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Trends in Anthropometric Measures Among US Children 6 to 23 Months, 1976–2014

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Abstract

BACKGROUND AND OBJECTIVES: The surveillance of children's growth reflects a population's nutritional status and risk for adverse outcomes. This study aimed to describe trends in length-for-age, weight-for-age, weight-for-length, and early childhood weight gain among US children aged 6 to 23 months.

METHODS: We analyzed NHANES data from 1976–1980, 1988–1994, 1999–2002, 2003–2006, 2007–2010, and 2011–2014. We estimated z scores < –2 (low) and ≥+2 (high) in comparison with World Health Organization growth standards for each indicator. Weight gain (relative to sex-age–specific medians) from birth until survey participation was estimated. Trends were assessed by low birth weight status and race/Hispanic origin. Race/Hispanic origin trends were assessed from 1988–1994 to 2011–2014.

RESULTS: In 2011–2014, the prevalence of low and high length-for-age was 3.3% (SE, 0.8) and 3.7% (SE, 0.8); weight-for-age was 0.6% (SE, 0.3) and 7.0% (SE, 1.1); and weight-for-length was 1.0% (SE, 0.4) and 7.7% (SE, 1.2). The only significant trend was a decrease in high length-for-age (5.5% in 1976–1980 vs 3.7% in 2011–2014; $P = .04$). Relative weight gain between birth and survey participation did not differ over time, although trends differed by race/Hispanic origin. Non-Hispanic black children gained more weight between birth and survey participation in 2011–2014 versus 1988–1994, versus no change among other groups.

CONCLUSIONS: Between 1976–1980 and 2011–2014, there were no significant trends in low or high weight-for-age and weight-for-length among 6- to 23-month-old children whereas the

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percent with high length-for-age decreased. A significant trend in relative weight gain between birth and survey participation was observed among non-Hispanic black children.

Surveillance of children's growth can provide valuable information related to a population's nutritional status. Underweight (low weight-for-age), short stature (low length-for-age), and wasting (low weight-for-length) are childhood growth outcomes that are monitored throughout the world.[1, 2] These indicators of nutritional adequacy are particularly important for young children for whom malnutrition may have long-lasting adverse consequences.[3,4] There is increasing attention to the impact of early nutrition and growth patterns (both under- and overnutrition) on the risk for obesity and chronic disease later in life.[1, 5, 6] A gap in knowledge about the risk of later chronic disease exists for the nutritional developmental period from birth to 24 months.[7] Filling this gap is important because, for the first time, the US government plans to provide dietary guidelines for children <24 months old.[8–10]

Recent studies of growth indicators among US children aged <24 months have focused primarily on high weight-for-length.[11] Data on common anthropometric measures (length-for-age, weight-for-age, and weight-for-length) among US children <24 months have recently been published, but do not provide trend testing or analysis of population subgroups.[12, 13] Additionally, a decreasing trend in birth weight has been noted,[14] including among term infants.[15] The extent to which declining birth weights has led to more rapid postnatal weight gain is unknown. Finally, trends in infant nutrition have changed, with an increased rate of breastfeeding initiation rates observed over the past 2 decades.[16] The objective of this study is to describe trends in the percentage of US children <24 months with low and high *z* scores for length-for-age, weight-for-age, and weight-for-length between 1976–1980 and 2011–2014. Given the research showing health associations with accelerated (or "catch-up") growth in early childhood,[17–19] a second objective was to assess trends in weight gain between birth and ages 6 to 23 months.

METHODS

Study Data

The NHANES, conducted by the National Center for Health Statistics, is a nationally representative sample of the civilian, noninstitutionalized US population. The survey design uses a stratified multistage probability sample; additional details of the complex survey design are described elsewhere.[20–22] NHANES was conducted periodically beginning in 1971–1974 and then became a continuous survey in 1999 with data release in 2-year cycles. We analyzed data for the continuous surveys in 4-year cycles to increase reliability of estimates. Examination response rates for children from birth to 5 years of age ranged from 76% to 90% between 1976 to 1980 and 2013 to 2014. Written parental consent was obtained for children aged <18 years. The National Center for Health Statistics Research Ethics Review Board approved the NHANES protocol.

Children aged 6 to 23 months were included in NHANES II (1976–1980), 2 to 23 months in NHANES III (1988–1994), and birth to 23 months in 1999 to 2014. This analysis included the common age group across all survey cycles, 6 to 23 months. NHANES I (1971–1974) was not included because data were collected only for children ≥1 year of age. Standardized protocols for measurement of weight and length were used in all the NHANES cycles.[23] Measurement protocols were similar across survey cycles.[23–25]

Trends in low and high weight and length were assessed by age group, low birth weight status, breastfeeding history, and race/Hispanic origin.

