Changes in Pediatric Waist Circumference Percentiles Despite Reported Pediatric Weight Stabilization in the United States

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Abstract

Background—Obesity is a global health concern but the United States has reported a leveling in obesity rates in the pediatric population.

Objective—To provide updated waist circumference (WC) percentile values, identify differences across time and discuss differences within the context of reported weight stabilization in a nationally representative sample of American children.

Methods—Percentiles for WC in self-identified African Americans (AA), European Americans (EA) and Mexican Americans (MA) were obtained from 2009–2014 National Health and Nutrition Examination Survey data (NHANES2014). Descriptive trends across time in 10th, 25th, 50th, 75th and 90th percentile WC distributions were identified by comparing NHANES2012 with previously reported NHANESIII (1988–94).

Results—WC increased in a monotonic fashion in AA, EA and MA boys and girls. When compared with NHANESIII data, a clear left shift of percentile categories was observed such that values that used to be in the 90th percentile are now in the 85th percentile. Differences in WC were observed in EA and MA boys during a reported period of weight stabilization.

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Conclusion and Relevance—WC has changed in the US pediatric population across time, even during times of reported weight stabilization, particularly among children of diverse racial/ ethnic backgrounds.

Keywords

pediatric obesity; waist circumference; racial/ethnic differences; percentiles; national data

INTRODUCTION

Pediatric obesity is a public health concern affecting 17% of children in the United States (1). Given the scientific evidence demonstrating that pediatric obesity is a precursor to other complex diseases both in children and adults, and given the health care costs implications attached to these conditions (2), the prevention of pediatric obesity is paramount.

Although BMI is perhaps the most used surrogate for excessive adiposity in humans, recent research has demonstrated that BMI is a limited indicator of pediatric metabolic risk because of its limited specificity in children (3). Waist circumference (WC) has emerged as an index of pediatric adiposity that predicts fat mass as well as or better than BMI (4, 5). WC has proven to be effective for estimating total adiposity, and has been validated against various other body composition methods, including skin fold (6, 7), bioelectrical impedance (8), air displacement plethysmography (9), and dual x-ray absorptiometry (5, 10)). Furthermore, the role of WC as an indicator of risk has been evaluated in several pathological conditions and physiological markers such as hypertension and cardiometabolic risk (11, 12), nonalcoholic fatty liver disease (13), 25-hydroxyvitamin D (14), adipokines (15), serum uric acid (16), intimae media thickness (17), C-reactive protein, homocysteine and cysteine (18). Evidently WC is of great utility and relevance in clinical and research settings.

In 2004, we used United States (US) nationally representative data from NHANESIII (1988–1994) to show that children at age 13 were already exceeding the recommended cut-off for healthy WC in adults (19). In 2014, scientists reported that levels of body mass index (BMI= kg/m^2) in the US have not significantly changed in the pediatric population between 2003–2004 and 2011–2012 (1), bringing hope to the public health arena. In this study, we have used NHANES data from 2009–2014 (NHANES2014) to create updated versions of previously published WC percentile tables according to race/ethnicity and sex, we have compared NHANES2014 gender- and racial/ethnic-specific WC percentiles to previously published percentiles from NHANESIII, and we have evaluated WC prevalence trends between the 2003–2004 and 2011–2012 period in which leveling-off of obesity prevalence in the pediatric population was reported.

METHODS

Sample

Data from the National Health and Nutrition Examination Survey (NHANES) were used. NHANES is a cross-sectional nationally representative study by the National Center for Health Statistics that uses a complex, stratified, multistage probability sample to represent

the civilian non-institutionalized US population. Race-ethnicity was based on self-report. For the updated WC percentile tables, we used NHANES data from 2009–2014 (NHANES2014) with a total of 7130 youths (2 to 18 years) were included in the analysis: 2374 were African Americans (AA), 2548 were European Americans (EA), and 2208 were Mexican Americans (MA). For the time trend comparison between 2003–2004 and 2011–2012, a total of 5529 were included, with 2184 AA, 1670 EA and 1675 MA.

Measurement

Waist circumference (WC) was measured by trained technicians using a tape measure at just above the uppermost lateral border of the right iliac crest at the end of a normal expiration, and was recorded at the nearest millimeter, as described by the National Center of Health Statistics. NHANES maintains high standards to ensure minimal non-sampling and measurement errors during survey planning, data collection and processing, and information about questionnaires, procedures and lab manuals used for NHANES can be obtained from the National Center for Health Statistics (20).

