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Black–White Disparities in Body Mass Index Trajectories From Adolescence to Adulthood: Assessing the Roles of Adverse Childhood Experiences and Exposures to Short Sleep Durations

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BLACK–WHITE DISPARITIES IN BODY MASS INDEX TRAJECTORIES FROM ADOLESCENCE TO ADULTHOOD: ASSESSING THE ROLES OF ADVERSE CHILDHOOD EXPERIENCES AND EXPOSURES TO SHORT SLEEP DURATIONS

by

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ABSTRACT

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by

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The Black population in the U.S. has experienced one of the highest prevalences of obesity relative to Whites and other racial groups. Research into the role of adverse childhood experiences (ACEs) has increased recently because the effects of ACEs often persist for a significant portion of a person's lifetime. Furthermore, the reduction in sleep duration in recent decades has sparked worries about public health. This dissertation assesses Black-White disparities in associations between (1) ACEs and BMI, and (2) short sleep durations and BMI from adolescence to adulthood. Public-use datasets from the National Longitudinal Study of Adolescent to Adult Health (Add Health) were used. Respondents were comprised of 5,438 Black and White individuals. The outcome measure was BMI, calculated in each wave as weight in kilograms divided by the square of height in meters. The Behavioral Risk Factor Surveillance System ACE Module and the CDC's kaiser ACE research were sources for the creation of ACE categories. In each wave, sleep duration below the National Sleep Foundation seven-hour standard was coded as short sleep. Multilevel growth curve models were estimated to address the study's objectives. Female respondents who reported 2 ACEs (β = 0.66, 95% CI: 0.03, 1.28) and 3 or more ACEs (β = 0.98, 95% CI: 0.33, 1.64) experienced higher mean BMI than females who did not report any ACE. Additionally, among females the effect of ACEs on BMI was moderated by race (LRT: $\chi^2 = 132.28$, $p < .001$). ACEs were not statistically associated with BMI trajectories among male respondents. Female respondents (β = 0.21, 95% CI: 0.04, 0.39) and male respondents (β = 0.16, 95% CI: 0.02, 0.31) who reported short sleep durations experienced higher BMI, on average, than those who did not report short sleep durations. However, the association did not differ by race among female or male respondents. The findings imply there may be distinct mechanisms for females and males that account for how ACEs affect Black-White gaps in BMI. Large racial gaps in BMI, especially among females, could be reduced through targeted interventions designed to support Black children and adolescents.

(132 pages)

PUBLIC ABSTRACT

Black–White Disparities in Body Mass Index Trajectories from Adolescence to Adulthood: Assessing the Roles of Adverse Childhood Experiences and Exposures to Short Sleep Durations

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In comparison to Whites and other racial groups, the Black population in the U.S. has experienced one of the highest prevalences of obesity. Research into the role of adverse childhood experiences (ACEs) has increased recently because the effects of ACEs often persist for a significant portion of a person's lifetime. Furthermore, the reduction in sleep duration in recent decades has sparked worries about public health. This dissertation assesses Black-White disparities in the associations between (1) ACEs and BMI, and (2) short sleep durations and BMI from adolescence to adulthood. Public-use datasets from the National Longitudinal Study of Adolescent to Adult Health were used to estimate these associations. Study participants included 5,438 Black and White individuals. This study found that female respondents who reported more ACEs experienced higher BMI, on average, than females who did not report any ACE. Additionally, among females this effect was stronger among Blacks in some instances. ACEs were not associated with BMI trajectories among male respondents. Female and male respondents who reported short sleep durations experienced higher BMI, on average, than those who did not report short sleep durations. However, the association did not differ by race among either female or male respondents. The findings imply that ACEs influence Black-White gaps in BMI, especially among females, through pathways that begin early in the lifecourse. Interventions designed to support disadvantaged Black children and adolescents may help reduce large racial disparities in BMI.

