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Overweight and Obesity Prevalence among Public School Children in Guam

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Abstract

Background—The Government of Guam passed Public Law 28-87, which established the collection of child Body Mass Index (BMI) measurements in the Guam Department of Education (GDOE). This paper aimed to analyze the BMI data and report the childhood obesity prevalence on Guam.

Methods—Secondary analysis was performed on a repeated cross-section of 106,827 children in the GDOE from 2010 to 2014. Age- and sex-specific prevalence estimates and 95% Confidence Intervals (CI) by weight status were calculated for each year. Test for trends in the high weight status were performed.

Results—The childhood obesity prevalence was 23.1% (95% CI, 22.9%–23.4%). It declined from 23.6% (95% CI, 23.1%–24.1%) in 2010–2011 to 22.6% (95% CI, 22.1%–23.0%) in 2013–2014 ($p=.007$).

Conclusion—Childhood obesity on Guam has declined, though it remains higher than the U.S. Mainland. Continued BMI data collection is needed to monitor childhood obesity and measure the impact of Public Law 28-87.

Keywords

Childhood obesity; Guam; chronic disease; Pacific Island

Obesity has become a global pandemic.^{1–3} More than half a billion adults (10% of men and 14% of women) worldwide were estimated to be obese in 2008 compared with almost half the prevalence in 1980 when 5% of men and 8% of women were obese.⁴ Childhood obesity,

in particular, has become a major public health concern. According to estimates in 2004, 10% of school-age children worldwide were overweight and 2–3% were obese.⁵

In the United States, the recent estimate of childhood obesity prevalence was approximately 17%.^{6–7} The United States Congress recognized the potential role that schools can play in promoting student health, combating problems associated with poor nutrition and physical inactivity, and ultimately preventing childhood obesity. When the Child Nutrition and Women, Infants, and Children (WIC) Reauthorization Act of 2004 (Section 204 of Public Law 108-205) was signed into law, it mandated the establishment of local school wellness policies in schools participating in the National School Lunch Program.⁸ The legislation made the local community responsible for developing the wellness policy so that the local needs of each community could be addressed. Furthermore, the Institute of Medicine recommended using school-based measurements of body mass index (BMI)⁹ as a way to prevent childhood obesity, in that communities can use the surveillance of childhood obesity as a tool to inform the development of policies and programs to improve children's health. Since then, several states have passed laws that mandate public school-based BMI assessments.¹⁰

One of the United States territories to follow suit is Guam, an island located in the northwestern Pacific Ocean approximately 3,700 miles west of Hawaii and 1,300 miles southeast of Japan. Chamorros are the natives of Guam, though the current population of Guam is characterized by substantial ethnic variation: 42% Chamorro, 33% Filipino, 7% White, 6% other Asian, 8% other Pacific Islander, and 4% other ethnicity.¹¹

In response to the federal mandate of the Child Nutrition and WIC Reauthorization Act of 2004, the Government of Guam passed Public Law 28-87 in 2005, which established the Healthy Wellness Policy within the Guam Department of Education.¹² First, the local law inspired the implementation of nutrition and physical activity programs in the Guam Department of Education. For example, the Department introduced its first nutritional mascot, named *Super Chef*, to educate students on healthy cooking and healthy eating.¹³ Additionally, through the Growing Up Active, Healthy, and Nutritious (GUAHAN—the Chamorro name for Guam) Project, the Guam Department of Education in collaboration with academic and community partners, hosted the School Meals Culinary Competition among high school culinary students.¹⁴ The goal of the GUAHAN Project is to improve children's lifelong eating and physical activity behaviors.¹⁴ Second, the law allowed for the uniform collection of BMI among school children in Guam. The purpose of this paper was to analyze the BMI data collected at the Guam Department of Education, and to determine the prevalence of high BMI, specifically overweight and obesity, among students enrolled in the public school system.

Methods

This study was approved by the University of Guam Committee on Human Research Subjects (#14-08b) and the Guam Department of Education Research Review Panel.

