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Ethnic disparities in adolescent body mass index in the United States: The role of parental socioeconomic status and economic contextual factors

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Abstract

This paper examined the importance of household and economic contextual factors as determinants of ethnic disparities in adolescent body mass index (BMI). Individual-level data from the National Longitudinal Survey of Youth 1997 for the years 1997 through 2000 were combined with economic contextual data on food prices, outlet density and median household income. The Oaxaca–Blinder decomposition method was used to examine the factors that could help explain ethnic disparities in BMI. Ethnic differences in household demographic, parental socioeconomic status (SES), and economic contextual factors explained the majority of the male black–white (63%), male Hispanic–white (78%) and female Hispanic–white (62%) BMI gaps but less than one-half of the female black–white BMI gap (44%). We found that adding the economic contextual factors increased the explained portion of the ethnic BMI gap for both female and male adolescents: the economic contextual factors explained 28% and 38% of the black–white and Hispanic–white BMI gaps for males and 13% and 8% of the black–white and Hispanic–white BMI gaps for females, respectively. Parental SES was more important in explaining the Hispanic–white BMI gap than the black–white BMI gap for both genders, whereas neighborhood economic contextual factors were more important in explaining the male BMI gap than the female BMI gap for both black–white and Hispanic–white ethnic disparities. A significantly large portion of the ethnic BMI gap, however, remained unexplained between black and white female adolescents.

Keywords

BMI; Body mass index; Ethnic disparity; Oaxaca–Blinder decomposition; Socioeconomic factors

Introduction

In the United States, black and Hispanic adolescents are more prone to obesity as measured by age-gender adjusted body mass index (BMI) than their white counterparts. In 2007–2008, obesity prevalence among U.S. non-Hispanic white, non-Hispanic black and Hispanic adolescents, respectively, was 14.5%, 29.2% and 17.5% for females and 16.7%, 19.8% and 25.5% for males (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). This implies that the rates

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of obesity among black adolescents were approximately 100% higher among females and almost 20% higher among males compared to white adolescents. Among Hispanic adolescents, the obesity rates were approximately 20% higher among females and approximately 52% higher among males when compared to white adolescents. The ethnic disparity in adolescent obesity is a major source of concern for public health given that childhood obesity tracks into adulthood (Freedman et al., 2005) and obesity is associated with long-term negative health and labor market outcomes later in life (Han, Norton, & Stearns, 2009; USDHHS, 2001). The underlying causes of the ethnic disparities in obesity in the United States remain poorly understood although many previous studies have examined the related questions (Wang & Beydoun, 2007).

Disparities in household demographic and socioeconomic status (SES) characteristics are potential sources for the ethnic BMI gap. For example, in 2008, median household income among whites, blacks and Hispanics was $65,000, $39,879, and $40,466, respectively, and college degree attainment was similarly diverse at 29.9%, 19.3%, and 13.2%, respectively (U.S. Census Bureau, 2011b). The percentage of children living in poverty also differed substantially at 15.3%, 34.4% and 30.3% and the percentage living in families with female heads of household with no spouse present was 18.3%, 57.0% and 27.9%, respectively, for whites, blacks and Hispanics (U.S. Census Bureau, 2011a, 2011b).

Associations between demographic characteristics such as ethnicity and family SES and obesity in U.S. children and adolescents have been described as important but complex (Beydoun & Wang, 2007; Gordon-Larsen, Adair, & Popkin, 2003; Shrewsbury & Wardle, 2008; Sobal & Stunkard, 1989; Wang, Monteiro, & Popkin, 2002; Wang & Zhang, 2006). For example, analyses of the National Health and Nutrition Examination Surveys (NHANES) data collected between 1971 and 2002 showed that not all sex-ethnic child groups from low-income families were at increased risk of being overweight or obese and an overall trend of a weakening association between family income and childhood obesity over time was observed (Wang & Zhang, 2006). Reviews of the literature reported that the association between obesity status and SES was weaker for children than for adults, and that the association was even weaker for children of ethnic minorities (McLaren, 2007; Sobal & Stunkard, 1989).

Data on U.S. adolescents (grades 7 through 12) enrolled in a nationally representative study of adolescent health showed a link between ethnic disparities in the prevalence of overweight and the ethnic disparities in family income and parental education, especially for girls (Gordon-Larsen, Adair & Popkin, 2003). The study showed that the racial/ethnic variation in overweight remained even when children had similar SES based on simulation analysis. Overall, these studies suggest that external factors outside of the household, such as economic and social environmental factors may have contributed significantly to the ethnic body weight disparities.

