HHS Public Access
Author manuscript
J Racial Ethn Health Disparities. Author manuscript; available in PMC 2017 March 01.

Published in final edited form as:
J Racial Ethn Health Disparities. 2016 March ; 3(1): 129–137. doi:10.1007/s40615-015-0122-y.

Racial and Ethnic Disparities in Early Childhood Obesity: Growth Trajectories in Body Mass Index

Alma D. Guerrero[1,2,3], **Cherry Mao**[4], **Bruce Fuller**[5], **Margaret Bridges**[5], **Todd Franke**[3,6], and **Alice A. Kuo**[1,3,7,8]

[1] Department of Pediatrics, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

[2] Children's Discovery and Innovation Institute Mattel Children's Hospital UCLA, Los Angeles, CA, USA

[3] UCLA Center for Healthier Children, Families and Communities, Los Angeles, CA, USA

[4] Statistical Center for HIV/AIDS Research & Prevention, Division of Vaccine and Infectious Diseases, Fred Hutchinson Cancer Research Center, Seattle, WA, USA

[5] UC Berkeley Institute of Human Development, University of California, Berkeley, CA, USA

[6] Department of Social Welfare, School of Public Affairs, University of California, Los Angeles, Los Angeles, CA, USA

[7] Departments of Pediatrics and Internal Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

[8] Department of Health Policy and Management, UCLA John Fielding School of Public Health, Los Angeles, CA, USA

Abstract

Objective—The aims of this study are to describe growth trajectories in the body mass index (BMI) among the major racial and ethnic groups of US children and to identify predictors of children's BMI trajectories.

Methods—The Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) was used to identify predictors of BMI growth trajectories, including child characteristics, maternal attributes, home practices related to diet and social behaviors, and family sociodemographic factors. Growth models, spanning 48 to 72 months of age, were estimated with hierarchical linear modeling via STATA/Xtmixed methods.

Results—Approximately one-third of 4-year-old females and males were overweight and/or obese. African-American and Latino children displayed higher predicted mean BMI scores and differing mean BMI trajectories, compared with White children, adjusting for time-independent and time-dependent predictors. Several factors were significantly associated with lower mean BMI

aguerrero@mednet.ucla.edu.

Compliance with Ethical Standards All authors have approved the manuscript as submitted and with the exception of the funding mentioned in the Acknowledgements section, author Guerrero, author Mao, author Fuller, author Bridges, author Franke, and author Kuo do not have any conflicts of interest to declare for the past three years dating from the month of this submission.

trajectories, including very low birth weight, higher maternal education level, residing in a two-parent household, and breastfeeding during infancy. Greater consumption of soda and fast food was associated with higher mean BMI growth. Soda consumption was a particularly strong predictor of mean BMI growth trajectory for young Black children. Neither the child's inactivity linked to television viewing nor fruit nor vegetable consumption was predictive of BMI growth for any racial/ethnic group.

Conclusion—Significant racial and ethnic differences are discernible in BMI trajectories among young children. Raising parents' and health practitioners' awareness of how fast food and sweetened-beverage consumption contributes to early obesity and growth in BMI—especially for Blacks and Latinos—could improve the health status of young children.

Keywords

BMI; Early childhood; Obesity; Ethnic disparities; Soda consumption; Fast-food

Introduction

The prevalence of overweight and obesity among young children is high and accompanied by significant disparities among racial and ethnic groups. For example, approximately 25 % of children living in the USA between the ages 2 and 5 years are overweight and young Latino children are disproportionately affected by overweight and obesity [1–3]. There are various risk factors for early childhood obesity including rapid infant weight gain, early introduction of solid foods, consumption of sugar-sweetened beverages, and sedentary behaviors with variations in these risk factors by racial and ethnic groups [4, 5]. Many studies focusing on early childhood obesity, however, have relied on cross-sectional data [6, 7], or use longitudinal data but fail to examine weight trajectories over time of very young children [8–10].

Additional studies are needed to further understand the critical growth periods for racially and ethnically diverse children, and to further identify early childhood attributes and home practices [11–13] that over time most strongly predict healthy weight outcomes [14, 15]. Such research can provide the knowledge and strategies to reduce obesity and morbidity across the life-span. To better understand these areas, we used the longitudinal data of the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) study to estimate BMI growth curves in order to examine (1) when young children (i.e., less than 6 years of age) display initial signs of rapid growth in body mass index (BMI), (2) whether growth in childhood BMI varies by racial and ethnic group membership, and (3) what early childhood attributes and home practices most strongly predict BMI growth trajectories [14, 15]. We hypothesized, based on the existing literature, that young Latino, Black, and Asian children would have differing BMI growth curves compared to White children, and that there would be significant between-group differences (i.e., Black-White, Latino-White, and Asian-White) in home practices that predict mean BMI growth in young children.