Design, setting, and participants

The secondary analysis performed in this study was based on a representative, repeated cross-section of 106,827 students enrolled in the Guam Department of Education during Schools Years 2010–2011, 2011–2012, 2012–2013, and 2013–2014. The students included Pre-Kindergarten (Head Start and Gifted and Talented Education (GATE) Pre School) and Kindergarten thru 12th grade. The students represented 26 elementary schools, eight middle schools, and five high schools on Guam. The largest proportion of students enrolled in the Guam Department of Education is made up of Chamorros—48%, followed by Filipinos—22%, non-Chamorro Pacific Islanders (Hawaiian, Samoan, Kosraean, Pohnpeian, Chuukese, Yapese, Marshallese, Palauan, and Fijian)—24%, and Others—6%.¹⁵

Data collection

Team—The team collected height and weight measurements throughout the school year. During the survey period, the Guam Department of Education employed 42 school health counselors who were also registered nurses (RNs) by training. Four licensed practical nurses (LPNs), as well as nursing students and nursing assistant students, supported the school health counselors. All staff and students had received basic training, through their profession or program curriculum, in collecting height and weight measurements.

Measurements—The schools were issued different types of stadiometers and scales, inclusive of digital and manual, and thus the Department staff used any available equipment. The school health counselors collected the majority (about 80%) of the measurements at the various schools they were assigned. The data collection in schools with more than 1,000 students (8 schools) were conducted with the assistance of members of the team.

Data entry—The height and weight measurements were entered in the Children’s BMI Tools for Schools Excel spreadsheet developed by the Centers for Disease Control and Prevention (CDC).¹⁶ Body mass index calculations in children differ from adult BMI calculations. Only height and weight measurements are needed for adult BMI calculations. In children, age and sex are needed in addition to height and weight measurements to account for the differences in growth with age and between males and females and therefore calculate BMI percentiles.¹⁷

The CDC Children’s BMI Tools for Schools contained a built-in calculator that computed BMI and age- and sex-specific BMI percentiles for up to 2,000 children in a group. The school health counselors reported the results of the individual student on the BMI Index Report Form developed by the Guam Department of Education. The form included a recommendation section for further evaluation by the child’s doctor, especially for students below the 5th or at or above the 85th BMI percentile. Individual forms were subsequently sent home for parent notification.

Analysis

To analyze the BMI of students from all 40 public schools on Guam, which surpassed the maximum capacity of the CDC Children’s BMI Tools for Schools, the height and weight measurements from each school were imported into a separate spreadsheet. The data were

checked and cleaned to the best of the authors' ability. The data were imported into the SAS[®], Version 9.4, where BMI and BMI percentiles were calculated using the SAS Program for the 2000 CDC Growth Charts.¹⁷ The BMI percentiles were used to categorize the children into weight status: Underweight (<5th percentile), Normal weight (5th–84th percentile), Overweight (85th–94th percentile), and Obese (95th percentile).¹⁸ Prevalence estimates and 95% confidence intervals were calculated with the PROC SURVEYFREQ option in the SAS[®]. For high BMI prevalence, logistic regression was used to test trends across years, where school years as an ordinal variable was regressed separately on the binary outcome of overweight and obesity. A significance level was established ($p < .05$).

Of the 107,145 students measured between 2010 and 2014, 318 students were excluded from the analyses for one of three reasons: missing data on sex or birthday, inaccurate birthday (determined through biological implausibility), or the student was over ± 20 years of age. The final sample size was 106,827 students.

Results

Demographic characteristics

The sample size per year is summarized in Table 1. Of the 106,827 students included in the analyses, 56,002 (or 52%) were boys and 50,825 (or 48%) were girls. The sex distribution in this study was comparable to the 2010 Guam Census.¹¹ Of the total sample size, 25,642 (or 24%) were collected in 2010–2011, 24,663 (or 23%) were collected in 2011–2012, 25,943 (or 24%) were collected in 2012–2013, and 30,579 (or 29%) were collected in 2013–2014. The age range was four to 19 years old, which corresponded with the minimum age requirement for enrollment in the Guam Department of Education and the maximum age in the CDC Growth Charts. When stratified by age group, 7,484 (or 7%) were four to five years old, 48,220 (or 45%) were six–11 years old, and 51,123 (or 48%) were 12–19 years old. The age distribution was slightly different from the 2010 Guam Census of 12% (4–5 year-old), 37% (6–11 year-olds), and 51% (12–19 year-olds).¹⁹