Recent studies showed that environmental or contextual factors were important determinants of adolescent obesity in addition to the influence of household characteristics in the United States (Auld & Powell, 2009; Chou, Rashad, & Grossman, 2008; Powell, 2009). Further, neighborhoods with higher concentrations of low-income and/or ethnic minority populations were more likely to be obesogenic with higher concentrations of fast food restaurants and convenience stores and lower availability of supermarkets and physical activity-related facilities (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Larson, Story, & Nelson, 2009; Powell, Slater, Chaloupka, & Harper, 2006).

Several previous studies have contributed to our understanding of the extent to which both individual-level SES and the SES of the neighborhood contribute to the ethnic BMI gap among adults. Two recent studies both found that simultaneously controlling for individual-level SES, neighborhood SES and neighborhood racial composition was moderately important in reducing the adult black–white BMI difference (Boardman, Saint Onge, Rogers, & Denney, 2005; Robert & Reither, 2004), particularly for women (Robert & Reither, 2004). However, similar contextual factors were found to be less important in another study that found that neighborhood SES and racial composition measures were associated with BMI outcomes but controlling for them did not reduce the ethnic BMI gap (Do et al., 2007). In a recent study that examined children, local area economic contextual factors such as food prices, food store and restaurant availability, and median household income were shown to be able to account for a significant part of the black–white BMI disparity (Powell & Chaloupka, 2011). Another recent study examined the importance of mothers' perceptions of neighborhood safety as a possible explanation for ethnic differences in children's BMI and reported that perceived police protection accounted for 12% of the explained black–white BMI gap and 15% of the explained Hispanic–white gap (Sen, Mennemeyer, & Gary, 2011).

Thus, previous studies have documented differential associations of parental SES with youths' weight outcomes by ethnicity and suggest that despite differences in endowments of SES, differences in risk of overweight persist. Further, previous research on adults suggested that neighborhood SES contributed to part of the ethnic differences in weight although significant differences persisted. Indeed, given that black and Hispanic adolescents are more often in households with lower SES and at the same time more often surrounded by less healthy environments than their white counterparts, it is important to simultaneously determine the contribution of such environments toward the ethnic disparities in adolescent obesity.

We built on the previous research by simultaneously examining the importance of household-level SES, local area SES, and contextual factors related to the cost and availability of food and the availability of physical activity-related facilities as contributors to the ethnic BMI gap. This paper used the Oaxaca–Blinder decomposition method to systematically examine the degree to which the observed ethnic disparities in U.S. adolescent BMI were due to household demographic, parental SES, and economic contextual factors, including food prices, the availability of food stores, restaurants, commercial physical activity-related facilities, and median household income. Evidence linking ethnic disparities in contextual factors to ethnic disparities in adolescent obesity is of major interest to policymakers because changes to such external factors could serve as policy instruments for reducing such disparities in public health.

Methods

Data

Individual-level data on adolescents were drawn from four annual waves (1997 through 2000) of the National Longitudinal Survey of Youth 1997 (NLSY97) with an original sample of 8984 youths between the ages of 12 and 17 in 1997. The NLSY97 is a nationally representative sample of youths and was designed to document the transition from school to work and into adulthood. It collects extensive information about youths' labor market behavior and educational experiences as well as other measures such as reported weight and height over time. Round 1 of the survey took place in 1997. In that round, both the eligible youth and one parent received hour-long personal interviews. In addition, an extensive two-part questionnaire was administered during the screening process that gathered demographic information on household members and on the youth's immediate family members living elsewhere.

The individual-level NLSY97 data were combined with external contextual data on food prices obtained from the American Chamber of Commerce Researchers Association (ACCRA), food- and physical activity-related outlet density data obtained from business lists developed by Dun and Bradstreet (D&B), and neighborhood median household income data obtained from Census 2000 data. The external contextual data were matched to the individual-level data by year using county-level geocode identifiers. Summary statistics and sample sizes are presented in Table 1.

Key study measures

Outcome measures—The outcomes of interest were the black–white and Hispanic–white ethnic disparities in female and male adolescent BMI, calculated from the self-reported weight in kilograms divided by height in meters squared. Disparities between Asians and those of other racial categories were not assessed due to their relatively small sample sizes.

Individual and household characteristics—Individual determinants of obesity included youth's sex, age, race, and their income (which included earned income and allowance from parents), family structure (youth lived with one parent versus both parents), youth's annual hours of work, mother's work status (not working, working part time, working full-time) and rural, suburban and urban indictors.

Parental SES—Measures of parental characteristics included (1) Parental income reported by parents from a parental questionnaire in each year, and (2) Mothers' education (less than high school, high school, some college and more) initially reported by parents in 1997 and then updated by youths in the subsequent years.