Methods

Sample

A non-probability birth sample was drawn in 2001 for the ECLS-B by the National Center for Education Statistics. In addition to data from birth certificates, home visits were fielded when the focal child was about 9 months, then again at 24, 48, 60, and 72 months of age, involving in-depth maternal interviews and direct child assessments of physical, cognitive, and social-emotional development. Since our overall project focuses on the influence of maternal and home practices on children's early development, we excluded a small sample of children that suffered from serious birth defects, such as spina bifida or heart defects, or who died before age 5 years. We included all other children who had complete data on weight and height and whose biological mothers were interviewed. Our final analytic sample included 15,418 children. The design and weighting structure of the overall ECLSB sample are described elsewhere [16].

Measures

Dependent Variables—The main dependent outcome variable was children's BMI. Children's height and weight were measured when children were 48, 60, and 72 months of age. Measurement protocols are described elsewhere and included steps to address differences in repeat measurements of height and weight [16]. Children's BMI was calculated and the Centers of Disease Control and Prevention (CDC) national growth reference data, that is age- and sex-specific, was used to determine children's weight status. Overweight is defined as a BMI between the 85th to 94th percentile and obesity as a BMI at or above the 95 % for age and sex using the CDC growth charts for the USA. The dependent variable for growth curve modeling was BMI raw scores and for estimating the prevalence of overweight and obesity, we used the age- and sex-specific BMI cutoffs provided by the CDC growth charts.

Independent Variables—The predictors of BMI included child characteristics, maternal attributes, and home practices that have been used in previous research using the ECLS-B data [9, 17–20]. The items of the ECLS-B questionnaires have undergone validation research and are useful for generating population estimates on numerous developmental, health, and educational indicators. Details about the ECLS-B methodology are described elsewhere [21]. The child characteristics for this study included birth weight, sex, and race and ethnicity and were considered as time invariant predictors in estimation models. The child's sex and whether the child was small for gestational age (SGA; <10 percentile), appropriate for gestational age, or large for gestational age (LGA; >90 percentile) or was born prematurely was reported from birth certificates. Child's race/ethnicity was assessed at 9 months by parental report and categorized as Latino, non-Latino African-American, non-Latino whites, and Asian. Latino families were further split by the primary language spoken in the home; this variable was assessed by responses to the following question, “What is the primary language spoken in your home?”

Maternal attribute variables included in this study were household configuration, education, income, and number of years in the US, and were assessed when the focal child was 48, 60, and 72 months old via the parent interview. Household configuration was categorized into a single-parent household versus a two-adult household. Census Bureau poverty thresholds and imputed values for any missing household income were used to establish the federal poverty threshold for a family of four in 2007 and categorized as 100, 130, and 180 % of the threshold.

The home practices included ever breastfeed, juice intake, soda intake, fast food consumption, daily vegetable servings, and daily fruit servings. These home practice variables were assessed when the focal child was 9, 24, 48, 60, and 72 months old via the parent interview (considered as time-variant in the estimation models). At 9 months of age, mothers were asked whether they had ever breastfed their child. Juice intake, soda intake, fast food consumption, daily vegetable servings, and daily fruit servings were assessed at the 48-, 60-, and 72-month parent interview waves. Juice intake was categorized as any intake of 100 % fruit juice in the last 7 days versus none in the last 7 days. Fast food and soda intake were categorized as any intake of either type of food or beverage in the last 7 days versus none in the last 7 days. The number of vegetable and fruit servings consumed was categorized into at least 1 serving of fruit and 1 serving of vegetable per day versus less than 1 serving per day. Parents reported the number of hours children spent watching television on weekdays and was used as a continuous variable in this analysis.