Prevalence estimates

The prevalence of weight status is shown in Table 2. Across the age groups and all years, the rounded prevalence estimates ranged from 3% to 6% in the underweight category, from 55% to 69% in the healthy weight category, from 13% to 18% in the overweight category, and from 12% to 25% in the obese category. The rounded prevalence estimates in boys was 4% in the underweight category, and ranged from 54% to 55% in the healthy weight category, from 15% to 16% in the overweight category, and from 26% to 27% in the obese category across all years. The rounded prevalence estimates in girls ranged from 3% to 4% in the underweight category, from 59% to 60% in the healthy weight category, and from 19% to 20% in the obese category across all years. The rounded prevalence estimate in girls was 17% in the overweight category across all years.

Overweight and obesity trend

The overall prevalence of overweight for all four years was 16.2% (95% CI, 16.0%–16.4%), whereas the overall prevalence of obesity was 23.1% (95% CI, 22.9%–23.4%) during the

same time period (Table 3). Overweight had slightly increased over the last four years, but the trend was not statistically significant ($p = .11$). Obesity had slightly declined during the same time period, and the trend was statistically significant ($p = .007$).

Discussion

Progress

Prior to the federal mandate of the Child Nutrition and WIC Reauthorization Act of 2004, there was no way of capturing the BMI weight status of a representative sample of children in Guam. This was especially true with the absence of Guam children from the National Health and Nutrition Examination Survey (NHANES),²⁰ despite the island's status as a territory of the United States. This is the first official documentation of weight status prevalence, especially overweight and obesity, from the Guam Department of Education's annual BMI collection mandated by Public Law 28-87. The results of this study can be viewed both positively and negatively.

On a positive note, the obesity prevalence of students in the public school system has declined, and to the best of our knowledge, the rates were the most representative estimates of childhood obesity on Guam. The decline, although slight, was a step in the right direction. It reinforced the importance of policy in childhood obesity prevention. The decline in childhood obesity may be attributed to the relentless efforts of many stakeholders in Guam and in the Pacific. For example, in 2008, the *Sustantia* Coalition, a coalition of local non-profit organizations, raised the awareness on the childhood obesity epidemic in Guam by actively launching a two-year campaign on childhood obesity prevention.²¹ *Sustantia*, meaning "nutritious" in local Chamorro language, promoted nutritious eating among children from low-income families through a health marketing strategy and by changing the grocery environment using a logo that helped buyers easily identify affordable and nutritious grocery items. In 2010, the Pacific Island Health Officers' Association, which is represented by the Ministers and Directors of Health in six United States-Associated Pacific Islands including Guam, had declared a regional non-communicable disease (NCD) state of emergency to address the NCD epidemic in the region.²² The following year, the Guam Department of Public Health and Social Services responded by establishing the Guam NCD Consortium and developing a strategic plan.²³ Guam stakeholders of child nutrition and physical fitness were called to act on childhood obesity via the consortium's Nutrition and Obesity Team and the Physical Activity Team. The NCD Consortium has been actively involved in childhood obesity prevention activities. Collaboratively, the Guam Department of Education had implemented a few programs, including the introduction and use of the mascot *Super Chef* and the GUAHAN Project. With continued routine collection of BMI at the Department of Education, stakeholders will be able to monitor the effectiveness of both Public Law 28-87 and the ongoing childhood obesity prevention activities occurring throughout the island.

A negative fact remains: the overall obesity prevalence estimate of 23% is higher than the estimated 17% reported in the United States.⁶⁻⁷ The disparity in BMI weight status between Guam and the United States was noted in a previous study by Leon Guerrero and Workman.²⁴ Of 590 high school students assessed via the 1999 Youth Risk Behavior Study

of Guam, they categorized 32% as overweight or obese, which was higher than the 26% overweight or obese prevalence reported among adolescents in the United States. There is still plenty room for improvement. Local stakeholders should be encouraged by the decline in childhood obesity rates, and motivated to continue on this path.

