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Trends in the Prevalence of Extreme Obesity Among US Preschool-Aged Children Living in Low-Income Families, 1998– 2010

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To the Editor

Obesity and extreme obesity in childhood, which are more prevalent among minority and low-income families, have been associated with other cardiovascular risk factors, increased health care costs, and premature death.^{1,2} Obesity and extreme obesity during early childhood are likely to continue into adulthood.³ Understanding trends in extreme obesity is important because the prevalence of cardiovascular risk factors increases with severity of childhood obesity.² However, national trends in extreme obesity among young children living in low-income families are unknown.

Methods

The Pediatric Nutrition Surveillance System (PedNSS) includes almost 50% of children eligible for federally funded maternal and child health and nutrition programs. The study population included 27.5 million children aged 2 through 4 years from 30 states and the District of Columbia that consistently reported data to PedNSS from 1998 through 2010. We

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Disclaimer: The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Author Contributions: Dr Pan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Pan, Sherry, Dalenius, Grummer-Strawn.

Acquisition of data: Dalenius, Grummer-Strawn.

Analysis and interpretation of data: Pan, Blanck, Dalenius, Grummer-Strawn.

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excluded those with missing (n=297 999; 1.1%), miscoded (n=106 844; 0.4%), or biologically implausible height, weight, or body mass index (BMI) (n=427 051; 1.6%), leaving 26 708 517 children. The study was exempt from ethics review by the US Centers for Disease Control and Prevention (CDC).

One routine clinic visit with demographic information and measured height and weight was randomly selected for each child.⁴ Obesity (BMI ≥95th percentile for age and sex) and extreme obesity (BMI ≥120% of the 95th percentile) were defined according to the 2000 CDC growth charts.⁵ We examined trends from 1998 through 2010 in mean BMI and the prevalence of obesity and extreme obesity. Significant changes in overall trends were identified by the Joinpoint regression program version 3.5.3 (National Cancer Institute). Piecewise logistic regression adjusting for age, sex, and race/ethnicity was performed to examine trends using SAS version 9.2 (SAS Institute Inc). Using the transition year for overall trend detected by Joinpoint, separate line segments prior to and after that year were fitted.

Results

The 2010 study population was slightly younger and had proportionally more Hispanics and fewer non-Hispanic whites and blacks compared with the 1998 population (Table 1). Joinpoint regression found significant changes in trends of obesity and extreme obesity in 2003. The prevalence of obesity increased from 13.05% (95% CI, 13.00%–13.09%) in 1998 to 15.21% (95% CI, 15.16%–15.26%) in 2003. The prevalence of extreme obesity increased from 1.75% (95% CI, 1.73%–1.77%) in 1998 to 2.22% (95% CI, 2.20%–2.24%) in 2003. However, the prevalence of obesity decreased slightly to 14.94% (95% CI, 14.89%–14.98%) in 2010. Similarly, the prevalence of extreme obesity decreased to 2.07% (95% CI, 2.05%–2.09%) in 2010 (Table 1).

From 1998 through 2003, the prevalence of extreme obesity significantly increased overall (adjusted odds ratio [AOR], 1.047; 95% CI, 1.045–1.049) and in all groups except Asians/Pacific Islanders; the greatest average annual increases were among those aged 4 years and non-Hispanic whites (Table 2). From 2003 through 2010, extreme obesity significantly decreased overall (AOR, 0.983; 95% CI, 0.981–0.984) and in all groups except American Indians/Alaska Natives; the greatest decreases were among those aged 2 years and Asians/Pacific Islanders (Table 2).

Comment

Results of a previous study⁶ based on a broader sample of children aged 2 through 4 years in PedNSS indicated that the prevalence of obesity increased from 12.4% in 1998 to 14.5% in 2003, but remained essentially unchanged until 2008. Few studies have focused on extreme obesity because of its relatively low prevalence in national data. With data through 2010, we found that the upward trends in obesity and extreme obesity turned downward slightly in 2003 among preschool-aged children living in low-income families. To our knowledge, this is the first national study to show that the prevalence of obesity and extreme obesity among young US children may have begun to decline.

