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Changes in Obesity Among US Children Aged 2 Through 4 Years Enrolled in WIC During 2010-2016

Prevalence of childhood obesity is high in the United States, especially among children from lower-income families.[1] Among children aged 2 through 4 years enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), obesity prevalence increased between 2000 and 2010 but declined through 2014.[2] The decline was statistically significant among all racial/ethnic groups and in 34 of 56 state WIC agencies. The present study examines trends in overweight and obesity by age, sex, and race/ethnicity using WIC data from 2010 to 2016.

Methods | The WIC Participant and Program Characteristics survey includes all participants certified to receive WIC benefits. Data are extracted from state WIC agencies in April of even reporting years. WIC applicants must have nutritional risk and gross household income less than or equal to 185% of the US poverty level or participate in the Supplemental Nutrition Assistance Program, Medicaid, or Temporary Assistance for Needy Families. Children's weight and height were measured by trained WIC professionals during certification or recertification visits. Children aged 2 through 4 years from 50 states, the District of Columbia, and 5 US territories enrolled in WIC in 2010, 2012, 2014, and 2016 were included in this study. The Centers for Disease Control and Prevention (CDC) determined that this study was not subject to review because deidentified secondary data were used.

Obesity was defined as a body mass index (BMI) at or above the 95th percentile for age and sex on the CDC growth charts.[3] Overweight was defined as a BMI between the 85th and 95th percentiles. We examined trends for overweight and obesity combined and obesity alone by including data from all years in log-binomial models (SAS version 9.4, SAS Institute) adjusted for age, sex, and race/ethnicity. Trends were considered statistically significant with a 2-sided $P < .01$. To show relative and absolute prevalence differences between 2010 and 2016, we obtained adjusted prevalence ratios (APRs) from log-binomial regression and calculated adjusted prevalence differences (APDs) ([prevalence in 2010 × APR between 2010 and 2016] − prevalence in 2010). Interactions of survey cycle with age, sex, and race/ethnicity were tested to determine whether trends differed within demographic subgroups.

Results | There were 12 403 629 children aged 2 through 4 years enrolled in WIC included (range, 3 307 442 in 2010 to 2 818 594 in 2016), excluding 171 272 children (1.4%) with missing age, sex, weight, height, or BMI information and 44 578 (0.4%) with biologically implausible anthropometric data. Compared with 2010, the 2016 study population had slightly lower proportions of non-Hispanic white and Hispanic children and higher proportions of non-Hispanic black and Asian/Pacific Islander children (**Table 1**).

The overall crude prevalence of obesity decreased from 15.9% in 2010 to 13.9% in 2016 (APD, −1.9% [95% CI, −1.9% to −1.8%]; APR, 0.88 [95% CI, 0.88-0.89]; $P < .001$) and the overall crude prevalence of overweight or obesity decreased from 32.5% in 2010 to 29.1% in 2016 (APD, −3.2% [95% CI, −3.3% to −3.2%]; APR, 0.90 [95% CI, 0.90-0.90]; $P < .001$). For overweight and obesity combined and obesity alone, multivariable trend analyses indicated statistically significant decreases in prevalence overall and in all age, sex, and racial/ethnic subgroups. Tests of interaction were significant

Table 1. Characteristics of US Children in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), 2010-2016

	No. (%)[a]			
Characteristics	2010 (n = 3 307 442)	2012 (n = 3 261 106)	2014 (n = 3 016 487)	2016 (n = 2 818 594)
Age, y				
2	1 333 334 (40.3)	1 268 827 (38.9)	1 198 411 (39.7)	1 152 176 (40.9)
3	1 166 350 (35.3)	1 173 931 (36.0)	1 106 205 (36.7)	1 027 505 (36.4)
4	807 758 (24.4)	818 348 (25.1)	711 871 (23.6)	638 913 (22.7)
Sex				
Male	1 676 395 (50.7)	1 654 510 (50.7)	1 532 467 (50.8)	1 431 197 (50.8)
Female	1 631 047 (49.3)	1 606 596 (49.3)	1 484 020 (49.2)	1 387 397 (49.2)
Race/ethnicity[b]				
Non-Hispanic white	966 673 (29.5)	919 697 (28.4)	841 132 (27.9)	776 843 (27.6)
Non-Hispanic black	618 580 (18.8)	634 965 (19.6)	615 395 (20.4)	594 060 (21.1)
Hispanic	1 536 644 (46.8)	1 513 145 (46.7)	1 389 135 (46.1)	1 274 650 (45.2)
American Indian/Alaska Native	38 661 (1.2)	40 814 (1.3)	36 456 (1.2)	35 682 (1.3)
Asian/Pacific Islander	121 667 (3.7)	130 252 (4.0)	129 770 (4.3)	136 141 (4.8)

[a] Percentages describe the distribution of study population and may not equal 100% because of rounding.