Limitations

This study was limited in two ways. First, formal standardization of the data collection team was absent and the equipment used varied across schools, primarily because the original purpose of the BMI collection was not research-based. The team members all had some basic training in measuring height and weight, as part of their professional training or program curriculum. Additional efforts are ongoing to help the Guam Department of Education address the standardization and equipment issues. However, this limitation is offset by the large number of measurements per year, which may reduce sampling error,²⁵ and the fact that the assessment of mostly every child from pre-kindergarten to 12th grade across all the public schools provides a representative sample of childhood obesity on Guam.

Second, student ethnicity was not collected. Obesity has been shown to have disparate effect on children among ethnic groups in the United States,⁶⁻⁷ as well as among children across jurisdictions in the United States–Affiliated Pacific region, including Guam.²⁶ Other studies²⁷⁻²⁸ have found ethnic differences in the prevalence of overweight and obesity among adults on Guam. It will be useful to know if there are ethnicity-specific differences in childhood obesity among public school children on Guam.

Recommendations

Two strategies are encouraged to help strengthen and sustain local childhood obesity surveillance and prevention efforts. First, to strengthen surveillance, the annual collection of BMI data by the Guam Department of Education should be standardized using tools and equipment that collect uniform and comparable data to reduce the error introduced by non-standardized data collection. Further, the BMI data may be added as a field in the Department's electronic student information system, so that more variables, such as ethnicity, academic performance, and other variables may be included similar to the detailed analyses in the NHANES.

Second, strong partnerships are needed to sustain childhood obesity prevention efforts. The Guam Department of Education would benefit from continued collaboration with local partners to further strengthen the BMI data collection system. The Guam NCD Consortium is an exemplary partner, as it comprises many other partners from both government and non-government organizations, including the *Sustantia* Coalition. The consortium recently updated the island's NCD Strategic Plan for 2014–2018,²⁹ in which members of the newly added Data and Surveillance Team committed to supporting the BMI data collection. The Consortium may explore ways to expand the surveillance system to include non-public school students. Additionally, stakeholders from programs involved with child BMI collection, such as the federal programs of the Guam Department of Public Health and

Social Services and the Children's Health Living (CHL) Program,^{30–31} should be invited to partake in the discussion.

Conclusion

The prevalence of childhood obesity on Guam has declined slightly though it is still higher than the childhood obesity prevalence in the continental United States. The establishment of the BMI data collection as an official surveillance system, the inclusion of other variables in the data collection, and the continued childhood obesity prevention activities of community partners, will help to further reduce the rates of childhood obesity in Guam.

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Table 1

SAMPLE SIZES OF PUBLIC SCHOOL STUDENTS IN GUAM, BY SCHOOL YEAR, SEX, AND AGE

School Year	Sex	All Ages	4–5 y	6–11 y	12–19 y
2010–2011	All	25,642	2,102	12,426	11,114
	Boys	13,391	1,043	6,415	5,933
	Girls	12,251	1,059	6,011	5,181
2011–2012	All	24,663	1,230	10,436	12,997
	Boys	13,041	626	5,440	6,975
	Girls	11,622	604	4,996	6,022
2012–2013	All	25,943	1,909	11,543	12,491
	Boys	13,529	996	6,010	6,523
	Girls	12,414	913	5,533	5,968
2013–2014	All	30,579	2,243	13,815	14,521
	Boys	16,041	1,163	7,209	7,669
	Girls	14,538	1,080	6,606	6,852

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Table 2**PREVALENCE OF WEIGHT STATUS OF PUBLIC SCHOOL STUDENTS IN GUAM, BY SCHOOL YEAR, AGE, AND SEX**