Statistical Analyses—We estimated growth trajectories for BMI between 4 and 6 years of age with hierarchical linear modeling (HLM), using Stata software version 12 and the XTMIXED routine, fitting a variety of mixed linear models to data that enables statistical inferences about the data using different covariance structures. Significant level was set as α=0.05 at minimum for all analyses to minimize type I errors, when noted we also included results that were significant at α=0.01. Because not every child in the dataset had the same number of repeated BMI measures, resulting in an unbalanced dataset, and because the child age at each collection point varied for each subject, a random-effects model was estimated with random intercepts and slopes (RIAS), with age controlling for covariates. We incorporated survey weights provided by ECLS-B in all of our analyses to relatively underweight the groups that were oversampled (Chinese children, Asian and Pacific Islander children, American Indian and Alaska Native children, twins, and children born with low and very low birth weight).

Results

Sample

Tables 1 and 2 show the weighted population frequency and means of child and maternal characteristics at the three waves of data collection. Females and males had similar mean BMI raw scores across the various waves of data collection. Using 85th and 95th percentile, BMI cutoffs for males and females at each age period (each wave sample) show that approximately a third of all 4-year-old females and a third of all 4-year-old males are overweight and/or obese; approximately 15 % of 4-year-old females and males are obese (Table 1). Most children in the sample were White and about half of the children were female. Over 75 % of children lived in two-parent households, and close to a quarter of all children lived in homes with incomes below the federal poverty level. On average, Latino children had higher average BMI raw scores compared to Whites, African-American, and Asian children while females on average had lower BMI raw scores compared to males across all racial and ethnic groups (Table 2). At preschool age, about three-quarters of children consumed soda and fast food in the past week (Table 3).

Trajectories of Early Childhood BMI

A growth curve of mean BMI by race and ethnicity was generated based on observed BMI raw scores at 48, 60, and 72 months of age (Fig. 1.) The general pattern of the mean BMI growth curve followed the typical BMI growth pattern seen in preschoolers with a nadir in BMI before increasing at approximately 6 years of age. Latinos from primary Spanish-speaking households started with higher BMI raw score trajectories at 4 years of age and maintained higher BMI raw score trajectories over time, compared with other ethnic groups. Using an HLM mixed-effects approach, we then estimated the mean BMI trajectories during childhood (ages 4–6) accounting for potential protective and risk factors as summarized in Table 4. Females were found to have significant differences in BMI raw score trajectories compared to males adjusting for the time-independent and time-dependent predictors. Compared to Whites, African-American and Latino children had higher rates of change in BMI raw score trajectories. Several factors were found to be significantly associated with lower mean BMI raw score trajectories including very low birth weight, higher maternal education level, residing in a two-parent household, and breastfeeding during infancy. Older age, soda, and fast food consumption, however, were risk factors and were associated with higher predicted mean BMI raw score trajectories, compared with non-consumption of either type of beverage or food. A mediation analysis was completed and it did not suggest that soda consumption was a mediator of the racial disparities in BMI trajectories.

We analyzed children's mean BMI raw score trajectories for each of the major racial and ethnic groups in the USA (Table 5). Birth weight was found to be significantly associated with lower mean BMI raw score trajectories for each group, while maternal education was significantly associated with lower mean BMI raw score trajectories for Whites and Asians. Breastfeeding was associated with lower predicted mean BMI raw score trajectories for White and Latino children from primary Spanish-speaking households. Soda consumption was found to be significantly associated with higher predicted mean BMI raw score trajectories for African-American children and Latino children from primary Spanish-speaking households. Neither fruit nor vegetable consumption was found to be associated with mean BMI raw score trajectories for any group of children.

Discussion

This is the first study to date that details BMI growth trajectories using the recent ECLS-B nationally representative birth sample using hierarchical linear modeling. Our study contributes to the relatively thin knowledge on the extent to which BMI growth among very young children varies by racial and ethnic group, along with identifying significant predictors [22]. The incidence of overweight/obesity status is already quite high by 4 years of age: approximately one-third for both females and males. The major racial and ethnic groups of the USA experience significantly different BMI growth curves between 4 and 6 years of age. African-American and Latino children display higher BMI raw scores from an early age and maintain these higher BMI growth trajectories, compared with White children. Several dietary behaviors were found to be associated with BMI trajectories. Soda and fast food consumption in early childhood were risk factors for higher predicted mean BMI raw score trajectories compared to those who did not consume this type of beverage or food while adjusting for child characteristics and socioeconomic factors.