Economic contextual factors—

1. Food at home and fast food price measures based on the ACCRA data were created and matched to the NLSY97 by year and by distance to the physically closest city match available in the ACCRA data using the county-level geocode identifiers. Observations without available price matches from the same or contiguous county were not included in the analyses. Further, a binary match indicator was included in the estimation to control for price matches based on a contiguous versus exact county match. The food at home food price measure was derived from 13 general grocery food prices available in the ACCRA data (Chou, Grossman, & Saffer, 2004; Chou et al., 2008; Powell, 2009). The fast food price measure was generated based on the three fast food items included in the ACCRA data. The price indices were weighted based on expenditure shares provided by ACCRA derived from the Bureau of Labor Statistics' (BLS) Consumer Expenditure Survey and both price measures were deflated by the BLS Consumer Price Index (1982–1984 = 1).

2. Food store, restaurant, and physical activity-related outlet density measures were developed for each year by county using D&B's business list data available through MarketPlace software, which allows sorting by multiple criteria such as location and Standard Industry Classification (SIC) codes. Food store outlets were pulled at the 6-digit SIC code level and defined separately by type according to their primary SIC code as supermarkets, convenience stores, and grocery stores. Restaurant outlet data under the D&B 4-digit classification of "Eating Places" were used to measure restaurant availability. Fast food restaurants included the full set of primary 8-digit SIC codes that fell under "Fast food restaurants and stands" (excluding coffee shops) and included the two primary 8-digit SIC codes for chain and independent pizzerias. Full-service restaurants were defined as the number of

total number of "Eating Places" minus fast food restaurants and excluding coffee shops, ice cream, soft drink and soda fountain stands, caterers, and contract food services. A measure of commercial physical activity-related facilities was also included and defined based on a list of facilities drawn from 100 different physical activity-related 8-digit SIC codes. These business SIC codes included facilities such as physical fitness facilities, membership sports and recreation clubs, public golf courses, ice rinks, swimming pools, dance studios, sports and athletic instruction (i.e. gymnastics), tennis courts, YMCA, etc. All outlet density measures were computed as the number of available outlets per 10,000 capita per county using Census 2000 county-level population estimates.

3. Additionally, Census data for the year 2000 on median household income were used as an additional contextual control variable matched at the county level (U.S. Census Bureau, 2002).

Statistical analysis—To examine the determinants of the BMI gap between various ethnicities we used the method of Oaxaca–Blinder decomposition (Blinder, 1973; Oaxaca, 1973) using Stata version 10.1. Since the ethnic BMI gap reflects the differences in the group means of the outcome, it lends itself to the decomposition analysis of the group means of determinants. This methodology decomposes the observed group difference in outcome into two main components: the disparity associated with the differences in determinants and the disparity associated with the differential response by ethnic groups to those determinants. Several recent studies have applied this methodology to studying disparities in public health including gender differences in smoking (Chung, Lim, & Lee, 2010) and cross-country differences in obesity between the U.S. and Canada (Auld & Powell, 2006) and Spain and Italy (Font, Fabbri, & Gil, 2010).

The Oaxaca–Blinder decomposition was implemented in the following form:

$$\overline{BMI}_W - \overline{BMI}_B = \overline{X}'_W \widehat{\beta}_W - \overline{X}'_B \widehat{\beta}_B \quad (1)$$

$$= \underbrace{\left(\overline{X}'_W - \overline{X}'_B\right)\widehat{\beta}}_{\text{explained portion}} \underbrace{+\overline{X}'\left(\widehat{\beta}_W - \widehat{\beta}_B\right)}_{\text{unexplained portion}} \quad (2)$$

where indices W and B indicate white and black populations, $\overline{BMI}_W$ and $\overline{BMI}_B$ were the mean BMI for the respective populations, $\overline{X}$ was the vector containing the means of the covariates, and $\widehat{\beta}$ was the vector containing a weighted average of the estimated coefficients for white, $\widehat{\beta}_W$, and for blacks, $\widehat{\beta}_B$. The Oaxaca–Blinder decomposition decomposes the difference in BMI between two groups into those due to the group differences in means of explanatory variables and those due to the group differences in the estimated coefficients. We followed the method proposed by Neumark (1988) which used the estimated coefficients from the pooled regression to obtain the weighted average for $\widehat{\beta}$ in the explained portion.

$$\overline{BMI}_W - \overline{BMI}_B = \underbrace{\left(\overline{X}'_W - \overline{X}'_B\right)\widehat{\beta}^*}_{\text{explained portion}} + \underbrace{\overline{X}'_W\left(\widehat{\beta}_W - \widehat{\beta}_B\right) + \overline{X}'_B\left(\widehat{\beta}_B - \widehat{\beta}W\right)}_{\text{unexplained portion}} \quad (3)$$

In Equations (2) and (3), the first term is interpreted as the explained portion of the ethnic disparity, while the rest are interpreted as the unexplained portion. The explained portion is driven by the differential endowments of covariates X. The unexplained portion, on the other hand, is driven by the differences in the estimated coefficients. The unexplained portion, therefore, can be interpreted as the differential response to the determinants of BMI by each ethnic group. That is, risk factors with large differences in magnitude or those operating in opposite directions contribute to the unexplained portion.