Statistical Analysis

All analyses were conducted according to NHANES Analytic and Reporting Guidelines (21). Sample weights were used to account for differential probabilities of selection and the complex sample design, as well as non-response and non-coverage, as presented in the Supplemental Materials. Standard errors and 95% confidence interval (CI) were calculated using Taylor series linearization. The percentile regression approach used in this study followed methods detailed in our previous papers (19, 22). In summary, WC observations were classified by an indicator variable (I) as falling above or below a predicted percentile τ of the distribution, and a logistic regression approach was used to model the significant contributions of explanatory variables (ethnicity, age, age by ethnicity interaction) to the log odds of being above the τ percentile. If significance was found, percentile regression lines were constructed using the method developed by Koenker and Bassett (23). Regression lines of the 10th, 25th, 50th, 75th, 85th, 90th and 95th percentiles of the distribution of WC across ages were modeled according to sex and racial/ethnic groups. To test for statistically significant racial/ethnic differences at each percentile, we modeled the percentile regression lines as a function of age for each sex, and compared the slope of those percentile regression lines between EA, AA and MA, using EA as the reference group. SAS for Windows version 9.3 (SAS Institute) was used for statistical analysis. Statistical significance was determined at $p < 0.05$.

To compare the results from the present study (NHANES2014) with our previously reported results from 2004 (NHANESIII), we calculated the NHANES2014 – NHANESIII difference between estimated percentiles for 10th, 25th, 50th, 75th and 90th percentiles for boys and girls at every age. Positive results indicated an increase in the percentile estimate both data cohorts and negative results indicated a decrease in the estimates. Logistic regression models were used to evaluate the statistical significance when comparing prevalence of WC at a percentile   85th and   95th across time (during the period between 2003–2004 and 2011–2012). Comparisons across time were performed by age groups (2–5, 6–11, and 12–18 years old), as reported by Ogden, et al. (1).

RESULTS

Table 1 demonstrates estimated WC percentile regression values for boys and girls after combining all racial/ethnic groups and according to race/ethnicity for ages 2–18. All racial/ethnic slope comparisons at the 10th, 25th, 50th, 75th, 85th, 90th and 95th WC percentile estimates as a function of age using the EA group as the reference group showed statistically significant at $p<0.05$. Comparisons for MA boys at the 10th percentile and MA girls at the 90th percentile were inestimable. Visual inspection of the different percentiles according to race/ethnicity and sex, show a fair amount of variability of percentile cut-off values that impairs the identification of one specific group having an overall predominant increase in WC compared to others.

Results from the comparison between NHANES2014 and NHANESIII are represented in Figure 1 and support an overall increase of WC in the combined sample and by age and sex. In the combined sample, the increase in WC is more pronounced in girls than in boys, with a steeper difference in the 75th and 90th percentiles. The highest difference value in the combined sample of boys was of 9.9 cm at age 18 of the 90th percentile. Interestingly, this value reflected a marked difference in trends among AA, EA and MA boys, whose difference values at age 18 of the 90th percentile were 16.2 cm, 7.9 cm and 15.1 cm, respectively. In girls, also at age 18 of the 90th percentile, the highest difference value in the combined sample was 15.5 cm, with values for AA of 11.4 cm, EA of 16.9 cm and MA of 11.2 cm. A table showing a comparison between the 90th percentile for NHANESIII and 75th, 85th and 90th percentile of NHANES2014 according to age is provided in the Supplemental Materials.

Table 2 shows the prevalence of WC above the 85th and 95th percentile for boys and girls in the combined sample, and according to racial/ethnic groups. A significant increase in WC prevalence across time was observed in Mexican Americans adolescents (ages 12–18) for the combined sample and in boys at the 85th percentile. However, a significant decrease in WC prevalence across time was observed in children (ages 2–5) at the 95th percentile in the combined sample and in boys, as well as in the combined sample of EA children. At the 85th percentile, MA boys (age 2–5) also showed a significant reduction of WC prevalence.

DISCUSSION

The results of this study demonstrate that WC has increased in the US pediatric population from NHANESIII to NHANES2014, and that this increase differs among boys and girls of diverse racial/ethnic groups. Despite reports indicating no increase in the prevalence of pediatric obesity in the US (1), our data shows an increase in WC prevalence across time in adolescents (ages 12–18), and a decrease in WC prevalence across time in younger children (ages 2–5).