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CHAPTER I

INTRODUCTION

According to the World Health Organization, abnormal fat buildup that might have a harmful impact on health characterizes obesity and overweight [1]. Although there are many different measurement methods, body mass index (BMI = kg/m^2) is a popular algorithm for determining obesity disparities and population-wide obesity trajectories. The BMI cutoffs for overweight and obesity reflect the weight-to-height ratios at which persons are most at risk for problems brought by having excess weight. BMIs of 25 to 29.9 kg/m^2 are typically considered overweight, whereas BMIs of 30 kg/m^2 or more are considered obese among adults. Children with BMIs between the 85th and 94th percentiles are overweight, while children with BMIs of the 95th percentile or more are obese, according to the age-sex specific growth charts of the United States Centers for Disease Prevention and Control [2].

Increasing obesity remains one of the most alarming health trends in the United States [3]. The prevalence of obesity rose steadily throughout the 1990s and, despite appearing to stabilize from 2009 to 2012 [4], continued to climb across the board for all age groups, reaching 42% in adults between 2017 and 2018 [5] and over 18% in children and adolescents in 2015–2016 [6]. By 2030, it is predicted that nearly one-third of American children, as well as around half of American adults and adolescents, will be obese [7]. The effects of body mass on the economy, society, and health are enormous. For instance, obesity-related medical costs in the United States reached $149.4 billion in 2014 [8]. In addition to constraining healthcare resources, the detrimental effects of body mass during early childhood generally remain throughout life and are linked to various chronic diseases and leading causes of mortality, including diabetes, heart disease, cancer, stroke, and injury [9,10].

According to the distribution of adult individuals with a BMI of 30 kg/m^2 or higher in 2017–2018, 17.4% of non–Hispanic Asians, 44.8% of Hispanics, 49.6% of non–Hispanic Blacks (henceforth, Blacks), and 42.2% of non–Hispanic Whites (henceforth, Whites) were obese [5]. These figures indicate that Blacks have experienced one of the greatest disparities in BMI compared to Whites and other racial groups. Most especially, Black women commonly exhibited BMI of 30 kg/m^2 and above (56.9% prevalence) that greatly surpassed obesity prevalence in White women (39.8%) and women of other racial groups [5]. Blacks have experienced a disproportionately rapid rise in BMI over time compared to the White population [11]. Substantial body mass disparities are considered a reason why America has lagged behind other wealthy nations in health rankings [3]. Additionally, if America aims to achieve the main goal of eliminating health disparities outlined in Healthy People 2030, it is crucial to reduce large BMI disparities among racial groups.

At the root of differences in BMI between Blacks and Whites are multifactorial causes. Studies have identified that not only is imbalance between calories consumed and energy expended crucial to elucidating Black-White disparities in BMI, but there are numerous biological [12,13], socioeconomic [11,14,15], environmental [16,17], behavioral [13,18–20], psychosocial [21–24] and racism-related factors [25] that also play important roles in the disparities. Studies have focused on the additive and interaction impacts of these risk factors, which are frequently interrelated, to shed light on the mechanisms underlying the disparate body mass outcomes among disadvantaged populations [12,26]. There have also been attempts in the literature to identify areas of intervention or prevention that may substantially reduce racial gaps in BMI changes by considering the relative roles among risk factors [27,28].

Research into the roles of psychosocial risk factors, in particular adverse childhood experiences (ACEs), has increased because exposure to these factors affect biological processes [29] and may often persist for a significant portion of a person's lifetime [30]. Psychosocial risk factors also contribute a considerable portion of racial disparities in BMI compared to other factors [28]. Furthermore, the sharp reduction in sleep duration over the previous few decades has sparked worries about public health. Short sleep duration is associated with a variety of harmful health conditions [31], has been identified as a contributing factor to BMI disparities [32] and is a priority research area that can lead to the creation of interventions that can lessen BMI disparities [13]. Existing research findings already support that ACEs [24,33–36] and short sleep duration [37–41] are linked to increased body mass, but the associations are still poorly understood because of knowledge gaps.