Our model specification began with a base model of individual- and household-level characteristics (Model 1) and then sequentially added parental SES covariates (Model 2) and the economic contextual factors (Model 3), to assess to what extent the ethnic BMI gaps can be "explained" by these factors. From a public health perspective, economic contextual factors that substantially increase the explained portion of the equation would be of great interest to policymakers because this would serve as evidence that any policy that reduces the ethnic differences in such factors may reduce the ethnic differences in the health outcome. This study was approved by the Institutional Review Boards of the University of Illinois at Chicago and Johns Hopkins University.

Results

Descriptive statistics

Table 1 shows ethnic differences in BMI, individual and household characteristics, parental SES, and neighborhood economic contextual factors. White female and male adolescents had significantly lower BMI compared to their respective black and Hispanic counterparts with the largest gap observed between black and white females. On average, white females had lower BMI by 2.3 units and 0.9 units, respectively, compared to black and Hispanic females. The ethnic BMI gap between white male adolescents and their minority counterparts was smaller at 1.1 units between white and black males and 0.8 units between white and Hispanic males. Fig. 1 shows the distribution of BMI by ethnic groups. Black female adolescents had higher BMI and their distribution was right-skewed. For males, the black adolescents had slightly higher BMI. The distribution of BMI for Hispanic males was wider, although the mean was very similar to black males.

As shown in Table 1, for the individual household characteristics, white adolescents were the least likely to live with only one biological parent, whereas black adolescents were the most likely with more than one-half of them doing so. A majority of all ethnicities had full-time working mothers, with the highest rate of two thirds of full-time working mothers for black youths. White female and male youths had higher own incomes and worked more hours per week than their black and Hispanic counterparts. More white adolescents lived in higher SES families compared to minority adolescents. Across both genders, mean parental income was approximately $38K in whites youths' families compared to around $18K for black youths and around $21K for Hispanics. White adolescents had mothers with significantly higher average levels of educational attainment compared to their minority counterparts. White adolescents also lived in neighborhoods with significantly higher median household income. White adolescents, on average, lived in neighborhoods with lower food at home (grocery) prices compared to black and Hispanic adolescents and higher fast food prices compared to blacks but lower fast food prices than those faced by Hispanic adolescents. Black female and male adolescents had higher availability of fast food restaurants than both whites and Hispanics, whereas white male adolescents had greater availability than Hispanic males. Black adolescents also had greater availability of food stores compared to white adolescents. Compared to Hispanic adolescents, white youth had greater access to both convenience stores and supermarkets. With respect to the physical activity-related facilities, white female and male adolescents had greater availability compared to their respective black and Hispanic counterparts.

Decomposition of ethnic BMI gaps

The respective contributions of the individual and household characteristics, parental SES and neighborhood economic contextual factors to the "explained" part of the BMI gaps are shown in Table 2. The results are presented for three models that sequentially included each set of covariates: Model 1 was the base model with individual and household characteristics; Model 2 added the parental SES covariates to Model 1; and, Model 3 was the full model that added the economic contextual factors to Model 2.

The results in Table 2 show that the full model that included the parental socioeconomic and contextual economic factors (Model 3) explained 44% and 62% of the black–white and Hispanic–white BMI gap, respectively, for females and 63% and 78%, respectively for males. The base model (Model 1) that included only the individual and household characteristics explained roughly one quarter of the adolescent black–white and Hispanic–white BMI gaps for both genders. Once parental SES and neighborhood economic contextual variables were included, the contribution of the individual and household covariates fell substantially for males but not females. With regard to the economic factors, adding the parental SES covariates further increased the explained portion of the ethnic BMI gaps for both genders. In particular, parental SES explained approximately 31% of the Hispanic–white male and female BMI gap but explained substantially less (just 10% in Model 2) of the black–white BMI gap. In the full model, Model 3, the economic contextual factors explained 13% and 8%, respectively, of the black–white and Hispanic–white female BMI gaps and substantially more, 28% and 38%, of the respective male ethnic BMI gaps.

Associations between adolescent BMI and its determinants

Table 3 reports the BMI regression results by sex and ethnicity and shows several ethnic differences in the associations between the determinants and BMI. For example, living in a single parent versus two-parent household was associated with higher BMI for all ethnicities but was only statistically significant for Hispanic adolescents. Higher youth income was significantly associated with higher BMI for both female and male black adolescents but not for white or Hispanic female or male adolescents. Higher parental income was a significant protective factor against higher BMI only for white male and female adolescents. An inverse relationship between mother's education and BMI was found only for female Hispanic adolescents. Previous research found an inverse association between overweight and SES among white girls only (Gordon-Larsen, Adair, et al., 2003; Wang & Zhang, 2006).