When comparing data from NHANESIII and NHANES2014 our results demonstrate a clear left shift of percentile categories: for example, in NHANESIII data the 90th percentile for 8 year old boys (combined) was 71.2 cm, a value that is under the 85th percentile in NHANES2012 data. Figure 1 shows noticeable differences between the NHANES 2014 and

NHANESIII percentiles. In all groups the greater change across ages occurred on the higher percentiles, whereas a small difference is observed in the lowest percentiles. The greatest increase in WC across time period considered occurred in 90th percentile of AA boys (increase of 16.2 cm) followed by EA girls (increase of 16.3 cm). No increase was observed in the 90th percentile at age 3 in AA girls, the 10th percentile at age 3 in AA boys, and the 10th percentile at age 2 in MA boys and girls. A reduction in WC was observed in the 10th and 25th percentile of AA boys and 25th percentile of AA girls at age 2, and in the 90th percentile of EA girls at age 3. The reason for such reduction is beyond the scope of this study, but it might well be a result of initiatives to reduce obesity in the early lifespan of minority populations.

The epidemiological finding of increased WC trajectory between NHANESIII and NHANES2014 is concerning. For example, the 88 cm cut-off for increased risk of obesity-related comorbidities in adult women was reported to be achieved at age 13 in MA and AA girls from NHANESIII (19), at same age in Messiah et al. evaluation of 2008 NHANES (24), and at age 11 in in the actual NHANES2014 data. The 102 cm cut-off for increased risk of obesity-related comorbidities in adult men was achieved at age 16 in MA, and 18 in EA and AA boys in NHANESIII, at age 14 in MA and 16 in EA and AA in Messiah et al. (24), and at age 16 in EA, 15 in AA, and 13 in MA in NHANES2014. Considering this increasing trajectory is pertinent in the development of preventive strategies, particularly when considering that an increase of one cm in waist circumference increases the relative risk of cardiovascular disease by 2% (25). WC has been shown to have increased in adults from 1999–2012 (26), and in areas of fast economic development a leveling-off of BMI in adults has also been accompanied by an increase in WC and abdominal obesity (27). Of note is that the comparisons between NHANESIII and NHANES2014 is provided herein to describe a trend and to support the shifting toward the left of the distribution on a 13-year period, and not to test for statistically significant differences that, in this case, might not have any research or clinical implications.

The consideration of changes in patterns of abdominal adiposity during a time of weight stabilization is of interest. A reduction of WC during early childhood provides hope for better cardiometabolic health among upcoming generations. An increase in WC among adolescents raises a potential concern as fat deposition might be shifting toward the accumulation of abdominal fat independent of weight stabilization, implying greater disease risk that might not be detected by body weight increase alone. Evidently, the interpretation of our results is limited by the extent to which WC represents a surrogate for visceral adiposity and does not provide insights into physiological mechanisms that can be further explored with more precise measurements of abdominal adiposity. It is relevant to consider that comparisons of time trends are dependent on the chosen points of examination; given the objectives of this study, we chose same points as the ones reported by Ogden and colleagues (1).

Our results emphasize the importance of evaluating WC, instead of BMI alone, in clinical practice and research protocols, particularly when examining metabolic disease risk in children. The distribution of adipose tissue in the human body has helped the understanding of how obesity associates with metabolic abnormalities and has also revealed complex and

incompletely understood phenomena such as the metabolically healthy obese (MHO) phenotype (28, 29). Awareness and understanding of adiposity depots and their role in improving the health of the pediatric populations is important. Public education initiatives focusing on accessible measures for monitoring potential health status and facilitating disease prevention are needed, as well as further research exploring changes across time in precisely-measured abdominal fat depots and their impact in pediatric and adolescent health.

In conclusion, our data show that WC in children and adolescents in the United States has increased in the last 20 years, and that there are racial/ethnic differences as well as differences between boys and girls. Within the last decade, a trend toward reduced WC in young children is emerging regardless of weight stabilization Pediatricians are advised to take into account these findings when assessing health risks to the pediatric population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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What is already known about this subject?

- Waist circumference percentiles have been previously published in 2004 for American children based on data from NHANES III

- Obesity trends in the US pediatric population show a stabilization in body weight between 2003–2004 and 2011–2012.

What this study adds?

- Updated waist circumference percentiles have been developed with updated data

- A comparison of waist circumference percentiles with previously published data (NHANESIII) shows an increase of abdominal adiposity in children of European-, African-, and Mexican-American ancestry.