The proposed research therefore has two broad objectives, which are to: (1) assess Black-White disparities in the longitudinal association between ACEs and BMI, and (2) examine Black-White disparities in the association between exposures to short sleep duration and BMI changes during adolescence and early adulthood age. Life course theories serve as the foundation for this dissertation, which describe how a single exposure or a combination of exposures at various stages of life may impact BMI trajectories. Data from the National Longitudinal Study of Adolescent to Adult Health (i.e., Add Health) was used to address the main objectives of this dissertation. I organize the sections of this dissertation based on a traditional-type format to include the introduction, review of academic literature, followed by a discussion of the materials and methods, results, and the discussion of findings.

CHAPTER II

REVIEW OF LITERATURE

Overview of Life Course Theories

Life course theories explain life trajectories of individuals or groups and how these impact multiple outcomes across different phases of life, emphasizing the social history that surrounds the development trajectories. The need to incorporate human past records and history into sociological research was initially recommended as far back as the 19th century, meanwhile the study of these social pathways gradually rose to prominence and came to be known as the life course within the bodies of social science research at the beginning of the 21st century [42]. Several life course concepts have evolved with time, such as trajectories, turning points, transitions, cohorts, and life events, providing insights into unique development of human lives through historical contexts.

As described by Elder and colleagues [42], life course theory is based on five traditional themes: (i) The interaction between social conditions and human development is enhanced through studying lives over extended periods of time; (ii) Human agency shapes the choices individually made, which in turn may determine future opportunities or consequences; (iii) As a result of historical time and geographical location, cohort effects are produced, which explain why people have different experiences and paths; (iv) The timing of life events matters since people can be affected differently by the same events at different developmental stages; and (v) Interdependence of human lives implies that whenever a person's life transitions positively or negatively, other people in their network stand a chance of being affected by such transitions and express changes in behavior.

In recent years, emerging themes of the life course theory have taken more cognizance of diversity in life course trajectories. Along this line, some groups' life course trajectories may be less flexible than other groups according to disparities by gender, social class, race, or individual experience.

The implication of life course theories is the idea that life histories and biographies can predict future changes in body mass. Life course perspectives allow the possibility to track changes in BMI over time, capturing BMI milestones of individuals during their lifetimes. Similarly, these perspectives allow interventions to be directed to different phases of life, rather than focusing only on factors in adulthood as these factors may not efficiently address racial disparities in BMI changes over time. Taking a life course approach is especially useful for explaining disparate body mass and other outcomes among Blacks because Black people fall short of White people, on average, in almost every aspect of their lives [43]. Stressors or disadvantages that are frequently experienced by Black people can lead to an unhealthy BMI in adulthood. By adopting a life course approach, we have better understanding of how significant life events can become compounded or accumulated over time and how these affect BMI.

Black-White disparities in BMI trajectories: Empirical evidence and implications

From early childhood, Black-White differences have been observed in BMI growth trajectories. For instance, a longitudinal study among children revealed that Blacks experienced higher mean BMI score at 48 months of age and higher growth in BMI score throughout 72 months of age as compared to Whites [18]. Studies demonstrate that disparities in body mass between Blacks and Whites are not limited to a specific period or stage of life, but rather Blacks exhibit faster growth in BMI than Whites as they transition through stages of adolescence, young adulthood, middle adulthood, and older age groups. An illustration is found in a study conducted by Yang and colleagues which assessed racial disparities in BMI trajectories over an almost complete life span (i.e., ages 11 to 107 years) [44]. Using pooled data from four nationally representative longitudinal cohort studies, results of the study indicate that Black women had an average BMI that was 3.23 kg/m^2 greater than that of White women, whereas Black men had an average BMI that was 0.21 kg/m^2 higher than that of White men from adolescence to old age.

As demonstrated by Yang and colleagues' study, women account for most of the Black-White gap in BMI. Other research also had similar results. Using data from the National Longitudinal Survey of Youth 1979 Cohort, Walsemann and colleagues [14] found that Black women displayed greater BMI by 3.41 kg/m^2 at age 32 and swifter linear growth in BMI by 0.12 kg/m^2 per year from adolescence to midlife compared to White women. On the other hand, Black men's BMI was 0.53 kg/m^2 higher at age 32 compared to White men's BMI, and Black men's BMI linearly increased more quickly from adolescence to midlife by only 0.05 kg/m^2 per year.