Higher fast food prices and greater availability of physical activity facilities were inversely associated with lower BMI only for white males. Greater availability of grocery stores was significantly associated with lower BMI for black males only. Greater convenience store availability was associated with higher BMI among Hispanic female adolescents. Unexpectedly, higher neighborhood income was associated with higher BMI for white male adolescents. Although parental income was not associated with black or Hispanic adolescents' BMI, neighborhood median household income was negatively associated with BMI for minority adolescents.

Discussion

We found that individual demographic and parental and neighborhood economic endowments across ethnicity helped explained the majority of the male black–white (63%), male Hispanic–white (78%) and female Hispanic–white (62%) BMI gaps, but only 44% of the female black–white BMI gap. The base model that included only the individual and household characteristics explained roughly 25% of all ethnic BMI gaps. Adding parental SES to the base model substantially increased the explained portion of the female and male Hispanic–white BMI gaps, but significantly less of the female and male black–white BMI gaps explaining 8% and 18% of these latter BMI gaps, respectively. Further adding the neighborhood economic contextual factors increased the explained portion of the respective black–white and Hispanic–white BMI gaps, by 28% and 38% for males but by only 13% and 7% for females.

A number of key and interesting results emerged from our analyses. First, differences in parental SES explained more of the Hispanic–white BMI gap than the black–white BMI gap for both genders. Second, neighborhood economic contextual factors explained substantially more of the ethnic BMI gaps for males than for females for both the black–white and Hispanic–white disparities. Third, individual/household-level factors remained the most important contributors to explaining the female ethnic BMI gaps, whereas the economic factors explained more of the male ethnic BMI disparities (28–38%). Finally, a substantial portion (ranging from 22% for Hispanic–white boys to 56% for black–white girls) of the ethnic disparity in adolescent BMI remained unexplained even after controlling for the demographic, parental SES and the economic contextual factors, particularly for the female black–white BMI disparity.

The results from the full model with the full set of covariates showed that we were able to explain more of the ethnic BMI gap for males than for females across both ethnic disparities and less of the black–white BMI gap compared to the Hispanic–white gap for both genders. In particular, after controlling for all covariates, we were able to explain less than one-half of the black–white female BMI gap. The large unexplained portion of the BMI gap for female adolescents, particularly among the blackewhite females, deserves further attention given that obesity tracks into adulthood and large disparities currently exist between female adults. Indeed, recent estimates from 2007 to 2008 show that obesity prevalence among non-Hispanic black women was significantly higher at 49.6% and was 43.0% for Hispanic adult females compared to 33.0% among white women (Flegal, Carroll, Ogden, & Curtin, 2010). Furthermore, significant obesity-related ethnic health disparities exist among female adults in the U.S. (Agency for Healthcare Research and Quality, 2006; Wang & Wang, 2004).

An alternative explanation for the existing ethnic disparities in adolescent obesity is that minority and white adolescents are affected differently by the determinants of obesity. In such cases, public health policies focused only on the contextual factors or low family income may be less effective in reducing the ethnic disparities. Similar to the previous literature, this study found that higher parental income is a significant protective factor for white but not black girls' risk of overweight. This study also found a number of differences in the association of the economic contextual factors with BMI by ethnicity.

This study is subject to some limitations. First, the geographic identifiers in the NLSY97 data only allowed us to link the economic contextual measures at the county level. If we were able to match these factors to the individuals at more proximate (smaller) geographic levels such as the zip code or census tract level, our models may have explained more. Second, height and weight were self-reported. Several previous studies, starting with Cawley (2004), attempted to adjust potential measurement errors for self-reported height and weight using NHANES III (1988–1994). However, the size or magnitude of the errors in self-reported height and weight in NHANES III may be different than those in the NLSY97, and such adjustments may introduce its own set of errors, particularly because the respondents in the NHANES were aware that their weight and height would be measured after their self-reports of weight and height (Han et al., 2009; U.S. Department of Health and

Human Services, 1996). Third, smaller sample sizes among the gender-ethnic subgroups have limited statistical power in our regression analyses that assessed the differential associations with BMI by ethnicity.