- An evaluation of the trend of waist circumference between 2003–2004 and 2011–2012 show changes in waist circumference despite reported waist stabilization, particularly in European- and Mexican-American boys.
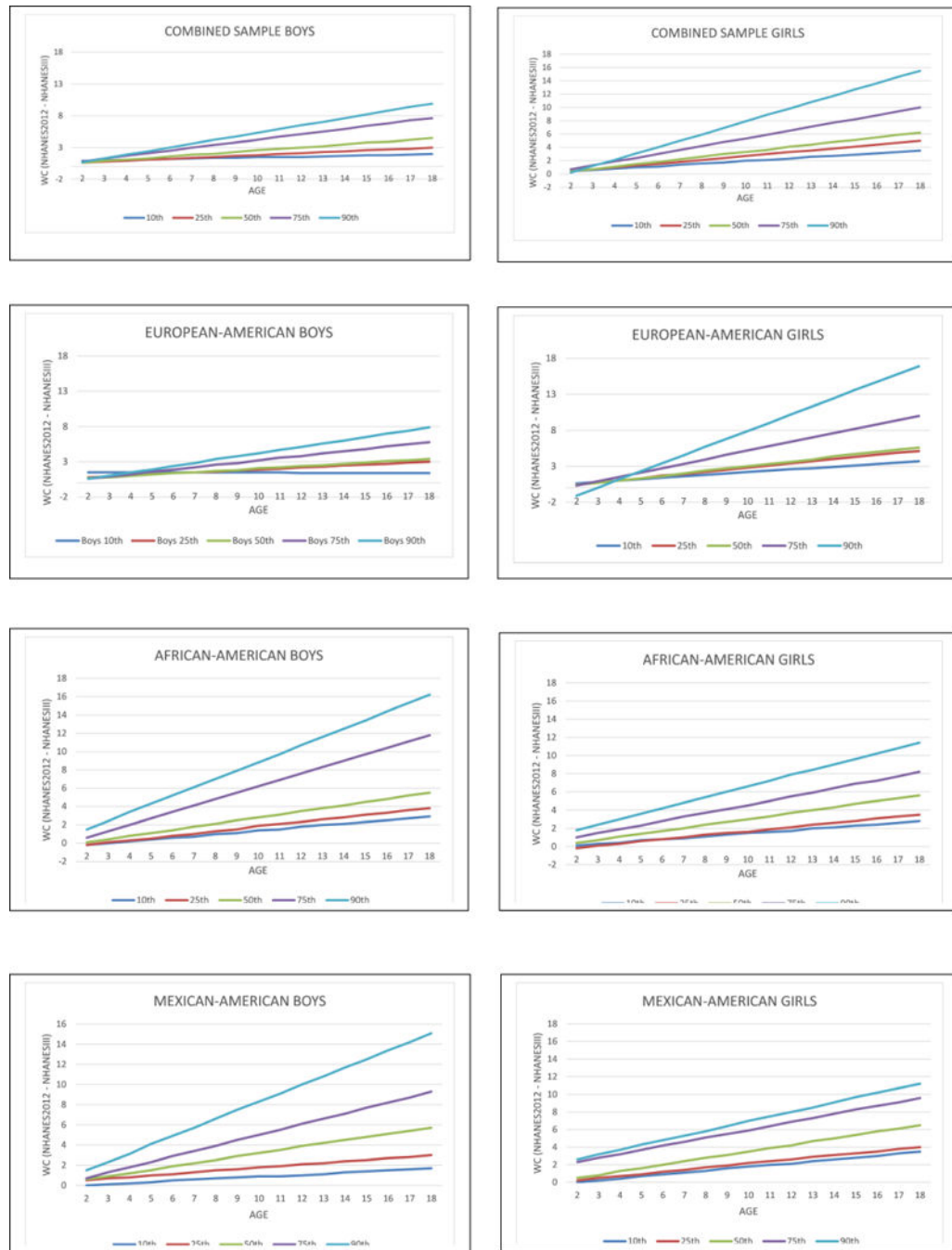
FIGURE 1.
WC Differences between NHANES2014 and NHANESIII WC for Boys and Girls
Combined and according to Racial/Ethnic Group

Table 1

Estimated value for percentile regression for all boys and girl children and adolescents combined, and according to race/ethnic classification.