Other investigators have used the ECLS-B data set or other longitudinal data to examine weight outcomes in children, but they typically estimate weight status using cross-sectional data (one wave of data collection) with simple logistic regression [4, 6, 8, 9, 23] or use longitudinal data that focuses on growth during middle childhood or adolescence [24–30]. Methodologically, we contribute to a sparse literature that tracks BMI growth and obesity incidence over time for young children, moving beyond cross-sectional estimations. We also show significant differences in trajectories of weight during early childhood in African-American and Latino children, relative to whites. These very early childhood racial/ethnic differences in weight trajectories have been shown by just one earlier study [14]. Our results indicate that Latino children in primary Spanish-speaking households have a higher mean BMI raw score at 4 years of age, and they continue to maintain higher mean BMI raw scores over time, compared with all other ethnic groups. In contrast, Latino children in primary English-speaking households displayed higher mean BMI raw score at 4 years of age, compared with African-American children, but then over time had lower mean BMI raw scores than African-American children that are apparent by 5 years of age.

Our findings suggest that Latino children of immigrant or recently immigrated parents display higher mean BMI trajectories during early childhood. Longitudinal studies that have examined weight trajectories in older children have found similar results highlighting the early life course development of weight status. For example, overweight trajectories of US children in middle childhood and adolescence have shown that children of immigrants display higher levels of over-weight status at each grade level [25, 27]. Possible risk factors for early childhood weight disparities among Latinos compared to Whites—stemming from our analysis and earlier research—include low maternal education, higher rates of maternal depression, early introduction of solid foods, restrictive feeding practices, physical inactivity, and beverage and fast food consumption patterns [4, 5, 31, 32]. In addition, these findings support theories which suggest Latino immigrant families may face rapid increases in income which when combined with indulging cultural feeding practices and easy accessibility to processed foods, which are often inexpensive and highly caloric, may contribute to unhealthy weight development [25, 33]. Additional research methodologies are needed to build on the etiologies of weight development in Latino children; however, it is clear that Latino children, particularly from primary Spanish-speaking households, may benefit from targeted efforts on known risk factors in order to reduce these early weight disparities and promote healthy weight development.

We found that children who consumed soda and fast food in the previous week, compared to children who did not consume either type of beverage or food, were found to have significantly higher predicted mean BMI trajectories. Although physical activity and beverage and fast food consumption patterns and their associations with overweight and obesity status have been well described [4, 24, 26, 34], our results are worrisome in showing that quite young children are exposed to highly caloric and low-nutrient-density foods. This exposure is particularly troublesome as young children are developing taste preferences and food-intake patterns that persist into adulthood [12]. Soda consumption has been shown to be a risk factor for obesity during early childhood among African-American children in one earlier study drawing on longitudinal data [34]. Our similar findings using longitudinal data suggests that targeted efforts to reduce sugar-sweetened beverages may be one mechanism for reducing early weight disparities for African-American children and may also benefit Latino children in primary Spanish-speaking households.

Our study has several limitations. Like many longitudinal data sets, the ECLS-B has missing data, given the multiple waves of data collection. Second, although our study describes weight trajectories at 48, 60, and 72 months of age, weight and height assessments ranged around these time points, due to the challenges of the ECLS-B study fielding a large number of home visits to collect height and weight data. Lastly, some of our measures did rely on parental reports, which may alter results based on parent recall bias. Unlike other studies, however, weight and height measurements for this study were taken by trained research staff at each data wave.

Conclusion

Our analysis identifies significant racial and ethnic differences in early childhood BMI trajectories using a nationally representative cohort of children. African-American and Latino children displayed higher BMI growth trajectories, compared with White children. Latino children from primary Spanish-speaking households were found to have the highest mean BMI trajectories. Our analysis also identified a few dietary behaviors that predict weight trajectories during early childhood. A BMI growth model of all children showed that fast food and soda consumption are risk factors and positively associated with BMI raw score trajectories over time and for African-American and Latino children, soda consumption appears to be a particularly significant predictor of early childhood BMI trajectories. Our results highlight the need for additional research to understand the early determinants of mean BMI trajectory differences across racial and ethnic groups but suggest that targeting the reduction of consuming fast food and sweetened beverages may improve early weight trajectories across all racial/ethnic groups, whereas specific efforts to reduce sweetened-beverage consumption may best improve BMI trajectories of African-American and Latino children. These findings, therefore, can have important clinical and research implications as they relate to anticipatory guidance and future research intervention efforts.