Age was defined in months at the time of the exam. Birth weight was reported in pounds and ounces by a responsible adult and converted into grams. Low birth weight was defined as <2500 g. Participants were classified as ever being breastfed if affirmative responses were provided for the following questions for 1988 to 1994 and 1999 to 2014: "Was (your child) ever breastfed or fed breastmilk?" The 7 children missing responses for these questions were omitted from breastfeeding history analyses, but included in all other analyses. The 1976 to 1980 breastfeeding question ["Was (your child) ever breastfed at any time on a regular basis?"] differed from the later question and we excluded this survey cycle from the analysis of breastfeeding history. Race/Hispanic origin was categorized as non-Hispanic white, non-Hispanic black, and Mexican American. Participants of other race/Hispanic origin groups were included in the total category but not shown separately. Hispanic origin data are available beginning in 1988 to 1994, and therefore trends by race were assessed from 1988–1994 to 2011–2014.

Anthropometric Indicators

The Centers for Disease Control and Prevention (CDC) recommends that health care providers assess growth among children <24 months of age using the World Health Organization (WHO) 2006 growth standards.[26] We used these standards to calculate *z* scores for reported birth weight, and measured length-for-age, weight-for-age, and weight-for-length among children aged 6 to 23 months.[27, 28] BMI-for-age was not included because the CDC does not recommend its use for children <24 months.[29] The 2006 WHO growth charts categorize measures by age in days. Age in days was calculated from age in months: age in months*(365.25/12).[28] We defined growth indicators as low (*z* score < –2, which corresponds to the 2.3rd percentile) and high (*z* score ≥ +2, which corresponds to the 97.7th percentile), based on CDC recommendations for identifying growth patterns that may be associated with adverse health conditions.[26] SAS GPLOT (SAS Institute, Inc, Cary, NC) was used with a kernel density estimate to plot the distribution of *z* scores for anthropometric indicators. We chose a low bandwidth ($C = 3$ on a scale of 1 to 100) to avoid oversmoothing. The WHO standards, which were designed to reflect optimal growth patterns among children <5 years of age,[30] excluded children with measures above +3 SD and below –3 SD of the mean for children <24 months of age.[27] However, sample children from NHANES with *z* scores outside 3 SD were included in the analysis, and, for the purpose of the plotting *z* scores only, data were bottom- and top-coded at –3 SD and +3 SD to reduce distortion of the plotted distributions by outliers. This method of coding could account for the apparent bimodal distribution in some figures.

Next, we assessed trends in population-level early childhood weight gain with age. To assess change in weight from birth to age at survey participation, we examined 2 measures that are more appropriate to assess trends in mean weight gain with age than mean change in *z* scores. First, we estimated change in relative weight. We calculated relative birth weight by subtracting the 2006 WHO sex-specific median weight at age 0 months from the reported birth weight. The relative weight at survey participation was calculated by subtracting the 2006 WHO sex-age-specific weight from the weight at survey participation. The relative weight change was the difference between relative weight and relative birth weight. This measure is similar to that used in studies of changes in BMI and height with age.[31, 32] Second, we calculated the absolute change in weight between birth and survey participation. Given that these measurements are not age- and sex-standardized, we analyzed the absolute change in weight by sex for specific ages (6, 9, 12, 15, 18, and 23 months). In Supplemental Table 6, we also report the mean change in weight-for-age *z* score between birth and survey participation. Although the *z* score standardizes measures across a study population, it is not an optimal measure to assess the population mean of change in weight with age over time. Researchers reporting change in BMI with age among children have noted limitations in using a *z* score based on growth charts; a given change in units at the top end of the BMI distribution results in a smaller change in *z* score compared with the same change in units at the middle of the range.[31, 33] In addition, other studies point out that assessing change over time by using *z* scores based on growth standards may be inappropriate given that they are based on SD from cross-sectional data.[32] The SD from median values of height and weight increase with age, as is apparent from the pattern of diverging percentiles on growth charts with age. If an absolute difference in weight from the median remains constant over age, the *z* score will change with age due solely to the change in SD. That is, a change in *z* score with age could result from either a change in relative weight gain or the change in the SD.

Statistical Analysis

Data were analyzed by using SAS (version 9.3) and SUDAAN (version 11.0; Research Triangle Institute, Research Triangle Park, NC) statistical software programs. All analyses included examination weights that account for the unequal probabilities of selection, oversampling, and nonresponse. SE for all analyses were estimated by using Taylor series linearization to account for the complex sample design. Confidence intervals for percentages were constructed by using the Korn and Graubard method.[34] Trends were tested by using orthogonal contrast for categorical variables and linear regression models for continuous variables. The survey year was treated as a continuous ordinal variable, and, to account for temporal spacing of the survey periods, the midpoint of the survey cycle was chosen for each time period. For orthogonal contrast testing, SAS PROC IML was used to calculate coefficients for unequally spaced intervals. Statistical significance was determined by using a P value of .05. No adjustments were made for multiple comparisons.

