounts for decreasing values below 5 and progressively more than ideal amounts for increasing values above 5.

CONCLUSIONS

We again found that most children and adolescents in American Samoa were either overweight (20%) or obese (35%). While the prevalence of overweight and of obesity seem to have stabilized over the past three years, based on cross-sectional data, average BMI percentiles increased slightly for the cohort of students followed over two years. In addition, the prevalence of obesity and of overweight increased substantially during adolescence. Whether or not the obesity epidemic among children and adolescents in American Samoa has reached a plateau, the current prevalence is disturbingly high and must not be ignored.

Students fell short of the optimal amount of sleep by 30 to 90 minutes. Girls, healthy weight students, and younger students slept longer, on average, than their comparative counterparts. About 1 in 5 students reported being sleepy in the morning and nearly 1 in 10 reported being sleepy in the afternoon at least sometimes. These were most likely to be overweight and obese students.

The school bus, at 38.5%, was the most used means of transportation for students in our survey, followed by the car (31.6%), walking (24.1%), and the aiga bus (5.8%). Most elementary school students relied upon the school bus, while most high school juniors—particularly girls—relied upon the car. Elementary students also accounted for most of the walkers, especially students in grades 5 and 8.

We found no connection between BMI category and parental presence. However, proportionately more younger children came from two-parent households. This may reflect a smaller incidence of separation, divorce, or spousal death among younger parents, as inferred by the presence of younger children, than households with older children and, presumably, older parents.

Nearly half of Tutuila Island students reported eating out for supper at least once a week, with second– and eighth-grade students accounting for most of these, regardless of BMI category. Eating together every evening around 7 o'clock was the usual supper setting for families.

High school juniors overwhelmingly viewed themselves as being at a healthy weight despite our finding that only 1 in 4

truly falls in this BMI category. And most students believed they got an adequate amount of exercise every day.

Our two earlier studies emphasized the need to take action now to stem the rise of childhood obesity in the Territory[1,2]. In addition to the organizations with which we are affiliated (See back cover), several other groups—the American Samoa Nutrition Coalition, Ina'ilau a Tama'ita'i, Savali Mo Oe, Healthy Kids Summer Camp, GEAR-UP Fitness Minicamp, and Policy Leadership Group—to name a few, have also contributed in one way or another toward promoting a healthier lifestyle.

At its most basic level, childhood obesity is a public health issue, yet it has other serious impacts as well. Obese children tend to become obese adults who will require expensive health care whose costs will persist or even increase over time. These costs will be borne by government and by families who will have less disposable income owing to healthcare spending and lost wages due to obesity-related illnesses. Obese students also suffer academically and emotionally through absenteeism[13] and low self-esteem[14].

We should now collectively go further to discover interventions that will help children who are at a healthy weight to maintain it and not become obese[14]. Healthy-weight children need only small daily changes to achieve a balance between calories consumed and calories expended through physical activity[15].

Interventions should be based on social marketing strategies. Rather than dictate policy, we should listen to the needs and suggestions of the students themselves. A step in this direction has already been taken by research interns of the American Samoa Community Cancer Network who, under the tutelage of Sara Krosch, conducted surveys and made observations of high school and community college students concerning food choices and physical activity[16].

The resulting action plan should be framed upon a perspective recognizing that food intake and physical activity are affected by and interact with multiple factors[14]. We may then be able to grapple with this seemingly intractable problem that disproportionately affects our children and threatens their future physical, emotional, and economic well-being.

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