Acknowledgments

We would like to thank Anthony Kim and Lynna Chu for their assistance in the preparation of this manuscript. This study was funded by grant R40 MC 21517 from the US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Research Program (PI: Dr. Guerrero). Drs. Fuller and Bridges are supported in part by the University of California's Institute of Human Development and the McCormick Foundation.

References

1. Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003-2006. JAMA. 2008; 299(20):2401–5. [PubMed: 18505949]
2. Anderson SE, Whitaker RC. Prevalence of obesity among US pre-school children in different racial and ethnic groups. Arch Pediatr Adolesc Med. 2009; 163(4):344–8. [PubMed: 19349563]
3. Singh GK, et al. Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing independent and joint associations. Ann Epidemiol. 2008; 18(9):682–95. [PubMed: 18794009]
4. Taveras EM, et al. Racial/ethnic differences in early-life risk factors for childhood obesity. Pediatrics. 2010; 125(4):686–95. [PubMed: 20194284]
5. Taveras EM, et al. Reducing racial/ethnic disparities in childhood obesity: the role of early life risk factors. JAMA Pediatr. 2013; 167(8):731–8. [PubMed: 23733179]
6. Anderson SE, Whitaker RC. Household routines and obesity in US preschool-aged children. Pediatrics. 2010; 125(3):420–8. [PubMed: 20142280]
7. Burdette HL, Whitaker RC. A national study of neighborhood safety, outdoor play, television viewing, and obesity in preschool children. Pediatrics. 2005; 116(3):657–62. [PubMed: 16140705]
8. Shankaran S, et al. Risk for obesity in adolescence starts in early childhood. J Perinatol. 2011; 31:711–6. [PubMed: 21415836]
9. Li N, et al. Is there a healthy foreign born effect for childhood obesity in the United States? Matern Child Health J. 2011; 15(3):310–23. [PubMed: 20229329]
10. Nevarez MD, et al. Associations of early life risk factors with infant sleep duration. Acad Pediatr. 2010; 10(3):187–93. [PubMed: 20347414]
11. Patrick H, Nicklas TA. A review of family and social determinants of children’s eating patterns and diet quality. J Am Coll Nutr. 2005; 24(2):83–92. [PubMed: 15798074]
12. Birch LL, Davison KK. Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. Pediatr Clin N Am. 2001; 48(4):893–907.
13. Larson NI, et al. Fruit and vegetable intake correlates during the transition to young adulthood. Am J Prev Med. 2008; 35(1):33–7. [PubMed: 18482818]
14. Li C, et al. Developmental trajectories of overweight during childhood: role of early life factors. Obesity (Silver Spring). 2007; 15(3):760–71. [PubMed: 17372328]
15. Lee JM, et al. Body mass index and timing of pubertal initiation in boys. Arch Pediatr Adolesc Med. 2010; 164(2):139–44. [PubMed: 20124142]
16. Kyle Snow, LT.; Derecho, A.; Wheeless, S.; Lennon, J.; Kinsey, S.; Rogers, J., et al. User’s manual for the ECLS-B longitudinal 9-month–preschool restricted-use data file and electronic codebook. National Center for Education Statistics; Washington, DC: 2007.
17. Garg A, Toy S, Tripodis Y, Cook J, Cordella N. Influence of maternal depression on household food insecurity for low-income families. Acad Pediatr. 2015; 15(3):305–10. [PubMed: 25454368]
18. Surkan PJ, et al. Early maternal depressive symptoms and child growth trajectories: a longitudinal analysis of a nationally representative US birth cohort. BMC Pediatr. 2014; 14:185. [PubMed: 25047367]
19. Gibbs BG, Forste R. Socioeconomic status, infant feeding practices and early childhood obesity. Pediatr Obes. 2014; 9(2):135–46. [PubMed: 23554385]
20. Ruzek E, et al. The quality of toddler child care and cognitive skills at 24 months: propensity score analysis results from the ECLS-B. Early Child Res Q. 2014; 28(1)
21. National Center for Education Statistics. [2015 April 9] Early childhood longitudinal study, birth cohort (ECLS-B) psychometric report for 2-year data collection. 2007. Available from: https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007084
22. Roy SM, et al. Body Mass Index (BMI) trajectories in infancy differ by population ancestry and may presage disparities in early childhood obesity. J Clin Endocrinol Metab. 2015; 100(4):1551–60. [PubMed: 25636051]