			Percentile for boys						Percentile for girls					
			10th	25th	50th	75th	85th	90th	10th	25th	50th	75th	85th	90th
COMBINED SAMPLE	Intercept		40.5	41.6	43.1	43.5	43.2	43.5	40.1	41.4	42.8	44.2	44.1	44.4
	Slope		1.8	2.0	2.3	3.0	3.6	4.0	1.8	2.0	2.3	3.0	3.6	4.0
	Age	2	44.1	45.6	47.7	49.5	50.4	52.4	43.6	45.4	47.5	50.2	51.4	52.4
		3	45.9	47.6	50.0	52.5	54.0	56.4	45.4	47.4	49.8	53.2	55.0	56.4
		4	47.7	49.6	52.2	55.5	57.6	60.4	47.1	49.4	52.2	56.2	58.6	60.4
		5	49.5	51.6	54.5	58.4	61.2	64.4	48.9	51.4	54.5	59.1	62.3	64.4
		6	51.3	53.6	56.8	61.4	64.8	68.4	50.6	53.3	56.8	62.1	65.9	68.4
		7	53.1	55.6	59.1	64.4	68.4	72.4	52.4	55.3	59.1	65.1	69.6	72.4
		8	54.9	57.6	61.3	67.4	72.0	76.4	54.2	57.3	61.5	68.1	73.2	76.4
		9	56.7	59.6	63.6	70.3	75.6	80.4	55.9	59.3	63.8	71.1	76.8	80.4
		10	58.5	61.6	65.9	73.3	79.3	84.5	57.7	61.3	66.1	74.0	80.5	84.5
		11	60.2	63.6	68.2	76.3	82.9	88.5	59.4	63.3	68.4	77.0	84.1	88.5
		12	62.0	65.6	70.4	79.3	86.5	92.5	61.2	65.3	70.8	80.0	87.8	92.5
		13	63.8	67.6	72.7	82.3	90.1	96.5	63.0	67.2	73.1	83.0	91.4	96.5
		14	65.6	69.6	75.0	85.2	93.7	100.5	64.7	69.2	75.4	86.0	95.0	100.5
		15	67.4	71.6	77.3	88.2	97.3	104.5	66.5	71.2	77.7	88.9	98.7	104.5
		16	69.2	73.6	79.5	91.2	100.9	108.5	68.2	73.2	80.1	91.9	102.3	108.5
		17	71.0	75.6	81.8	94.2	104.5	112.5	70.0	75.2	82.4	94.9	106.0	112.5
		18	72.8	77.6	84.1	97.1	108.1	116.5	71.8	77.2	84.7	97.9	109.6	116.5
European Americans	Intercept		40.8	41.9	43.3	43.2	43.0	43.4	40.1	41.6	43.3	44.1	43.6	43.4
	Slope		1.8	2.0	2.3	3.0	3.5	4.0	1.8	2.0	2.2	2.9	3.7	4.0
	Age	2	44.4	45.9	47.8	49.1	50.0	51.4	43.6	45.5	47.8	49.9	50.9	51.4
		3	46.2	47.9	50.0	52.1	53.5	55.4	45.4	47.5	50.0	52.8	54.6	55.4
		4	48.0	49.9	52.3	55.0	57.1	59.4	47.2	49.5	52.2	55.7	58.2	59.4
		5	49.8	51.9	54.5	58.0	60.6	63.4	49.0	51.5	54.4	58.6	61.9	63.4
		6	51.6	53.9	56.8	61.0	64.1	67.4	50.8	53.5	56.6	61.5	65.5	67.4
		7	53.4	55.9	59.0	63.9	67.6	71.4	52.6	55.4	58.8	64.4	69.2	71.4