Elevated body mass is associated with different chronic conditions and major causes of death [9,10]. In part due to Black-White differences in BMI growth across the life course, there are substantial Black-White disparities in many health outcomes, including but not limited to diabetes, heart disease, cancer, stroke, and coronavirus disease (COVID-19). Evidence from a systematic literature review, for instance, shows that people with higher body mass are more at severe risk of COVID-19-related morbidity and mortality [45], and studies have implicated that the burden of COVID-19 disease may have been exacerbated in Black people owing to the higher prevalence of obesity among Blacks [46]. The unequal distributions of BMI between Black and White populations also presage that Blacks may be burdened by the direct medical expenditures and additional repercussions associated with higher BMI, like low school attendance, stigma, victimization, discrimination, and social ostracism [9,10]. Given that Black-

White disparities in BMI across the life course are concentrated among women, this implies greater potential among Black women to experience the negative effects of BMI-related outcomes.

ACEs and BMI trajectories in Black and White populations

Life course perspectives encompass several models that are well-known in various fields, some of which offer concepts that are useful to comprehend potential mechanisms associated with racial disparities in BMI trajectories. The *critical period model* from the life course perspective states that individuals are only exposed to ACEs during the first 17 years of life, then the adverse effects on BMI growth become apparent during the subsequent life span. ACEs are linked to emotional disorders, a lack of social support, disadvantaged social environment, risky lifestyles, and unhealthy behaviors or habits like binge drinking, smoking, getting little sleep, unbalanced diet, or insufficient physical activity, all of which could have adverse effects on BMI levels during a person's lifetime [47–49]. Many of these ACE-related behaviors and lifestyle choices have been found to influence the expressions of genes that cause obesity [12]. Additionally, those who are victims of ACEs are at increased risk of experiencing chronic stress [47] and chronic psychosocial stress, which can accelerate the impact of genetic predisposition to elevated BMI [12].

Although adolescents from all racial backgrounds have the capacity to report experiencing ACEs, Blacks are more likely than Whites to live within social environments where they are at risk of being exposed to ACEs. Blacks have a history of experiencing racism through enslavement, oppression, segregation, Jim Crow legislation, and numerous other policies that weakened their status in the society. The impact of centuries of racism experience continues to influence the social conditions of today even though many of the historical practices were discontinued [50]. For example, due to the continued existence of residential segregation, Black adolescents and adults are more likely to have grown up from communities concentrated with high levels of crime, poverty, violence, substance abuse, parental separation, and premature deaths [51]. Modern society is permeated with racist ideologies and attitudes that are reinforced by the media, law enforcement, the judiciary system, and various institutions [52–54]. These clarify why Blacks disconcertingly encounter several occurrences that may aggravate the risk of ACEs like school suspension [52], arrest and criminal punishment [53], and wrongful deaths [54].

As a result, Blacks are more likely than Whites to be exposed to ACEs, both in terms of total number of ACEs and specific forms of ACEs. An analysis of the National Survey of Children's Health 2016 data indicates that 64% of Black children aged 0-17 years were exposed to 1 or more ACEs, compared to about 41% of White children in this age range [55]. The same study revealed that, relative to White children, Black children exhibited greater exposure to most forms of ACEs, such as parental death, parental divorce or separation, witnessing domestic violence, being treated or judged unfairly because of one's race, and parental incarceration.

Exposure to ACEs may have a long-term negative effect on BMI growth, especially if victims of ACEs lack access to protective resources that can foster resilience in the context of ACEs. In the event of ACEs, Black adolescents have less access to protective resources that support resilience at the family, school, and community levels, such as having an adult mentor, taking part in community activities or service work, or having a safe neighborhood [56]. Studies have revealed that although ACEs contribute to elevated BMI, resilience may reduce the magnitude effect of ACEs on BMI [57].