Major strengths of the study were that weight and height were measured and the sample size was large. Limitations included that we only included children from 30 states and the District of Columbia and our findings may have been slightly affected by the cut points for the biologically implausible values.

The results of this study indicate modest recent progress of obesity prevention among young children. These findings may have important health implications because of the lifelong health risks of obesity and extreme obesity in early childhood.

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Distribution of the Study Population and Prevalence of Obesity and Extreme Obesity Among US Children Aged 2 Through 4 Years Living in Low-Income Families, 1998–2010

Table 1

Year	Overall No.	Age, Mean, mo	Race/Ethnicity, % ^a				BMI, Mean (SD) ^b	Prevalence, % (95% CI)		
			Non-Hispanic White	Non-Hispanic Black	Hispanic	American Indian/Alaska Native		Asian/Pacific Islander	Obesity ^{b,c}	Extreme Obesity ^{b,d}
1998	1 945 115	40.9	43.7	23.5	28.6	0.8	3.4	16.52 (1.88)	13.05 (13.00–13.09)	1.75 (1.73–1.77)
1999	1 887 622	40.8	42.5	23.9	29.6	0.7	3.2	16.56 (1.90)	13.58 (13.53–13.63)	1.85 (1.83–1.87)
2000	1 869 593	40.6	42.6	22.7	30.5	0.8	3.4	16.62 (1.93)	14.37 (14.32–14.42)	2.02 (2.00–2.04)
2001	1 823 377	40.5	43.0	22.7	30.2	0.7	3.4	16.61 (1.93)	14.32 (14.26–14.37)	2.03 (2.01–2.05)
2002	1 887 032	40.5	42.9	22.4	30.7	0.7	3.4	16.65 (1.96)	14.89 (14.84–14.94)	2.15 (2.13–2.17)
2003 ^e	1 958 480	40.4	42.3	21.5	31.6	0.8	3.8	16.68 (1.97)	15.21 (15.16–15.26)	2.22 (2.20–2.24)
2004 ^f	2 014 085	40.5	42.4	21.7	31.5	0.8	3.6	16.70 (1.96)	15.36 (15.31–15.41)	2.22 (2.20–2.24)
2005	2 078 203	40.5	40.8	21.1	33.9	0.7	3.4	16.69 (1.95)	15.13 (15.09–15.18)	2.16 (2.14–2.18)
2006	2 042 050	40.4	38.9	20.5	36.5	0.8	3.3	16.70 (1.94)	15.17 (15.12–15.22)	2.15 (2.13–2.17)
2007	2 095 442	40.4	38.9	20.5	36.4	0.8	3.3	16.70 (1.94)	15.23 (15.18–15.28)	2.14 (2.12–2.16)
2008	2 249 621	40.4	38.9	20.6	36.5	0.8	3.2	16.71 (1.92)	15.24 (15.19–15.29)	2.10 (2.08–2.12)
2009	2 453 464	40.3	38.5	20.0	37.6	0.7	3.1	16.71 (1.92)	15.12 (15.07–15.16)	2.09 (2.07–2.11)
2010	2 404 433	40.5	38.9	20.5	36.7	0.7	3.2	16.68 (1.92)	14.94 (14.89–14.98)	2.07 (2.05–2.09)

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).

^aReported by parent or caregiver. The percentages describe the distribution of the study population.

^bExcluded missing, miscoded, or biologically implausible height, weight, and BMI. Because the distribution of weight, height, and BMI in the study population was skewed, we expanded the upper cutoff points for biological implausible z scores recommended by the World Health Organization to the following: height for age, –5.0 or less or greater than 5.0; weight for age, –5.0 or less or greater than 8.0; and BMI for age, –4.0 or less or greater than 8.0.

^cDefined as having a BMI for age and sex in the 95th percentile or greater according to 2000 Centers for Disease Control and Prevention growth charts.

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^dDefined as having a BMI for age and sex in the 120% or greater of the 95th percentile according to 2000 Centers for Disease Control and Prevention growth charts.