RESULTS

Sample characteristics and mean *z* scores for anthropometric indicators are shown in Table 1 by survey cycle. The proportion of non-Hispanic white children declined from 1988–1994 to 2011–2014, whereas the proportion of Mexican American children increased. The mean birth weight decreased from 1976–1980 to 2011–2014 (the 2011–2014 mean birth weight was 50 g less than the 1976–1980 mean; $P = .012$ for trend), as did the mean *z* score for birth weight and the mean relative birth weight. The percentage of children ever breastfed increased during the study period. There were no significant trends in mean values for weight-for-age, length-for-age, or weight-for-length among 6- to 23-month-old children from 1976–1980 to 2011–2014.

To additionally assess trends in early childhood growth, we compared distributions of *z* scores for weight-for-age, length-for-age, weight-for-length, and birth weight for 6- to 23-month-old children for 1976–1980 to those for 2011–2014 (Fig 1). Overall, the patterns in distributions were consistent with those for mean values. The weight-for-age and length-for-age *z* score distributions appear slightly wider in 2011–2014 compared with 1976–1980. For the weight-for-length *z* score, there is a narrower peak distribution with similar tails. For the birth weight *z* score, there is a slight shift of the distribution to the left in 2011–2014.

The percentages of children with low (*z* score < –2.0) and high (*z* score ≥ +2.0) values for growth indicators for all survey cycles are shown in Table 2. Similar to the patterns in means and *z* score distributions, the percentage of children with low and high values did not differ from 1976–1980 to 2011–2014 for weight-forage or weight-for-length. There was a significant trend in the percentage of 6 to 23-month-old children with high, but not low, length-for-age (5.5% in 1976–1980 vs 3.7% in 2011–2104; P = .04 for trend). We also examined trends in high and low *z* scores for children by birth weight status (normal and low birth weight) and by race/Hispanic origin and breastfeeding history (Supplemental Table 5). No significant trends were observed by birth weight status or race/Hispanic origin except for a declining trend for low length-for-age among Mexican American children.

The decline in reported birth weight over the study period, although small, could imply that, on average, children in 2011–2014 who were born lighter had higher rates of weight gain during early childhood than their 1976–1980 counterparts to achieve similar weight at ages 6 to 23 months. Table 3 shows trends in the mean change in relative weight in kilograms from birth among children aged 6 to 23 months by race/Hispanic origin, and by breastfeeding history for the total population and those with normal birth weight. Sample sizes were too small to analyze race/Hispanic origin and breastfeeding groups among low birth weight infants, so only overall estimates for low birth weight are shown. As expected, children with low birth weight had a higher mean change in relative weight from birth compared with children with normal birth weight (eg, 1.19 kg vs 0.60 kg in 2011–2014). The trend in change in relative weight was not significant overall, or for infants and children with normal and low birth weight. In contrast, there were differences in trend by race/Hispanic origin, with significant increases in the mean change in relative weight between 1988–1994 and 2011–2014 observed for non-Hispanic black children overall (the mean change in relative weight increased by a mean of 240 g from 0.73 to 0.97 kg; P = .032 for trend) and those with normal birth weight (mean change in relative weight increased by a mean of 220 g from 0.70 to 0.92 kg; P = .039 for trend). Among normal birth weight children, there was also a significant increasing trend in the mean change in relative weight among children who were never breastfed (P = .01). Results were similar for the mean change in weight-for-age *z* score between birth and survey participation (see Supplemental Table 6) with significant trends for non-Hispanic black children overall and those with normal birth weight, and for never breastfed children with normal birth weight. However, in contrast to no overall trend observed for the mean change in relative weight in Table 3, there was an increasing trend in the mean change in weight-for-age *z* score among all children (P = .04) as well as among those ever breastfed (*P* = .04). As noted in the Methods section, trends in the mean change in *z* score may be less appropriate for assessing population trends in change in mean weight gain with age.

Table 4 shows the mean change in absolute weight by sex and age in months. The magnitude in weight change with age is similar to the general clinical guidance[35, 36] of doubling birth weight (mean, 3.3 kg) by 4 to 6 months of age (the mean weight gain in 2011–2014 by 6 months was 4.8 kg for boys and 4.4 kg for girls) and tripling birth weight by 12 months of age (mean weight gain in 2011–2014 by 12 months was 7.0 kg for boys and 6.0 kg for girls). The only group with a significant trend in the mean change in absolute weight was 6-month-old girls (*P* = .046), among whom the mean weight gain was 3.8 kg in 1976–1980 and 4.4 kg in 2011–2014. However, the sample sizes in some survey cycles were small, and this trend is not significant if the 1976–1980 observation for this group is omitted.