		Percentile for boys						Percentile for girls					
		10th	25th	50th	75th	85th	90th	10th	25th	50th	75th	85th	90th
	8	55.2	57.9	61.3	66.9	71.2	74.3	54.4	57.4	61.1	67.3	72.8	75.4
	9	57.0	59.9	63.5	69.8	74.7	78.1	56.2	59.4	63.3	70.3	76.5	79.4
	10	58.8	61.9	65.8	72.8	78.2	81.9	58.0	61.4	65.5	73.2	80.1	83.4
	11	60.6	63.9	68.0	75.8	81.7	85.8	59.8	63.4	67.7	76.1	83.8	87.4
	12	62.3	65.9	70.3	78.7	85.3	89.6	61.6	65.4	69.9	79.0	87.4	91.4
	13	64.1	67.9	72.5	81.7	88.8	93.5	63.3	67.3	72.1	81.9	91.1	95.4
	14	65.9	69.9	74.8	84.6	92.3	97.3	65.1	69.3	74.4	84.8	94.7	99.4
	15	67.7	71.9	77.0	87.6	95.8	101.2	66.9	71.3	76.6	87.7	98.4	103.4
	16	69.5	73.9	79.3	90.6	99.4	105.0	68.7	73.3	78.8	90.6	102.0	107.4
	17	71.3	75.9	81.5	93.5	102.9	108.8	70.5	75.3	81.0	93.5	105.7	111.4
	18	73.1	77.9	83.8	96.5	106.4	112.7	72.3	77.2	83.2	96.4	109.3	115.4
African Americans		10th	25th	50th	75th	85th	90th	10th	25th	50th	75th	85th	90th
	Intercept	39.6	40.4	42.1	43.3	43.2	43.3	39.6	40.6	41.4	42.2	43.6	43.4
	Slope	1.7	1.9	2.2	2.9	3.6	4.1	1.7	1.9	2.5	3.3	3.7	4.3
Age	2	43.0	44.3	46.5	49.1	50.3	51.5	43.1	44.4	46.3	48.7	51.1	51.9
	3	44.8	46.3	48.7	52.0	53.9	55.6	44.8	46.4	48.8	52.0	54.8	56.2
	4	46.5	48.2	50.9	54.9	57.4	59.8	46.5	48.3	51.3	55.3	58.5	60.5
	5	48.3	50.1	53.1	57.8	61.0	63.9	48.3	50.3	53.7	58.5	62.2	64.7
	6	50.0	52.1	55.3	60.7	64.5	68.0	50.0	52.2	56.2	61.8	66.0	69.0
	7	51.7	54.0	57.5	63.6	68.1	72.1	51.7	54.1	58.6	65.1	69.7	73.3
	8	53.5	56.0	59.7	66.5	71.7	76.3	53.4	56.1	61.1	68.3	73.4	77.6
	9	55.2	57.9	61.9	69.4	75.2	80.4	55.2	58.0	63.5	71.6	77.1	81.8
	10	57.0	59.9	64.1	72.3	78.8	84.5	56.9	59.9	66.0	74.8	80.9	86.1
	11	58.7	61.8	66.3	75.2	82.3	88.6	58.6	61.9	68.4	78.1	84.6	90.4
	12	60.5	63.7	68.5	78.1	85.9	92.8	60.3	63.8	70.9	81.4	88.3	94.7
	13	62.2	65.7	70.7	81.0	89.4	96.9	62.1	65.8	73.4	84.6	92.0	98.9
	14	63.9	67.6	72.9	83.9	93.0	101.0	63.8	67.7	75.8	87.9	95.8	103.2
	15	65.7	69.6	75.1	86.8	96.6	105.1	65.5	69.6	78.3	91.2	99.5	107.5
	16	67.4	71.5	77.3	89.7	100.1	109.3	67.2	71.6	80.7	94.4	103.2	111.8
	17	69.2	73.5	79.5	92.6	103.7	113.4	69.0	73.5	83.2	97.7	106.9	116.0

	Percentile for boys						Percentile for girls					
	10th	25th	50th	75th	85th	90th	10th	25th	50th	75th	85th	90th
18	70.9	75.4	81.7	95.5	107.2	117.5	70.7	75.4	85.6	101.0	110.7	120.3
	10th	25th	50th	75th	85th	90th	10th	25th	50th	75th	85th	90th
Intercept	40.8	42.0	43.2	44.0	45.0	46.0	41.0	41.9	43.6	46.1	47.0	48.7
Slope	1.8	2.1	2.5	3.3	3.8	4.3	1.7	2.0	2.4	3.1	3.6	3.7
Age 2	44.4	46.1	48.2	50.5	52.7	54.7	44.5	45.9	48.5	52.2	54.1	56.1
3	46.2	48.2	50.7	53.8	56.6	59.0	46.2	47.9	50.9	55.3	57.7	59.9
4	48.0	50.2	53.2	57.1	60.4	63.3	47.9	49.9	53.4	58.4	61.2	63.6
5	49.8	52.3	55.7	60.3	64.2	67.7	49.7	51.9	55.8	61.5	64.8	67.3
6	51.7	54.3	58.2	63.6	68.1	72.0	51.4	53.9	58.3	64.6	68.3	71.0
7	53.5	56.4	60.7	66.9	71.9	76.3	53.1	55.9	60.7	67.7	71.9	74.7
8	55.3	58.5	63.2	70.1	75.8	80.7	54.8	58.0	63.2	70.8	75.4	78.4
9	57.1	60.5	65.8	73.4	79.6	85.0	56.6	60.0	65.6	73.8	79.0	82.2
10	58.9	62.6	68.3	76.7	83.4	89.3	58.3	62.0	68.0	76.9	82.5	85.9
11	60.7	64.6	70.8	79.9	87.3	93.6	60.0	64.0	70.5	80.0	86.1	89.6
12	62.5	66.7	73.3	83.2	91.1	98.0	61.7	66.0	72.9	83.1	89.6	93.3
13	64.3	68.7	75.8	86.5	95.0	102.3	63.5	68.0	75.4	86.2	93.2	97.0
14	66.2	70.8	78.3	89.7	98.8	106.6	65.2	70.0	77.8	89.3	96.7	100.8
15	68.0	72.8	80.8	93.0	102.6	110.9	66.9	72.0	80.3	92.4	100.3	104.5
16	69.8	74.9	83.3	96.3	106.5	115.3	68.6	74.0	82.7	95.5	103.8	108.2
17	71.6	76.9	85.8	99.5	110.3	119.6	70.4	76.0	85.1	98.5	107.4	111.9
18	73.4	79.0	88.3	102.8	114.2	123.9	72.1	78.0	87.6	101.6	110.9	115.6