Similarly, health outcomes associated with ACEs may be more deleterious for Blacks than Whites, owing to racism's persistent effects [58]. For instance, schools are supposed to be a place where adolescents who have experienced ACEs can access support, but many Black adolescents continue to experience racial microaggressions from schools which further hinders their ability to build resilience against the harmful effects of ACEs [59]. Racial biases have been documented in mental health diagnoses for individuals exposed to ACEs, leading to less likelihood for Blacks to be diagnosed of mental disorders and under-identification of Blacks for ACEs-related mental health services [60], which eventually increases the probability of having an unhealthy BMI during one's lifetime. Thus, racism is not only a risk factor for Blacks' disproportionate exposure to ACEs, but its persistence across the lifetime may also contribute to amplifying the effects of ACEs on outcomes such as overweight and obesity among Blacks.

Cross-sectional studies have documented associations between ACEs and BMI, showing that chances of having a BMI over 30 kg/m^2 in adulthood increase with the number of ACE exposures [36,61,62]. But the association between ACEs and trajectories of BMI over time may not be revealed in cross-sectional studies due to lack of repeated BMI measurement. As well, Black-White differences in the relationship between ACEs and BMI are scarcely examined so far. A study by Vásquez and colleagues is one of the rare cross-sectional studies examining whether there are racial disparities in the relationship between ACEs and BMI [23]. This study found that ACEs did not have a significant association with BMI for either Black or White adults aged 55 and over, despite the fact that self-reported ACEs and perceived racial discrimination were higher among Black than White participants. While the authors attempted to explain how ACEs might affect BMI differently between Black and White adults using stratified models, their analytical models did not address how the interaction between race and ACEs may influence the levels of BMI.

Many existing studies – both cross-sectional and longitudinal – have simply considered one type or few types of ACEs, failing to account for numerous categories of ACE exposures. For instance, in a longitudinal study among 6,718 adolescents, growth in BMI was found to vary by child maltreatment experiences, whereby an adolescent group classified as having concurrent experience of sexual abuse, physical abuse, and neglect had substantially greater increase in BMI than other groups who had no maltreatment, physical abuse, or physical abuse combined with neglect [63]. Another 12-year longitudinal study found that women who had experienced parental incarceration had baseline BMIs that were 0.49 kg/m^2 higher and slope of BMI change that was 0.92 kg/m^2 steeper than women who had not experienced parental incarceration [34]. These studies offer important findings indicating that ACE exposure may accelerate the increase of BMI during adolescence and adulthood, but a consideration for multiple categories of ACEs may further reveal dose-response effects of ACEs on BMI trajectories.

On how race may influence the association between ACEs and BMI trajectories, existing longitudinal studies have revealed two broad patterns. First, studies have examined how ACEs affect BMI changes by incorporating racial identity as a covariate in the analytic models [34,63]. In Sokol and colleagues' study, for instance, the positive relationship between child maltreatment categories and BMI changes was observed after controlling for race and other factors [63]. These studies, however, did not examine how racial identity interacted with the longitudinal association between ACEs and BMI.

Second, studies have ignored racial diversity in ACE exposures in favor of data collected among predominantly White populations. For instance, Caleyachetty and colleagues [64] conducted important research that examined variety of childhood social risk factors predicting the trajectory of BMI among British adults from ages 20 to 64 years. They discovered, using prospective data from the UK National Survey of Health and Development, that greater exposures to socioeconomic risk factors in childhood predicted higher mean BMI for men and women from ages 20 to 64 years, and a faster rise in BMI among women. Nonetheless, the majority of the study participants were Whites, potentially limiting generalizability.