DISCUSSION

Over >3 decades, among 6- to 23-month-old US children, there were no significant changes in the mean values for length-for-age, weight-for-age, and weight-for-length, or the percentage with high or low values for these indicators, with the exception of a decreasing trend for the percentage of children with high length-for-age. In contrast, among older US children and adolescents, the percentage with high BMI, or obesity, increased in all age groups until at least 2003 to 2004.[37] A review of data from the European Union revealed no obvious trend in the prevalence of obesity among infant and preschool-aged children.[38] Similarly, a study of changes in obesity among a large sample of Chinese children <7 years of age found that obesity increased from 1986 to 2006 among preschool-aged children, but not in children <2 years of age.[39] The findings in this study for US children aged 6 to 23 months are similar, showing a stable pattern of weight among this age group overall over the past few decades.

We also assessed trends over time in mean weight gain with age. The mean birth weight declined over this same period, so that children in 2011–2014 theoretically underwent a higher rate of weight gain to achieve similar weights at ages 6 to 23 months than their 1976–1980 counterparts. This decline in birth weight was also observed among all live births by the early 2000s.[14] Greater relative weight gain during infancy has been found to be associated with childhood fat mass, central adiposity, and an increased risk for obesity in childhood and adulthood,[5, 18, 40] as well as associated poor health outcomes downstream.[4, 41] However, the observed change in birth weight in this study was small and did not translate into an observable change in the average weight gain in infancy among normal birth weight children for whom catch-up growth is not necessarily expected, or among low birth weight children, although the small sample size is a limitation for this group. Additionally, NHANES does not provide longitudinal data for individual children, and more research with appropriate study design is needed to more definitively explore growth trajectories. Examining trends in the mean change in weight-for-age *z* scores showed a significant increasing trend overall, but for reasons outlined above, the mean change in *z* scores may not be the optimal measure of trends in change in weight with age. The overall patterns for both the mean change in relative weight and the mean change in weight-for-age *z* scores was driven by the trend in non-Hispanic black children. Although it is difficult to interpret the relative weight gain in kilograms over the 6- to 23-month age range, we note that the change in the mean relative weight gain for non-Hispanic black children from 1988–1994 to 2011–2014 was 240 g, which is ~3% of the mean absolute weight gain of 7 kg by 15 months. It is unclear if this magnitude of difference has clinical significance. Additional studies could investigate whether this finding is relevant to race/ethnic disparities in childhood obesity prevalence.

Over the study period, infant feeding practices changed, with an increased percentage of children reported to have ever been breastfed. These changes could have implications for early childhood growth. However, our study does not present sufficient evidence to support or refute the role of breastfeeding in preventing rapid weight gain or obesity. First, we were unable to provide a summary measure of nutrition that accounts for breastfeeding duration, timing of introduction of solid foods, and other important variations relevant to growth patterns. The duration of breastfeeding, in particular, is an important consideration given the steep drop-off in breastfeeding after initiation.[16] Second, in using serial cross-sectional data, it is possible that observed trends reflect changes in successive cohorts that have made them less comparable to each other (eg, changes that could affect the composition of breast milk, such as differing maternal diet or increasing rates of pumping and storing milk).[42] Third, findings by breastfeeding history differed between trends in the mean change in relative weight and the mean change in weight-forage *z* scores. Although meta-analyses have concluded that breastfeeding reduces the risk of obesity,[43–46] concerns have been raised about the validity of the current evidence due to publication bias, potential heterogeneity between studies, and residual confounding, but also because outcomes may differ depending on the measure used, for example, by weight category (ie, the percentage with obesity) versus the change in mean BMI.[45, 47]

Growth charts are vital tools in monitoring childhood growth and serve as a comparison for a child's growth indicators to an external population. In the United States, the 2000 CDC growth charts have served as the primary growth charts to which children are compared. However, in 2010, the CDC recommended the use of the 2006 WHO growth charts for children <24 months of age.[26] There are differences between the CDC and WHO growth charts, such as the population included and recruitment criteria. Consequently, differences exist in the prevalence of low- and high-growth indicators based on the different charts. If weight and length for US infants and children aged <24 months matched those of infants and children used for the construction of the 2006 WHO growth charts, we would expect 2.3% of infants and children to have low and high values for weight-for-length, low length-for-age, and low weight-forage. However, we observed lower percentages for low weight-for-age and low weight-for-length and higher percentages for high weight-for-age and weight-for length. This suggests that the US population is heavier than the children who make up the WHO growth charts. Nevertheless, there were no significant trends in the percentages of US children aged 6 to 23 months with both low and high values for these anthropometric measurements.