Mexican Americans

Table 2

Prevalence (and confidence intervals) of waist circumference above the 85th and 95th percentile for 2003–2004 data and 2011–2012 data, according to age groups. **Bold** numbers represents a significant increase or decrease in prevalence between the two time periods (statistical significant a p ≤ 0.05.

Sample		Age	85th Percentile		95th Percentile	
			2003–2004	2011–2012	2003–2004	2011–2012
Combined Sample	All	2–18	15.6 (12.4–18.8)	15.4 (13.1–17.6)	5.6 (3.8–7.4)	5.5 (3.9–7.1)
		2–5	15.3 (11.7–18.9)	13.1 (10.1–16.2)	**5.5 (3.3–7.6)**	**2.7 (1.7–3.7)** **
		6–11	17.3 (12.9–21.7)	16.4 (12.0–20.8)	8.1 (5.5–10.7)	7.9 (4.3–11.4)
		12–18	14.3 (10.7–17.9)	15.7 (11.6–19.8)	3.6 (1.8–5.3)	5.1 (2.8–7.3)
	Boys	2–18	17.9 (14.1–21.7)	14.7 (12.0–17.5)	5.9 (4.0–7.8)	4.4 (2.5–6.2)
		2–5	19.0 (15.2–22.9)	13.7 (7.7–19.7)	**6.4 (3.7–9.0)**	**2.5 (0.3–4.7)** *
		6–11	17.7 (11.3–24.0)	14.2 (9.5–18.8)	7.8 (3.9–11.7)	6.1 (2.3–9.9)
		12–18	17.6 (12.9–22.2)	15.8 (10.8–20.7)	4.2 (2.0–6.4)	3.9 (1.0–6.8)
	Girls	2–18	13.2 (10.1–16.3)	16.0 (12.4–19.7)	5.2 (2.6–7.8)	6.7 (5.0–8.4)
		2–5	11.7 (7.0–16.5)	12.5 (4.8–20.2)	4.6 (1.5–7.7)	3.0 (0.3–5.6)
		6–11	16.9 (12.3–21.5)	18.8 (13.7–24.0)	8.4 (4.3–12.6)	9.8 (5.8–13.7)
		12–18	10.9 (6.5–15.2)	15.6 (10.1–21.0)	2.9 (0.7–5.2)	6.2 (3.6–8.8)
European Americans	All	2–18	16.5 (12.4–20.6)	15.2 (11.6–18.8)	5.8 (3.4–8.1)	5.5 (3.0–8.0)
		2–5	17.0 (12.6–21.3)	14.1 (8.5–19.8)	**6.0 (2.9–9.2)**	**2.1 (1.1–3.2)** **
		6–11	17.9 (11.9–23.9)	15.1 (7.8–22.4)	8.5 (4.9–12.1)	7.5 (1.5–13.5)
		12–18	15.3 (10.6–19.9)	15.9 (9.6–22.1)	3.6 (1.3–5.8)	5.4 (2.2–8.6)
	Boys	2–18	19.8 (15.3–24.4)	13.7 (10.0–17.4)	6.2 (3.8–8.5)	3.7 (1.2–6.3)
		2–5	20.7 (16.3–25.0)	15.2 (4.4–26.1)	6.4 (2.8–10.1)	2.0 (0.0–5.4)
		6–11	19.5 (11.2–27.9)	11.0 (3.6–18.3)	8.6 (3.4–13.8)	4.7 (0.0–10.9)
		12–18	19.7 (13.8–25.7)	15.4 (9.4–21.5)	4.2 (1.4–7.1)	3.7 (0.0–7.6)
	Girls	2–18	13.2 (9.0–17.3)	16.7 (10.7–22.7)	5.3 (1.7–8.9)	7.2 (4.3–10.0)
		2–5	13.4 (7.1–19.7)	13.0 (0.2–25.7)	5.7 (1.2–10.1)	2.3 (0.0–5.8)
		6–11	16.3 (10.2–22.4)	19.7 (10.5–28.8)	8.4 (2.6–14.1)	10.5 (3.8–17.2)
		12–18	10.7 (5.0–16.5)	16.2 (8.0–24.5)	2.9 (0.0–6.1)	6.9 (2.9–11.0)