23. Moss BG, Yeaton WH. Young children's weight trajectories and associated risk factors: results from the Early Childhood Longitudinal Study-Birth Cohort. Am J Health Promot. 2011; 25(3): 190–8. [PubMed: 21192749]
24. Gable S, Chang Y, Krull JL. Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. J Am Diet Assoc. 2007; 107(1):53–61. [PubMed: 17197271]
25. Balistreri KS, Van Hook J. Trajectories of overweight among US school children: a focus on social and economic characteristics. Matern Child Health J. 2011; 15(5):610–9. [PubMed: 20535537]
26. Fiorito LM, et al. Girls' early sweetened carbonated beverage intake predicts different patterns of beverage and nutrient intake across childhood and adolescence. J Am Diet Assoc. 2010; 110(4): 543–50. [PubMed: 20338280]
27. Harris KM, Perreira KM, Lee D. Obesity in the transition to adulthood: predictions across race/ ethnicity, immigrant generation, and sex. Arch Pediatr Adolesc Med. 2009; 163(11):1022–8. [PubMed: 19884593]
28. Cecil-Karb R, Grogan-Kaylor A. Childhood body mass index in community context: neighborhood safety, television viewing, and growth trajectories of BMI. Health Soc Work. 2009; 34(3):169–77. [PubMed: 19728476]
29. Nonnemaker JM, et al. Youth BMI trajectories: evidence from the NLSY97. Obesity (Silver Spring). 2009; 17(6):1274–80. [PubMed: 19584884]
30. Morrissey TW, Dunifon RE, Kalil A. Maternal employment, work schedules, and children's body mass index. Child Dev. 2011; 82(1):66–81. [PubMed: 21291429]
31. Iriart C, et al. Obesity and malnutrition among Hispanic children in the United States: double burden on health inequities. Rev Panam Salud Publica. 2013; 34(4):235–43. [PubMed: 24301734]
32. Carroll-Scott A, et al. Disentangling neighborhood contextual associations with child body mass index, diet, and physical activity: the role of built, socioeconomic, and social environments. Soc Sci Med. 2013; 95:106–14. [PubMed: 23642646]
33. Balistreri KS, Van Hook J. Socioeconomic status and body mass index among Hispanic children of immigrants and children of natives. Am J Public Health. 2009; 99(12):2238–46. [PubMed: 19846690]
34. Lim S, et al. Obesity and sugar-sweetened beverages in African-American preschool children: a longitudinal study. Obesity (Silver Spring). 2009; 17(6):1262–8. [PubMed: 19197261]

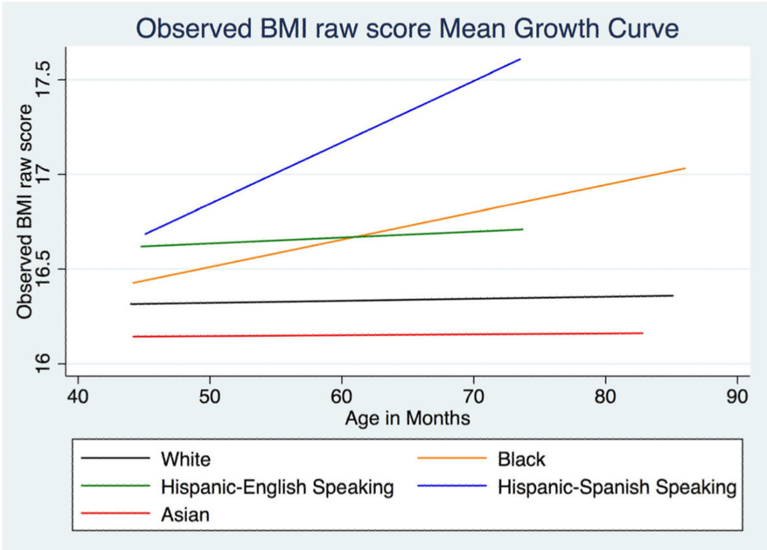

Fig. 1.
Observed BMI raw score mean growth curve

Table 1

BMI characteristics of sample population by gender and data wave (*n*=15,418)