Limitations of this study include its cross-sectional nature. Although we could assess weight change between birth and survey participation, we could neither observe growth trajectories from birth to 24 months nor examine their consequences. Birth weight was reported in pounds and ounces in all survey cycles, and we assumed that the validity of this measure did not vary over time. No data were collected on length at birth. NHANES lacks information on gestational age and had a relatively low sample size for infants and children with low birth weight; these limitations curtailed the possible analyses of the impact of birth weight on population-level anthropometric indicators. We used the 2006 WHO sex-specific median weight at age 0 months to calculate relative birth weight without correction for gestational age. The pattern of relative weight change is likely fundamentally different for children with low birth weight/low gestational age because these children frequently grow on a different trajectory (eg, catch-up growth). In particular, differences between this group and those with normal birth weights may still be pronounced at younger ages before catch-up growth is complete. However, analyses among normal birth weight children should ameliorate this limitation to some extent. Another limitation includes survey nonresponse, but NHANES weights provide adjustment for nonresponse. Finally, the sample sizes were small for some subgroups, and, subsequently, some estimates have lower reliability.

CONCLUSIONS

Anthropometric measurements among 6- to 23-month-old children have remained stable over the past 3 decades. Although the mean birth weight declined slightly from 1976–1980 to 2011–2014, there was no significant trend in the mean change in relative weight from birth to 6 to 23 months overall. The exception was for non-Hispanic black children. Additional study is necessary to characterize the significance of this finding, if any, for observed disparities in obesity and for later health consequences.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
WHO	World Health Organization

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WHAT'S KNOWN ON THIS SUBJECT: Studies on growth indicators of US children have primarily focused on high weight-for-length rather than the spectrum of outcomes, including stunting and wasting.

WHAT THIS STUDY ADDS: Between 1976–1980 and between 2011–2014, there were no trends in low or high weight-for-age and weight-for-length among 6- to 23-month-old children. Weight gain between birth and survey participation increased among non-Hispanic black children, but implications for health outcomes are unclear.