^eResults of Joinpoint regression showed that the upward trends in the prevalence of obesity and extreme obesity ended in 2003.

^fResults of Joinpoint regression showed that the upward trend in mean BMI ended in 2004.

Table 2
Trends in the Prevalence of Extreme Obesity From 1998–2003 and From 2003–2010 Among US Children Aged 2 Through 4 Years Living in Low-Income Families^d

Characteristic	Prevalence, %			OR (95% CI) Per Year Change			
	1998 ^b	2003 ^c	2010 ^d	1998–2003	2003–2010	1998–2003	2003–2010
Overall	1.75	2.22	2.07	1.048 (1.046–1.050)	0.988 (0.987–0.990)	1.047 (1.045–1.049)	0.983 (0.981–0.984)
Age, y							
2	1.18	1.39	1.14	1.028 (1.023–1.032)	0.971 (0.968–0.973)	1.021 (1.017–1.026)	0.965 (0.962–0.967)
3	1.76	2.28	2.08	1.052 (1.049–1.056)	0.988 (0.986–0.990)	1.048 (1.044–1.051)	0.982 (0.979–0.984)
4	2.40	3.21	3.24	1.062 (1.058–1.065)	0.998 (0.996–1.000)	1.059 (1.056–1.063)	0.993 (0.991–0.995)
Sex							
Boys	1.69	2.17	2.01	1.053 (1.050–1.057)	0.986 (0.985–0.988)	1.052 (1.049–1.055)	0.980 (0.979–0.982)
Girls	1.81	2.27	2.14	1.042 (1.039–1.045)	0.991 (0.989–0.992)	1.042 (1.039–1.045)	0.985 (0.983–0.987)
Race/ethnicity ^g							
Non-Hispanic white	1.17	1.64	1.60	1.071 (1.067–1.075)	0.987 (0.985–0.990)	1.072 (1.068–1.076)	0.987 (0.985–0.989)
Non-Hispanic black	1.40	1.73	1.50	1.045 (1.040–1.050)	0.979 (0.976–0.983)	1.047 (1.042–1.052)	0.980 (0.976–0.983)
Hispanic	2.85	3.30	2.92	1.028 (1.025–1.031)	0.982 (0.980–0.984)	1.032 (1.029–1.036)	0.982 (0.980–0.984)
American Indian/Alaska Native	2.24	2.95	2.98	1.046 (1.025–1.068)	1.003 (0.989–1.018)	1.048 (1.027–1.070)	1.003 (0.989–1.018)
Asian/Pacific Islander	1.99	1.97	1.58	0.996 (0.985–1.007)	0.968 (0.963–0.973)	1.002 (0.991–1.013)	0.966 (0.960–0.971)

Abbreviation: OR, odds ratio.

^aExtreme obesity defined as body mass index for age and sex in the 120% or greater of the 95th percentile according to 2000 Centers for Disease Control and Prevention growth charts.

^bBonferroni adjustments were used during the multiple subgroup comparisons with *t* tests. Results of all subgroup comparisons are all statistically significant at *P* < .005, except for the prevalence difference between American Indian/Alaska Native and Asian/Pacific Islander children.

^c Bonferroni adjustments were used during the multiple subgroup comparisons with *t* tests. Results of all subgroup comparisons are all statistically significant at $P < .005$, except the prevalence difference between Hispanic and American Indian/Alaska Native children.

^d Bonferroni adjustments were used during the multiple subgroup comparisons with *t* tests. Results of all subgroup comparisons are all statistically significant at $P < .005$, except the prevalence differences between Asian/Pacific Islander and non-Hispanic white or black children and between Hispanic and American Indian/Alaska Native children.

^e Unadjusted odds of being extremely obese for 1 year's increase in time, calculated from piecewise logistic regression.

^f Adjusted odds of being extremely obese for 1 year's increase in time, calculated from piecewise logistic regression controlling for age, sex, and race/ethnicity.

^g Trends are presented because they are important for identifying health disparities.