Finally, there are other important potential contributors to ethnic differences in adolescents' BMI which were not assessed in this study. For example, differences in social and cultural practices are likely to affect dietary and physical activity patterns. Cultural norms may also differentially affect preferences of ideal body weight (Barroso, Peters, Johnson, Kelder, & Jefferson, 2010; Brener, Eaton, Lowry, & McManus, 2004; Chen & Wang, 2011). Further, cultural differences may impact on weight outcomes differentially according to the immigrant status of the youths. Previous studies have shown that children of immigrants, especially Hispanic boys, are at greater risk for obesity compared to native born children and that such associations vary by generation of immigration (Gordon-Larsen, Harris, Ward, & Popkin, 2003; Kandula, Kersey, & Lurie, 2004; Popkin & Udry, 1998). Ethnic differences in social support systems and stress among youths may also contribute to disparities (De Vriendt, Moreno, & De Henauw, 2009; Story, Neumark-Stzainer, & French, 2002). Although, recent evidence for adults found that accounting for social support and financial stress did not explain black–white racial disparities in adult BMI (Robert & Reither, 2004). Other environmental factors such as differences across communities in the outdoor physical environment, crime, along with perceived safety, and differential exposure to marketing may also be important contributors (Black & Macinko, 2008; Powell, Szczypka, & Chaloupka, 2007; Sen et al., 2011; Slater et al., 2010; Story et al., 2002). These factors deserve further attention in future disparities-related obesity research.

Investigating the contributions of household and economic contextual factors toward ethnic disparities in adolescent obesity is timely and particularly important given that youth obesity is shown to track into adulthood (Freedman et al., 2005), the increasing evidence on ethnic health disparities (Agency for Healthcare Research and Quality, 2006; Wang & Beydoun, 2007), and the important role of contextual factors in affecting childhood obesity (Brennan, Castro, Brownson, Claus, & Orleans, 2011; Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). The evidence presented in this paper and elsewhere increasingly suggests that public health policies addressing ethnic differences in household socioeconomic and contextual factors could serve as an effective method for reducing ethnic disparities in adolescent obesity in the United States and, therefore, reducing long-term differences in health outcomes later in life. However, the results also suggest that additional research is needed to further understand the possible role played by social, cultural, and environmental factors and their interactions that may be important for informing potential interventions that aim to eliminate ethnic disparities in adolescent obesity.

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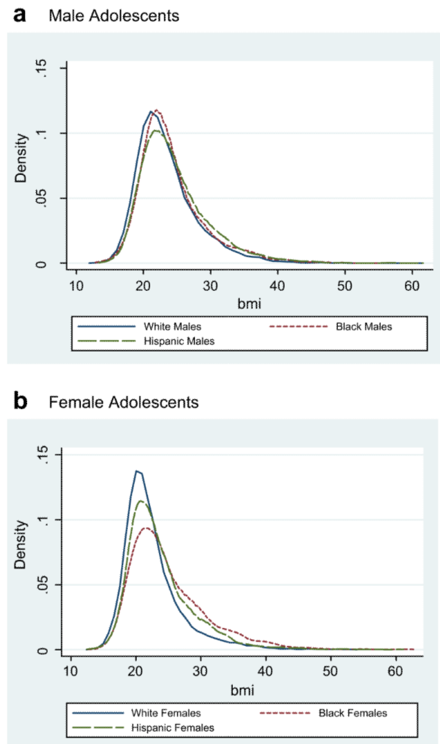

Fig. 1.
Body mass index density of US adolescents, 1997–2000, by ethnicity. a) Male adolescents, b) Female adolescents. Source: authors' calculations of NLSY97 1997–2000.

Table 1

Summary statistics: means (SD) and frequencies.