Characteristic	Underweight ^a	Healthy Weight ^b	Overweight ^c	Obese ^d
School Year 2010–2011				
Age				
4–5 y	6.2 (5.1–7.2)	63.7 (61.7–65.8)	15.5 (13.9–17.0)	14.5 (12.9–16.0)
6–11y	4.1 (3.7–4.4)	56.5 (55.6–57.4)	15.3 (14.7–16.0)	23.9 (23.1–24.6)
12–19y	3.3 (2.9–3.6)	54.7 (53.8–55.6)	16.9 (16.2–17.6)	25.0 (24.2–25.8)
Sex				
Boys	4.0 (3.7–4.4)	53.5 (52.6–54.3)	15.3 (14.7–15.9)	27.0 (26.2–27.7)
Girls	3.7 (3.4–4.1)	59.4 (58.6–60.3)	16.8 (16.1–17.4)	19.9 (19.2–20.6)
School Year 2011–2012				
Age				
4–5 y	5.0 (3.8–6.2)	65.8 (63.2–68.5)	12.5 (10.6–14.3)	16.5 (14.4–18.6)
6–11y	3.4 (3.0–3.7)	56.5 (55.6–57.5)	16.3 (15.6–17.0)	23.6 (22.8–24.4)
12–19y	3.7 (3.4–4.1)	56.1 (55.3–57.0)	16.3 (15.6–16.9)	23.7 (22.9–24.4)
Sex				
Boys	4.2 (3.8–4.5)	53.6 (52.8–54.5)	15.5 (14.9–16.1)	26.5 (25.7–27.2)
Girls	3.0 (2.7–3.3)	60.3 (59.5–61.2)	16.7 (16.1–17.4)	19.7 (19.0–20.4)
School Year 2012–2013				
Age				
4–5 y	6.4 (5.3–7.5)	66.3 (64.2–68.4)	13.1 (11.6–14.6)	14.0 (12.4–15.5)
6–11y	3.8 (3.5–4.2)	56.3 (55.4–57.2)	15.8 (15.1–16.5)	23.0 (23.1–24.7)
12–19y	3.6 (3.2–3.9)	55.4 (54.5–56.2)	16.9 (16.3–17.6)	24.0 (23.2–24.7)
Sex				
Boys	4.0 (3.6–4.3)	53.8 (53.0–54.7)	15.6 (15.0–16.2)	26.4 (25.7–27.1)
Girls	3.8 (3.5–4.1)	59.6 (58.7–60.4)	16.7 (16.1–17.4)	19.7 (19.0–20.4)
School Year 2013–2014				
Age				
4–5 y	4.9 (4.0–5.8)	69.0 (67.1–70.9)	13.5 (12.1–15.0)	12.3 (11.0–13.7)
6–11y	3.6 (3.3–3.9)	57.3 (56.4–58.2)	15.8 (15.2–16.4)	23.0 (22.3–23.8)
12–19y	3.3 (3.0–3.6)	55.3 (54.4–56.1)	17.5 (16.9–18.2)	23.7 (23.0–24.4)
Sex				
Boys	3.6 (3.3–3.9)	54.6 (53.8–55.3)	16.1 (15.6–16.7)	25.5 (24.8–26.2)
Girls	3.5 (3.2–3.8)	60.1 (59.3–60.9)	16.8 (16.2–17.4)	19.3 (18.7–20.0)

Notes:

^aBMI < 5th percentile.^bBMI 5th–84th percentile.^cBMI 85th–94th percentile.

d_{BMI} 95th percentile.

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Table 3

PREVALENCE OF HIGH BODY MASS INDEX OF PUBLIC SCHOOL STUDENTS IN GUAM, BY SCHOOL YEAR

	% (95% CI)	p value ^a
Overweight		
All years	16.2 (16.0–16.4)	
2010–2011	16.0 (15.6–16.5)	
2011–2012	16.1 (15.6–16.6)	.11
2012–2013	16.1 (15.7–16.6)	
2013–2014	16.5 (16.0–16.9)	
Obesity		
All years	23.1 (22.9–23.4)	
2010–2011	23.6 (23.1–24.1)	
2011–2012	23.3 (22.8–23.8)	.007
2012–2013	23.2 (22.7–23.7)	
2013–2014	22.6 (22.1–23.0)	

Notes:

^a p values represent tests of linear trends across year.