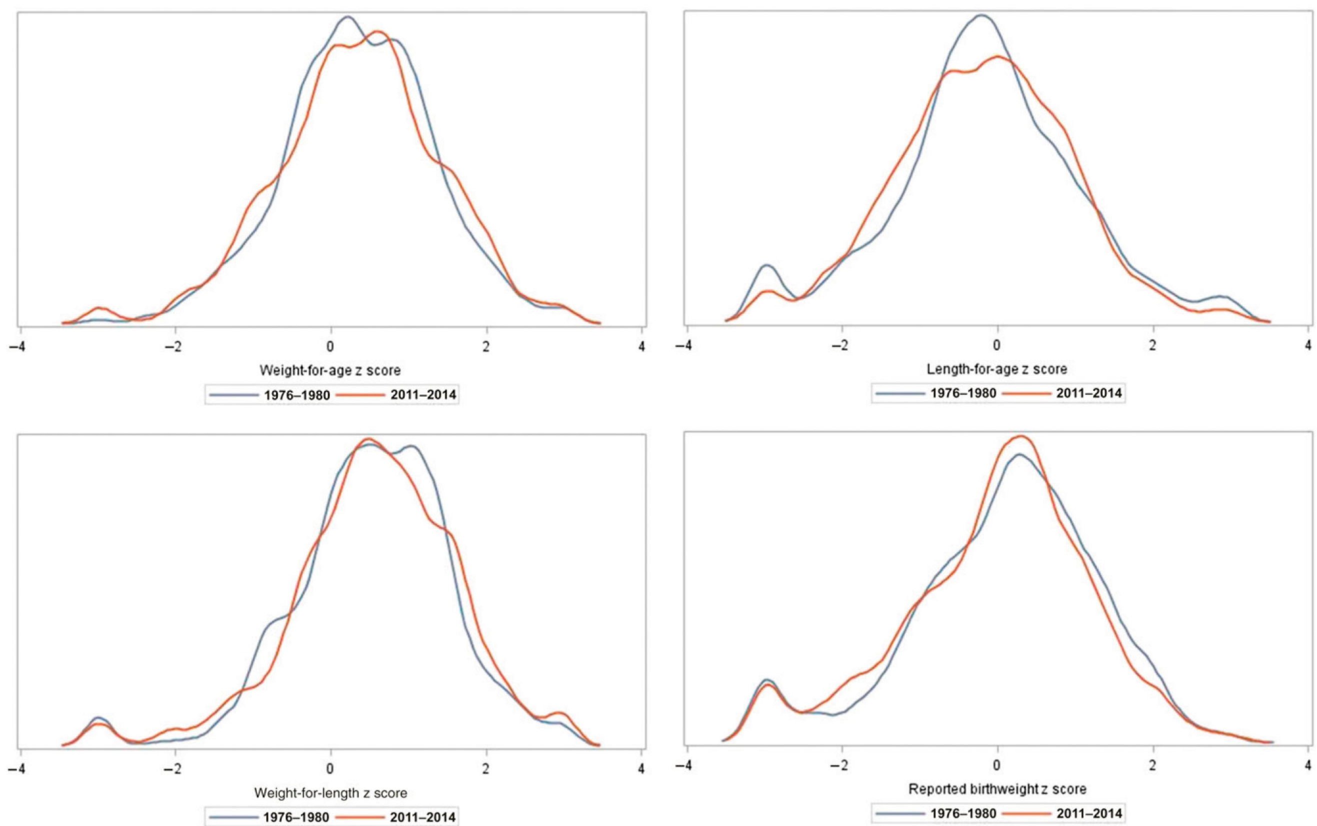

FIGURE 1.

Z score distribution for weight-for-age, weight-for length, and length-for-age and birth weight among US children aged 6 to 23 months, 1976–1980 and 2011–2014. Kernel density estimation. Children with *z* scores <–3 SD and >3 SD were recoded to –3 SD and 3 SD. Data source: NHANES.

TABLE 1

Characteristics of US Children Aged 6 to 23 Months by Survey Cycle, 1976 to 2014

	1976–1980	1988–1994	1999–2002	2003–2006	2007–2010	2011–2014	*P* for Trend[a]
N (unweighted)	1026	2470	1097	1195	1055	864	
Sex							
Boy, % (SE)	51.1 (2.3)	52.2 (1.2)	55.5 (2.2)	51.4 (1.8)	48.6 (1.7)	53.0 (2.0)	.12
Age, mo							
Mean (SE)	14.8 (0.2)	14.5 (0.2)	14.2 (0.2)	14.9 (0.2)	14.3 (0.2)	14.4 (0.2)	.20
Race/Hispanic origin[b]							
Non-Hispanic white, % (SE)	NA	64.1 (2.1)	53.9 (2.6)	60.7 (2.9)	53.0 (3.9)	48.6 (4.3)	.001
Non-Hispanic black, % (SE)	NA	16.4 (1.3)	12.6 (1.6)	13.3 (1.7)	13.4 (1.5)	13.0 (2.1)	.15
Mexican American, % (SE)	NA	9.8 (1.0)	16.9 (1.9)	15.6 (1.7)	18.5 (2.4)	18.6 (3.3)	.002
Reported birth weight							
Low birth weight, % (SE)	7.8 (1.2)	9.0 (0.8)	10.4 (1.1)	8.8 (1.0)	8.5 (1.1)	9.4 (1.1)	.44
Mean birth weight, kg (SE)	3.36 (0.03)	3.36 (0.02)	3.31 (0.03)	3.28 (0.02)	3.31 (0.03)	3.31 (0.02)	.01
Mean birth weight *z* score (SE)	0.08 (0.06)	0.05 (0.05)	−0.06 (0.06)	−0.10 (0.05)	−0.02 (0.06)	−0.04 (0.04)	.02
Mean relative birth weight, kg (SE)	0.07 (0.03)	0.07 (0.02)	0.01 (0.03)	−0.01 (0.02)	0.03 (0.03)	0.02 (0.02)	.01
Ever breastfed							
Yes, % (SE)	NA	54.3 (1.9)	67.8 (2.2)	73.2 (26.8)	72.9 (1.8)	79.2 (1.5)	<.001
Anthropometric measures							
Weight-for-age *n* (unweighted)	1026	2462	959	1190	1048	859	
Mean *z* score (SE)	0.48 (0.04)	0.48 (0.02)	0.46 (0.04)	0.47 (0.05)	0.48 (0.03)	0.48 (0.05)	.92
Mean relative weight, kg (SE)	0.65 (0.05)	0.64 (0.03)	0.61 (0.06)	0.66 (0.06)	0.65 (0.04)	0.67 (0.06)	.84
Length-for-age, *n* (unweighted)	1015	2447	1082	1176	1045	854	
Mean *z* score (SE)	0.11 (0.05)	0.19 (0.03)	0.05 (0.05)	0.12 (0.05)	0.05 (0.05)	0.06 (0.06)	.19
Weight-for-length, *n* (unweighted)	1014	2442	954	1176	1045	853	
Mean *z* score (SE)	0.63 (0.06)	0.55 (0.03)	0.62 (0.04)	0.57 (0.06)	0.63 (0.03)	0.63 (0.04)	.68

The *z* score and relative values are based on comparison with the WHO 2006 growth charts. Data source: NHANES. NA, not available.