[b] Reported by parent or WIC professional. Racial/ethnic data are included to help identify health disparities.

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Table 2. Overweight and Obesity Among US Children in the Special Supplemental Nutrition Program for Women, Infants, and Children

	Prevalence, % (95% CI)[a]				2016 vs 2010	
	2010	2012	2014	2016	Adjusted Prevalence Ratio (95% CI)	Adjusted Prevalence Difference (95% CI)[b]
Overweight or Obesity (BMI at or above the 85th percentile for age and sex on the CDC growth charts)						
Overall[c]	32.5 (32.5-32.6)	31.2 (31.1-31.2)	30.2 (30.1-30.2)	29.1 (29.1-29.2)	0.90 (0.90-0.90)	−3.2 (−3.3 to −3.2)
Age, y[c,d]						
2	30.2 (30.2-30.3)	28.6 (28.5-28.7)	27.5 (27.5-27.6)	27.1 (27.0-27.2)	0.90 (0.90-0.90)	−3.0 (−3.1 to −2.9)
3	33.4 (33.3-33.4)	32.0 (31.9-32.1)	31.1 (31.1-31.2)	29.7 (29.7-29.8)	0.90 (0.89-0.90)	−3.5 (−3.6 to −3.4)
4	35.2 (35.1-35.3)	33.9 (33.8-34.0)	33.2 (33.1-33.3)	31.7 (31.5-31.8)	0.91 (0.90-0.91)	−3.3 (−3.5 to −3.2)
Sex[c,d]						
Male	33.5 (33.4-33.6)	31.8 (31.8-31.9)	30.9 (30.8-31.0)	29.6 (29.5-29.6)	0.89 (0.88-0.89)	−3.8 (−3.9 to −3.7)
Female	31.5 (31.5-31.6)	30.5 (30.4-30.5)	29.5 (29.4-29.6)	28.6 (28.6-28.7)	0.92 (0.91-0.92)	−2.7 (−2.8 to −2.6)
Race/ethnicity[c,d]						
Non-Hispanic white	28.8 (28.7-28.9)	27.8 (27.7-27.9)	27.7 (27.6-27.8)	27.4 (27.3-27.5)	0.95 (0.95-0.96)	−1.4 (−1.5 to −1.3)
Non-Hispanic black	27.3 (27.2-27.4)	26.3 (26.2-26.4)	25.9 (25.8-26.0)	25.0 (24.9-25.1)	0.92 (0.91-0.92)	−2.2 (−2.4 to −2.1)
Hispanic	37.2 (37.1-37.3)	35.5 (35.4-35.6)	34.0 (33.9-34.1)	32.6 (32.5-32.6)	0.88 (0.87-0.88)	−4.6 (−4.7 to −4.5)
American Indian/Alaska Native	40.3 (39.8-40.8)	37.5 (37.0-37.9)	36.2 (35.7-36.7)	36.7 (36.2-37.2)	0.91 (0.90-0.93)	−3.6 (−4.2 to −2.9)
Asian/Pacific Islander	26.6 (26.4-26.9)	25.2 (25.0-25.5)	24.2 (24.0-24.4)	22.4 (22.1-22.6)	0.84 (0.83-0.85)	−4.2 (−4.5 to −3.9)
Obesity (BMI at or above the 95th percentile for age and sex on the CDC growth charts)						
Overall[c]	15.9 (15.9-16.0)	15.2 (15.1-15.2)	14.5 (14.5-14.6)	13.9 (13.9-13.9)	0.88 (0.88-0.89)	−1.9 (−1.9 to −1.8)
Age, y[c,d]						
2	14.1 (14.0-14.1)	13.2 (13.1-13.3)	12.5 (12.4-12.5)	12.3 (12.2-12.3)	0.88 (0.87-0.88)	−1.7 (−1.8 to −1.6)
3	16.6 (16.6-16.7)	15.9 (15.8-15.9)	15.4 (15.3-15.4)	14.5 (14.5-14.6)	0.88 (0.87-0.88)	−2.0 (−2.1 to −1.9)
4	17.9 (17.8-18.0)	17.2 (17.1-17.3)	16.8 (16.7-16.9)	15.8 (15.7-15.9)	0.89 (0.88-0.90)	−2.0 (−2.1 to −1.9)
Sex[c,d]						
Male	16.8 (16.7-16.9)	15.9 (15.8-15.9)	15.2 (15.1-15.2)	14.4 (14.3-14.5)	0.87 (0.86-0.87)	−2.2 (−2.3 to −2.2)
Female	15.0 (14.9-15.1)	14.4 (14.4-14.5)	13.9 (13.8-14.0)	13.4 (13.3-13.4)	0.90 (0.90-0.91)	−1.5 (−1.6 to −1.4)
Race/ethnicity[c,d]						
Non-Hispanic white	12.8 (12.7-12.9)	12.4 (12.3-12.4)	12.2 (12.2-12.3)	12.1 (12.0-12.2)	0.95 (0.94-0.95)	−0.7 (−0.8 to −0.6)
Non-Hispanic black	12.7 (12.6-12.8)	12.1 (12.0-12.2)	11.9 (11.8-11.9)	11.4 (11.3-11.5)	0.90 (0.89-0.91)	−1.2 (−1.3 to −1.1)
Hispanic	19.3 (19.2-19.3)	18.3 (18.2-18.3)	17.3 (17.3-17.4)	16.4 (16.4-16.5)	0.86 (0.85-0.86)	−2.8 (−2.9 to −2.7)
American Indian/Alaska Native	20.9 (20.5-21.3)	18.9 (18.5-19.2)	18.0 (17.6-18.3)	18.5 (18.1-18.9)	0.88 (0.86-0.91)	−2.4 (−3.0 to −1.9)
Asian/Pacific Islander	12.5 (12.3-12.6)	11.7 (11.5-11.9)	11.1 (10.9-11.3)	10.0 (9.9-10.2)	0.81 (0.79-0.82)	−2.4 (−2.6 to −2.2)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CDC, Centers for Disease Control and Prevention.