Characteristic	Female (*n*=7553)			Male (*n*=7865)		
	Wave 3 (48 mo.)	Wave 4 (60 mo.)	Wave 5 (72 mo.)	Wave 3 (48 mo.)	Wave 4 (60 mo.)	Wave 5 (72 mo.)
n [a]	3783	3020	750	3913	3082	870
Age (mean)	52.83	65.07	74.11	52.91	65.08	74.67
Age (range)	44-64.8	56.7-74.3	70.2-85	44-65.3	56.8-73.8	70.3-86
BMI, mean (SD)	16.37 (2.47)	16.46 (2.48)	16.76 (2.95)	16.62 (2.38)	16.62 (2.36)	16.59 (2.37)
≥85th percentile BMI, n (%)	1132 (29.9 %)	967 (32.0 %)	236 (31.5 %)	1237 (31.6 %)	1041 (33.8 %)	263 (30.2 %)
≥95th percentile BMI, n (%)	541 (14.3 %)	432 (14.3 %)	111 (14.8 %)	700 (17.9 %)	559 (18.1 %)	137 (15.7%)

[a] 48, 60, and 72 month 85th and 95th percentile BMI cutoffs were applied to each respective wave sample

Table 2

BMI characteristics of sample population by gender and race and ethnicity (*n*= 15,418)

Characteristic	Female (*n*=7553)					Male (*n*=7865)				
	White	**African-American**	**Latino**	**Asian**	**Other**	**White**	**African-American**	**Latino**	**Asian**	**Other**
n	3312	1208	1450	798	785	3354	1211	1552	934	814
BMI, mean (SD)	16.29 (2.26)	16.66 (2.95)	16.72 (2.55)	15.89 (2.33)	16.87 (2.91)	16.4 (2.25)	16.73 (2.48)	17.04 (2.65)	16.34 (2.14)	16.9 (2.27)
Minimum BMI	8.20	8.40	11.5	11.0	9.80	7.90	47.50	8.60	10.40	9.80
Maximum BMI	50.20	45.22	45.9	40.5	36.80	7.90	41.20	38.90	31.00	31.30

Table 3

Selected demographic characteristics of US children 2 to 5 years old and their parents

Time invariant predictors	Frequency (%)		
Gender			
Male	7865 (51.01)		
Female	7553 (48.99)		
Race/ethnicity			
White	6666 (43.25)		
Black	2419 (15.69)		
Asian	1732 (11.23)		
Other	1599 (10.37)		
Hispanic	3002 (19.47)		
Spanish speaking	1390 (9.02)		
Breastfeeding			
Never breastfed	4638 (30.08)		
Ever breastfed	10780 (69.92)		
Birth weight			
Normal	11614 (75.33)		
Moderately low	2317 (15.03)		
Very low	1487 (9.64)		
Predictors	Waves		
	48 mos (*n*=7696)	60 mos (*n*=6102)	72 mos (*n*=1620)
Adults in household			
Two-parent	6105 (79.33)	4799 (78.65)	1266 (78.15)
Dietary consumption			
Any soda last week	5488 (71.31)	4336 (71.06)	1194 (73.70)
Any juice last week	7090 (92.13)	5453 (89.36)	1432 (88.40)
Any fast food last week	5805 (75.43)	4413 (72.32)	1214 (74.94)
Fruit 7 times/week	5520 (71.73)	4235 (69.40)	1072 (66.17)
Veggies 7 times/week	5270 (68.48)	4103 (67.24)	1055 (65.12)
Acculturation			
Number of years in USA	27.6 (10.4)	28.5 (10.7)	30.5 (10.3)
Maternal education			
<High school			
High school	1638 (21.28)	1330 (21.80)	348 (21.48)
College	2044 (26.56)	1625 (26.63)	434 (26.79)
≥Bachelor	2361 (30.68)	1949 (31.94)	525 (32.41)
Household income			
Under FPL	1816 (23.60)	1379 (22.60)	376 (23.21)
Age	53 (4.1)	65.1 (3.8)	74.4 (2.8)

Continuous time-dependent predictors

Federal Poverty Level at 100 %

Table 4

Full mixed-effects linear regression of factors associated with BMI trajectory levels