	Female adolescents			Male adolescents		
	White *N* = 2699	**Black** *N* = 1320	**Hispanic** *N* = 1022	**White** *N* = 3268	**Black** *N* = 1438	**Hispanic** *N* = 1222
Outcome measure						
Body mass index	21.56 (3.80)	23.81[a,c] (5.28)	22.43[b] (4.36)	22.79 (4.41)	23.91[a] (4.83)	23.56[b] (4.67)
Individual and household characteristics						
Age of menarche	12.22 (1.49)	11.64[a] (1.55)	11.79[b] (1.52)	–	–	–
Youth income	794.33 (1534)	544.08[a] (1123)	592.55[b] (1546)	908.64 (1873)	652.09[a,c] (1478)	786.68[b] (1656)
Hours per week worked by youth	12.21 (14.18)	10.79[a] (14.11)	10.19[b] (13.86)	14.01 (15.97)	12.19[a,c] (16.84)	14.00[b] (17.12)
Urban residence	70.65%	77.00%[a,c]	90.00%[b]	72.44%	76.31%[a,c]	92.86%[b]
Suburban residence	9.58%	6.62%[a]	4.51%[b]	11.58%	5.26%[a]	3.41%[b]
Rural residence	19.77%	16.38%[a,c]	5.49%[b]	15.98%	18.43%[a,c]	3.73%[b]
Mother does not work	17.49%	21.61%[a,c]	26.73%[b]	18.52%	23.03%[a,c]	29.39%[b]
Mother works part time	20.34%	11.95%[a,c]	15.98%[b]	18.15%	11.19%[a]	10.14%[b]
Mother works full-time	62.17%	66.44%[a,c]	57.29%[b]	63.33%	65.78%[a,c]	60.47%
Youth lives with one biological parent	20.94%	50.45%[a,c]	30.10%[b]	18.72%	54.67%[a,c]	28.36%[b]
Age	15.86 (1.84)	15.88 (1.80)	15.79 (1.86)	15.82 (1.85)	15.94 (1.90)	16.04 (1.83)
1997	31.84%	30.56%	31.97%	29.75%	29.70%	29.00%
1998	27.05%	30.40%[a]	29.30%	28.57%	30.15%	31.31%
1999	22.31%	19.83%	22.71%	22.70%	18.91%[a]	21.44%
2000	18.80%	19.21%[c]	15.99%[b]	18.98%	21.24%	18.25%
Parental socioeconomic status						
Parental income ($1982–1984)	39,367 (31,526)	18,991[a] (25,078)	21,450[b] (23,553)	38,283 (33,634)	17,121[a,c] (17,912)	22,274[b] (22,400)
Mother not completed high school	8.71%	18.20%[a,c]	37.80%[b]	10.03%	20.78%[a,c]	41.81%[b]
Mother completed high school	35.87%	42.40%[a,c]	34.38%	35.39%	40.35%[a,c]	31.11%[b]
Mother completed more than high school	55.42%	39.40%[a,c]	27.82%[b]	54.58%	38.87%[a,c]	27.08%[b]
Neighborhood food, physical activity, and socioeconomic contextual factors						
Price of fast food	2.76 (0.16)	2.74[a,c] (0.19)	2.84[b] (0.18)	2.76 (0.16)	2.74[a,c] (0.18)	2.82[b] (0.18)
Price of food at home	1.09 (0.09)	1.09[c] (0.12)	1.14[b] (0.16)	1.09 (0.08)	1.10[a,c] (0.13)	1.14[b] (0.16)
Fast food restaurants (per 10,000 capita)	2.36 (0.82)	2.60[a,c] (0.82)	2.31 (0.56)	2.41 (0.79)	2.52[a,c] (0.86)	2.36[b] (0.54)
Full-service restaurants (per 10,000 capita)	10.54 (2.91)	11.36[a,c] (4.29)	11.08[b] (3.16)	10.78 (2.87)	10.77[c] (4.04)	11.27[b] (2.92)
Grocery stores (per 10,000 capita)	3.00 (1.42)	4.15[a,c] (2.48)	3.04 (1.68)	2.92 (1.36)	4.02[a,c] (2.61)	3.00 (1.50)

	Female adolescents			Male adolescents		
	White **N = 2699**	**Black** **N = 1320**	**Hispanic** **N = 1022**	**White** **N = 3268**	**Black** **N = 1438**	**Hispanic** **N = 1222**
Convenience stores (per 10,000 capita)	1.96 (1.11)	2.48[a,c] (1.60)	1.51[b] (0.89)	1.91 (1.08)	2.41[a,c] (1.57)	1.53[b] (0.94)
Supermarkets (per 10,000 capita)	0.54 (0.28)	0.62[a,c] (0.28)	0.48[b] (0.20)	0.54 (0.26)	0.60[a,c] (0.28)	0.50[b] (0.20)
Physical activity outlets (per 10,000 capita)	3.68 (1.11)	3.24[a,c] (1.37)	2.96[b] (1.04)	3.84 (1.19)	3.13[a,c] (1.35)	2.92[b] (1.07)
County-level median household income ($2000)	44,191 (10,389)	39,222[a,c] (8873)	43,390[b] (10,536)	43,447 (9591)	39,623[a,c] (8789)	43,023 (9719)

Notes: summary statistics are weighted using the NLSY sampling weights. SD is standard deviation.

[a]Statistically different than whites at $p \leq 0.05$.

[b]Statistically different than whites at $p \leq 0.05$.

[c]Statistically different than Hispanics at $p \leq 0.05$.

Table 2

Percentage contributions from decomposition of ethnic differences in U.S. adolescent body mass index, by gender.

Variables	**Black–white female adolescents (BMI gap = 2.25 units) *N* = 4019**			**Black–white male adolescents (BMI gap = 1.12 units) *N* = 4706**		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Individual and household characteristics	28.9%	24.7%	24.1%	28.9%	22.7%	17.5%
Parental socioeconomic status		10.3%	7.9%		17.0%	17.8%
Neighborhood food and physical activity contextual factors			12.5%			27.8%
Total percentage explained	28.9%	35.0%	44.4%	28.9%	39.7%	63.1%
Variables	Hispanic–white female adolescents (BMI gap = 0.87 units) *N* = 3721			Hispanic–white male adolescents (BMI gap = 0.77 units) *N* = 4490		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Individual and household characteristics	28.4%	25.6%	27.5%	24.6%	22.5%	11.4%
Parental socioeconomic status		31.8%	27.1%		31.1%	28.1%
Neighborhood food and physical activity contextual factors			7.4%			38.0%
Total percentage explained	28.4%	57.4%	62.0%	24.6%	53.6%	77.5%

Note: variables included in each category correspond to the list shown in Table 1.