[a]Trend tested by using orthogonal contrast matrices (categorical) and linear regression (continuous).

[b]Children of other race/Hispanic origin groups are not classified separately, but are included in all categories of other characteristics.

TABLE 2

Percentage With Low (−2 SD) and High (2+ SD) Age-Specific *z* Scores and 95% Confidence Intervals for Anthropometric Indicators Among US Children Aged 6 to 23 Months, 1976 to 2014

	1976–1980	1988–1994	1999–2002	2003–2006	2007–2010	2011–2014	*P* for Trend[a]
Weight-for-age							
z score < −2	0.6 (0.2–1.5)[b]	0.5 (0.2–0.9)[c]	1.4 (0.6–2.8)[c]	1.8 (0.9–3.3)	1.0 (0.5–2.0)[c]	0.6 (0.2–1.5)[b]	.17
z score 2+	5.6 (4.0–7.7)	6.0 (4.8–7.4)	5.9 (4.6–7.4)	6.0 (4.1–8.3)	6.3 (4.5–8.6)	7.0 (5.0–9.5)	.37
Length-for-age							
z score < −2	4.4 (3.0–6.2)	2.7 (1.9–3.8)	4.6 (3.2–6.5)	3.1 (1.8–4.9)	3.1 (2.2–4.2)	3.3 (1.9–5.4)	.35
z score 2+	5.5 (4.1–7.1)	5.0 (4.3–5.8)	4.1 (3.0–5.6)	4.0 (2.3—6.5)	3.9 (2.1–6.5)	3.7 (2.2–5.7)	.04
Weight-for-length							
z score < −2	0.4 (0.1–1.1)[b]	0.8 (0.4–1.2)	0.6 (0.1–1.9)[b]	1.0 (0.4–2.1)[c]	0.6 (0.1–1.7)[b]	1.0 (0.3–2.3)[b]	.28
z score 2+	6.2 (4.4–8.4)	7.0 (5.8–8.5)	7.6 (5.8–98)	7.4 (5.3–10.0)	8.7 (6.8–10.9)	7.7 (5.5–10.4)	.12

Data source: NHANES.

[a]Trends tested by using orthogonal contrast matrices.

[b]Relative SE >40%, numerator <10.

[c]Relative SE 30% to 40%.

TABLE 3

Mean Change in Relative Weight (kg) From Birth Weight and 95% Confidence Intervals Among US Children Aged 6 to 23 Months, by Race/Hispanic Origin, 1988 to 2014, and Low Birth Weight Status 1976 to 2014

	1976–1980	1988–1994	1999–2002	2003–2006	2007–2010	201 1–2014	*P* for Trend[a]
Total	0.58 (0.48–0.68)	0.57 (0.52–0.62)	0.61 (0.53–0.69)	0.66 (0.54–0.78)	0.63 (0.55–0.70)	0.65 (0.54–0.77)	.15
Race/Hispanic origin							
NH white	NA	0.49 (0.42–0.56)	0.47 (0.35–0.59)	0.64 (0.48–0.80)	0.50 (0.37–0.63)	0.53 (0.30–0.76)	.54
NH black	NA	0.73 (0.61–0.85)	0.95 (0.75–1.15)	0.84 (0.68–1.00)	0.92 (0.62–1.23)	0.97 (0.83–1.1 1)	.03
Mexican American	NA	0.73 (0.60–0.85)	0.82 (0.64–1.00)	0.65 (0.51–0.80)	0.74 (0.62–0.85)	0.85 (0.65–1.05)	.51
Breastfeeding history							
Ever breastfed	NA	0.52 (0.45–0.58)	0.56 (0.45–0.67)	0.64 (0.52–0.76)	0.57 (0.49–0.65)	0.61 (0.47–0.75)	.22
Not breastfed	NA	0.64 (0.55–0.72)	0.71 (0.59–0.83)	0.72 (0.52–0.92)	0.78 (0.60–0.95)	0.82 (0.59–1.05)	.05
Normal birth weight	0.54 (0.45–0.64)	0.54 (0.48–0.59)	0.55 (0.48–0.59)	0.63 (0.51–0.76)	0.61 (0.53–0.69)	0.60 (0.47–0.73)	.16
Race/Hispanic origin							
NH white	NA	0.46 (0.39–0.53)	0.44 (0.32–0.57)	0.62 (0.46–0.79)	0.50 (0.36–0.65)	0.47 (0.25–0.69)	.53
NH black	NA	0.70 (0.56–0.84)	0.74 (0.53–0.95)	0.77 (0.58–0.95)	0.94 (0.60–1.28)	0.92 (0.73–1.1 1)	.04
Mexican American	NA	0.71 (0.57–0.85)	0.78 (0.59–0.97)	0.59 (0.44–0.73)	0.70 (0.58–0.81)	0.80 (0.59–1.01)	.70
Breastfeeding history							
Ever breastfed	NA	0.50 (0.44–0.57)	0.53 (0.42–0.63)	0.61 (0.49–0.74)	0.55 (0.46–0.64)	0.54 (0.40–0.68)	.51
Not breastfed	NA	0.58 (0.50–0.67)	0.59 (0.47–0.71)	0.69 (0.48–0.91)	0.76 (0.56–0.96)	0.83 (0.61–1.05)	.01
Low birth weight	1.09 (0.78–1.41)	1.02 (0.83–1.21)	1.21 (0.88–1.53)	1.01 (0.80–1.21)	0.84 (0.57–1.10)	1.19 (0.83–1.54)	.85