Full model	BMI trajectory levels	
	Est	SE
Age	0.008*	0.001
Male	Reference	
Female	–0.192*	0.050
White	Reference	
Black	0.247*	0.081
Hispanic	0.402*	0.076
Asian	–0.34*	0.100
Other	0.307*	0.089
Birth weight normal	Reference	
Birth weight mod low	–0.705*	0.071
Birthweightverylow	–1.093*	0.088
Single-parent household	Reference	
Dual parent household	–0.120*	0.053
Over FPL	Reference	
Under FPL	–0.035	0.048
Mother's education < high school	Reference	
Mother's education: high school	–0.073	0.054
Mother's education: college	–0.187*	0.061
Mother's education: ≥bachelor	–0.251*	0.071
Mother's acculturation		
Number of years in USA	–0.002	0.003
Never breastfed	Reference	
Ever breastfed	–0.225*	0.058
No soda	Reference	
Any soda	0.138*	0.037
No Juice	Reference	
Any juice	–0.101	0.053
No fast food	Reference	
Any fast food	0.103*	0.035
No fruit 7 times/week	Reference	
Fruit 7 times/week	–0.007	0.037
No vegetables 7 times/week	Reference	
Vegetables 7 times/week	0.006	0.037

Full model	BMI trajectory levels	
	Est	SE
Intercept	16.638*	0.161

*P value less than 0.05

*P value less than 0.01

Table 5

Mixed-effects linear regression of factors associated with BMI trajectory levels

By race	BMI trajectory levels									
	White		Black		Asian		Hispanic	English	Hispanic	Spanish
	Est	SE	Est	SE	Est	SE	Est	SE	Est	SE
Age	0.005*	0.002	0.013**	0.004	–0.001	0.005	–0.005	0.006	0.026**	0.006
Male	Reference		Reference		Reference		Reference		Reference	
Female	–0.136*	0.069	–0.009	0.141	–0.527**	0.138	–0.340	0.182	–0.288	0.175
Birth weight normal	Reference		Reference		Reference		Reference		Reference	
Birth weight mod low	–0.704**	0.092	–0.691**	0.178	–0.903**	0.261	–0.567*	0.261	–0.804**	0.267
Birthweightverylow	–1.127**	0.117	–1.114**	0.191	–0.765	0.582	–1.296**	0.313	–0.645*	0.309
Single-parent household	Reference		Reference		Reference		Reference		Reference	
Dual parent household	–0.097	0.087	–0.034	0.121	0.044	0.276	–0.240	0.161	–0.191	0.184
Over FPL	Reference		Reference		Reference		Reference		Reference	
Under FPL	–0.052	0.086	–0.107	0.113	0.114	0.187	0.051	0.168	–0.153	0.118
Mother's education < high school	Reference		Reference		Reference		Reference		Reference	
Mother's education: high school	–0.094	0.092	0.027	0.134	–0.427*	0.196	0.456*	0.180	–0.196	0.137
Mother's education: college	–0.243*	0.098	–0.119	0.154	–0.610**	0.211	0.303	0.206	–0.160	0.194
Mother's education: ≥bachelor	–0.374**	0.106	0.117	0.222	–0.537**	0.191	0.420	0.274	–0.262	0.280
Number of years in USA	–0.002	0.005	0.011	0.008	0.006	0.008	0.003	0.011	–0.019	0.010
Never breastfed	Reference		Reference		Reference		Reference		Reference	
Ever breastfed	–0.400**	0.080	–0.048	0.147	0.263	0.181	–0.210	0.207	–0.731**	0.222
No soda	Reference		Reference		Reference		Reference		Reference	
Any soda	0.087	0.054	0.288**	0.107	0.065	0.100	0.027	0.139	0.234*	0.115
No juice	Reference		Reference		Reference		Reference		Reference	
Any juice	–0.142*	0.070	–0.082	0.197	0.277	0.156	–0.226	0.207	–0.021	0.203
No fast food	Reference		Reference		Reference		Reference		Reference	
Any fast food	0.090	0.052	0.092	0.104	0.154	0.099	0.140	0.135	0.039	0.112

By race	BMI trajectory levels									
	White		Black		Asian		Hispanic English		Hispanic Spanish	
	Est	SE	Est	SE	Est	SE	Est	SE	Est	SE
No fruit 7 times/week	Reference		Reference		Reference		Reference		Reference	
Fruit 7 times/week	–0.003	0.055	0.010	0.104	0.099	0.113	–0.130	0.133	0.012	0.120
No vegetables 7 times/week	Reference		Reference		Reference		Reference		Reference	
Vegetables 7 times/week	0.003	0.055	–0.043	0.107	–0.056	0.110	0.101	0.130	–0.036	0.110
Intercept	17.039**	0.235	15.883**	0.420	16.216**	0.500	17.344**	0.597	16.951**	0.507

* *P* value less than 0.05

** *P* value less than 0.01