Sample		Age	85th Percentile		95th Percentile	
			2003–2004	2011–2012	2003–2004	2011–2012
African Americans	All	2–18	14.7 (12.3–17.2)	16.1 (12.6–19.5)	5.3 (4.2–6.5)	5.9 (3.4–8.4)
		2–5	10.6 (6.9–14.4)	12.6 (7.2–18.1)	2.7 (0.6–4.8)	3.8 (1.5–6.1)
		6–11	17.7 (13.4–21.9)	18.3 (13.4–23.2)	8.1 (5.4–10.7)	8.6 (4.8–12.5)
		12–18	14.3 (11.3–17.2)	16.2 (10.3–22.0)	4.3 (2.7–5.9)	4.8 (1.4–8.2)
	Boys	2–18	14.1 (11.0–17.2)	16.2 (13.3–19.1)	4.9 (3.3–6.6)	5.2 (2.3–8.2)
		2–5	11.7 (6.3–17.1)	12.0 (3.9–20.1)	2.0 (0.0–4.5)	3.0 (0.0–7.0)
		6–11	13.8 (9.2–18.4)	19.1 (13.2–25.0)	6.3 (3.2–9.4)	8.2 (2.6–13.8)
		12–18	15.5 (11.4–19.6)	16.4 (11.4–21.4)	5.2 (3.0–7.5)	4.1 (0.0–8.4)
	Girls	2–18	15.4 (12.3–18.5)	15.9 (10.3–21.5)	5.7 (3.9–7.6)	6.6 (3.4–9.8)
		2–5	9.6 (6.4–12.8)	13.4 (9.4–17.4)	3.4 (1.0–5.9)	4.7 (1.4–8.0)
		6–11	21.6 (15.7–27.6)	17.6 (9.5–25.7)	9.9 (5.4–14.3)	9.1 (4.0–14.1)
		12–18	12.9 (9.3–16.6)	15.9 (7.7–24.1)	3.3 (1.2–5.4)	5.5 (1.0–10.0)
Mexican Americans	All	2–18	11.9 (8.8–14.9)	15.2 (11.8–18.7)	4.9 (3.0–6.9)	5.4 (3.8–7.0)
		2–5	13.7 (7.2–20.2)	10.4 (6.9–14.0)	6.0 (2.4–9.6)	3.3 (1.2–5.4)
		6–11	14.1 (8.8–19.4)	19.2 (14.3–24.1)	6.5 (3.3–9.7)	8.5 (5.7–11.3)
		12–18	**8.4 (6.9–9.9)**	**14.5 (10.2–18.7)** [**]	2.6 (1.7–3.6)	3.9 (1.5–6.4)
	Boys	2–18	13.2 (10.3–16.2)	16.7 (12.1–21.3)	5.7 (3.4–8.0)	5.8 (3.3–8.3)
		2–5	**19.9 (10.6–29.3)**	**10.6 (6.9–14.4)** [*]	10.3 (4.9–15.7)	3.3 (0.0–7.4)
		6–11	13.9 (8.8–19.1)	21.1 (13.4–28.8)	5.9 (2.5–9.3)	9.1 (4.9–13.2)
		12–18	**8.0 (5.4–10.6)**	**16.4 (9.0–23.8)** [**]	2.4 (0.6–4.1)	4.4 (0.3–8.6)
	Girls	2–18	10.4 (6.7–14.1)	13.7 (9.0–18.3)	4.1 (1.6–6.5)	5.0 (3.2–6.9)
		2–5	7.1 (1.1–13.0)	10.3 (2.7–17.9)	1.5 (0.0–3.7)	3.3 (0.0–6.7)
		6–11	14.3 (5.7–22.9)	17.4 (10.2–24.5)	7.1 (1.8–12.4)	7.9 (3.1–12.6)
		12–18	8.9 (4.6–13.2)	12.3 (5.2–19.4)	2.9 (1.2–4.6)	3.4 (0.0–6.9)

[*] p 0.05

[**] p 0.01