Children with “other” race/Hispanic origin are included in the total although results are not shown separately. The 7 children missing breastfeeding information are not included in the breastfeeding analysis, but are included in the other analyses. The estimates for race/Hispanic origin subgroups within the low birth weight group were not reliable due to small sample sizes. Data source: NHANES. NA, not available; NH, non-Hispanic.

[a]Trend tested by using linear regression.

TABLE 4

Mean Change in Absolute Weight (kg) From Birth for Selected Month of Age Among US Children, by Sex, 1976 to 2014

	n	1976–1980	1988–1994	1999–2002	2003–2006	2007–2010	2011–2014	*P* for Trend[a]
Boys								
6 mo olds	267	4.7 (4.3–5.2)[b]	4.9 (4.7–5.1)	5.0 (4.8–5.2)	5.1 (4.8–5.3)	5.3 (5.0–5.6)	4.8 (4.4–5.2)	.51
9 mo olds	266	5.9 (5.5–6.2)	5.9 (5.7–6.1)	6.3 (5.9–6.6)	6.1 (5.8–6.5)	5.7 (5.1–6.2)[b]	6.2 (5.6–6.8)	.49
12 mo olds	230	6.8 (6.4—7.2)	7.1 (6.9–7.3)	7.2 (6.8–7.3)	6.5 (5.9–7.1)	6.8 (6.4–7.3)	7.0 (6.4–7.6)[b]	.79
15 mo olds	176	8.5 (7.8–9.2)[b]	7.8 (7.5–8.2)	7.7 (7.1–8.4)[b]	7.0 (6.6–7.4)	7.9 (7.0–8.7)[b]	7.7 (6.8–8.7)[b]	.06
18 mo olds	182	8.5 (8.1–8.8)	8.1 (7.6–8.6)	8.2 (7.4–8.9)[b]	8.0 (7.6–8.5)[b]	8.0 (7.4–8.6)	8.1 (7.6–8.6)[b]	.13
23 mo olds	182	9.3 (8.8–9.7)	9.0 (8.5–9.4)	9.6 (9.0–10.2)[b]	9.4 (8.8–10.0)	9.2 (8.1–10.3)[b]	8.9 (8.2–9.6)[b]	.97
Girls								
6 mo olds	236	3.8 (32–4.3)[b]	4.3 (4.1–4.5)	4.8 (4.5–5.2)	4.5 (4.1–5.0)	4.5 (4.3–4.7)	4.4 (4.1–4.6)	.046
9 mo olds	284	5.5 (5.2–5.8)[b]	5.4 (5.2–5.6)	5.7 (5.2–6.2)	5.4 (5.1–5.7)	5.3 (5.0–5.7)	5.8 (5.5–6.2)	.49
12 mo olds	224	6.4 (6.0–6.7)	6.7 (6.4–7.0)	6.8 (6.5–7.1)	6.4 (5.8–7.0)[b]	6.5 (6.1–7.0)	6.0 (5.6–6.4)[b]	.59
15 mo olds	174	6.8 (6.2–7.4)	7.0 (6.7–7.3)	6.6 (6.1–7.0)[b]	7.1 (6.6–7.6)[b]	7.3 (6.6–7.9)[b]	7.1 (6.7–7.6)[b]	.32
18 mo olds	163	7.8 (7.3–8.3)[b]	7.9 (7.4–8.3)	7.8 (7.3–8.3)[b]	8.0 (7.6–8.5)[b]	7.6 (7.0–8.1)[b]	8.5 (8.0–9.0)[b]	.37
23 mo olds	174	8.1 (7.6–8.7)[b]	8.9 (8.6–9.2)	8.8 (8.2–9.4)[b]	9.5 (8.9–10.0)[b]	9.5 (8.4–10.6)[b]	8.8 (8.4–9.3)[b]	.09

Data source: NHANES.

[a]Trend tested by using linear regression.

[b]Sample size <30.