Table 3

Regressions estimates of adolescents body mass index, by ethnicity and gender.

BMI	Females			Males		
	White	Black	Hispanic	White	Black	Hispanic
Age of menarche	−0.621*** (0.076)	−0.423*** (0.149)	−0.305** (0.124)			
Youth income[a]	0.799 (0.574)	3.557** (1.734)	−0.341 (0.896)	−0.126 (0.392)	4.147*** (1.308)	1.494 (1.037)
Hours of work per week	0.010* (0.006)	0.003 (0.015)	0.005 (0.011)	0.012** (0.006)	0.028*** (0.010)	0.0004 (0.009)
Suburban residence	−0.523 (0.366)	0.745 (0.871)	−1.074 (0.836)	−0.111 (0.433)	0.937 (0.619)	−0.0842 (0.833)
Rural residence	0.475 (0.417)	0.563 (1.023)	−1.377 (1.276)	1.019** (0.438)	1.714*** (0.605)	−0.901 (1.099)
Mother works part time	−0.105 (0.246)	−1.009 (0.780)	−0.507 (0.453)	−0.495 (0.311)	0.781 (0.754)	−0.975* (0.571)
Mother works full-time	0.048 (0.252)	−0.536 (0.614)	−0.409 (0.412)	0.082 (0.299)	−0.203 (0.423)	−0.188 (0.445)
Youth lives with one parent	0.339 (0.319)	0.596 (0.452)	0.760* (0.452)	0.276 (0.335)	0.351 (0.339)	1.026** (0.412)
Parental income[a]	−0.084*** (0.029)	−0.015 (0.088)	−0.020 (0.055)	−0.074** (0.032)	0.034 (0.094)	0.063 (0.091)
Mother completed high school	0.239 (0.360)	−0.194 (0.622)	−1.153* (0.625)	0.129 (0.367)	−0.037 (0.533)	0.103 (0.534)
Mother completed more than high school	0.303 (0.326)	0.320 (0.787)	−1.418*** (0.521)	−0.308 (0.349)	0.375 (0.512)	−0.797 (0.563)
Price of fast food	−0.228 (0.665)	0.070 (1.406)	1.473 (1.339)	−1.836** (0.732)	0.074 (1.604)	1.290 (1.811)
Price of food at home	−0.172 (1.397)	−1.825 (2.394)	3.300 (2.021)	1.361 (1.365)	−0.557 (2.187)	−1.914 (2.437)
Number[b] of fast food restaurants	0.279 (0.217)	0.241 (0.294)	−0.341 (0.305)	0.048 (0.204)	0.620* (0.334)	−0.229 (0.516)
Number[b] of non fast food restaurants	−0.075 (0.060)	−0.035 (0.087)	0.088 (0.085)	0.138** (0.060)	−0.021 (0.068)	0.092 (0.092)
Number[b] of grocery stores	0.108 (0.108)	−0.085 (0.139)	−0.313 (0.210)	0.052 (0.126)	−0.201*** (0.076)	−0.187 (0.195)
Number[b] of convenience stores	−0.222* (0.121)	−0.026 (0.228)	1.352*** (0.486)	0.198 (0.174)	0.057 (0.200)	−0.333 (0.409)
Number[b] of supermarkets	0.356 (0.412)	0.568 (0.916)	0.090 (1.050)	0.161 (0.516)	−0.762 (0.651)	0.310 (1.102)
Number[b] of total physical activity facilities	0.051 (0.131)	−0.210 (0.233)	−0.239 (0.250)	−0.382*** (0.137)	−0.117 (0.182)	0.197 (0.295)
Median household income[c]	−0.158 (0.179)	−0.689** (0.294)	−0.355** (0.167)	0.295** (0.147)	−0.484* (0.257)	−0.470* (0.267)
N	2699	1320	1022	3268	1438	1222

Notes: regressions include the full set of age dummy variables, a dummy variable indicator of the quality of the price match, and year fixed effects. The regressions are weighted using NLSY sampling weights. Standard errors are reported in parentheses and are robust and adjusted for two-way clustering within individuals and counties (Cameron, Gelbach, & Miller, 2011).

*Significant at $p \leq 0.10$

**significant at $p \leq 0.05$

***significant at $p \leq 0.01$.

[a]In ten thousands of $1982–1984.

[b] Per 10,000 capita.

[c] In ten thousands of $2000.