[a] Crude prevalence. Biologically implausible z scores were defined as the following when calculating the prevalence: height for age <−5.0 or >4.0, weight for age <−5.0 or >8.0, and BMI for age <−4.0 or >8.0.[3]

[b] Calculated from prevalence in 2010 and adjusted prevalence ratio between 2010 and 2016 obtained from log-binomial regression model controlled for age, sex, and race/ethnicity: (prevalence in 2010 × adjusted prevalence ratio between 2010 and 2016) – prevalence in 2010.

[c] $P < .001$ for trend tests with all years' data included; P values were obtained from log-binomial regression models controlled for age, sex, and race/ethnicity.

[d] Tests of interaction were significant ($P < .001$) for age, sex, and racial/ethnic subgroups.

($P < .001$) for sex and racial/ethnic subgroups, with the greatest relative decreases among boys and Asian/Pacific Islander children (**Table 2**).

Discussion | Obesity in low-income children aged 2 through 4 years declined between 2010 and 2016, although 13.9% had obesity in 2016. Results from the National Health and Nutrition Examination surveys indicated a quadratic obesity trend among children aged 2 to 5 years, decreasing from the 2007-2008 to 2011-2012 surveys and then increasing to the 2015-2016 survey.[4] Differences may be due to a smaller sample of children from families of all income levels being used.

A study limitation is that fewer children were enrolled in WIC in recent years and characteristics of eligible children who were not enrolled might be different from those enrolled.

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However, demographic characteristics were accounted for in trend analyses.

Reasons for the declines in obesity among young children in WIC remain undetermined but may include WIC food package revisions[5] and local, state, and national initiatives.[6]

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COMMENT & RESPONSE

Evaluation of Patients With a History of Penicillin Allergy

To the Editor Dr Shenoy and colleagues[1] encouraged physicians, not only allergists, to evaluate patients with penicillin allergy before deciding not to use penicillin or other β-lactam antibiotics. Their approach is supported by evidence that shows that true penicillin allergy is rare and that penicillin oral challenge is a safe and effective method to rule out penicillin allergy. Ruling out penicillin allergy serves as an important tool for antimicrobial stewardship.

We would like to highlight 2 issues. First, there was only a brief discussion of the option to perform a longer oral challenge with penicillin. Many individuals who have penicillin allergy react only after a few doses or days, so it may be important to use longer exposure to penicillin (usually 5 days) to rule out delayed allergic reactions and ensure better adherence to future penicillin use.[2]

Second, the conclusion that any patient who has had a reaction with features of IgE-mediated reactions, such as urticaria or other pruritic rashes, should be routinely evaluated by skin testing before an oral challenge is not completely supported by publications that investigated the role of skin testing in penicillin allergy. Studies by Mill et al[3] and Confino-Cohen et al[4] showed that skin testing does not contribute to the diagnosis of penicillin allergy, and that avoiding skin testing in patients with a history of mild reactions removed the penicillin allergy label from more participants without causing any harm. Clinical guidelines that recommend that primary care physicians use skin testing might discourage them from performing this evaluation because of a lack of time, resources, knowledge, or proper reimbursement and might diminish the number of patients who have the label of penicillin allergy removed.

There are still indications for skin testing, but, in our opinion, only individuals who are at high risk with a history of a true anaphylactic reaction or other serious drug reactions should be evaluated with skin testing by an experienced allergist. As suggested by Moral et al,[5] it is time to change the paradigm regarding skin testing in penicillin allergy to make sure that patients receive the best antibiotic treatment.

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