Overall, studies employing both cross-sectional and longitudinal research designs have shown relationships between ACEs and BMI. With adjusted and stratified models, association modification by race has been demonstrated, suggesting that racial identity may contribute to the relationship between ACEs and BMI. The dearth of longitudinal studies has, however, made it difficult to explain the relationship between ACEs and trajectories of repeated BMIs over time. Most of the existing longitudinal studies on the relationship between ACEs and BMI have relied on one or a small number of ACEs for their analyses. Additionally, the potential for ACEs to disproportionately affect different racial groups has not received sufficient attention in existing studies. Thus, one of the objectives of this dissertation aimed to advance current knowledge by determining how ACEs are prospectively and disproportionately associated with BMI trajectories between Blacks and Whites during adolescence and adulthood using multiple distinct categories of ACEs and nationally representative longitudinal data.

Sleep and BMI trajectories between Black and White populations

The *cumulative disadvantage model* from the life course perspective points out that BMI disparities may emerge between Black and White adolescents on account of shorter average sleep duration among Blacks. Short sleep is a health-harming behavior that may be associated with increased BMI in different ways. Fatigue and low levels of physical activity may result from inadequate sleep. When people do not get enough sleep, hormones might become out of balance, which can alter how much they eat. In addition to eating greater amount of food, short sleep duration is related to eating sugary, fatty, and other unhealthy foods [13].

Blacks spend fewer hours in bed, sleep less efficiently, and are more likely than Whites to exhibit high levels of daytime sleepiness [65]. Low socioeconomic status, racial discrimination, and residential segregation are prominent social risk factors that have an impact on sleep health over the life course; these risk factors are more likely to occur among Black individuals [66]. For instance, having low socioeconomic status may raise the chances of living in overcrowded households. Exposure to discrimination is linked to sleep disturbance among minority racial groups. Residential segregation may increase exposure to poor housing conditions, crime and violence, nighttime noise pollution, security light exposure, and other conditions that interfere with sleep [66].

Long-term variations in Black-White exposure to social risk factors may be responsible for differential risk of hormone imbalance linked to short sleep. Hormonal imbalances arising from short sleep duration can lead to disproportionate gains in BMI among Blacks [67]. Environmental and social factors can modify a gene’s expression without changing its DNA sequence, according to epigenetic studies [12]. These gene expressions then biologically influence people’s health behaviors that increase the risk of elevated body mass [12]. Black-White inequalities in exposure to sleep-related social risk factors serve as a source of epigenetic modifications that may result in disproportionate increases in BMI among Blacks, because Blacks and Whites are differentially exposed to social risk factors that affect short sleep duration across the life course [67].

Although studies have linked both short sleep and long sleep durations to higher BMI, a systematic review of literature shows that the link between short sleep duration and higher BMI is more consistently supported [68]. In the literature, two types of results are provided from cross-sectional studies assessing the association between short sleep duration and BMI. A group of studies have found short sleep duration to be linked to increased BMI [69–72]. But these studies either excluded race or added race as one of the covariates in the adjusted models. An analysis of pooled data from the U.S. National Health Interview Survey (1977-2009) showed that very short sleep (< 5 hours) was associated with a two-fold increased risk of obesity and short sleep (5 to 6 hours) was associated with having 57% higher odds of obesity than having an optimal sleep duration (7 to 8 hours) [69]. Although this study incorporated race as a covariate in the adjusted associations between sleep duration and BMI categories, the interaction or interplay between race and short sleep duration, and how this may affect BMI, was not explored.

Secondly, a number of studies have attempted to determine moderating effect of race in the association between short sleep and BMI [73,74]. Jean-Louis and colleagues [73] observed that chances of having BMI of 30 kg/m^2 increased by 51% among White adults sleeping ≤ 5 hours compared to 81% among Black adults sleeping ≤ 5 hours, using data from the National Health Interview Survey. According to Ogilvie and colleagues' analysis of 1,116 residents of Louisiana, the association between short sleep duration and BMI was not significantly modified by race [74]. These studies used race-stratified models which produced important results showing how short sleep may affect BMI differently for Black and White adults. The stratified models, however, are unable to clarify whether race significantly interacts with short sleep to affect BMI.

The kinds of results described from cross-sectional research have also been found through longitudinal studies [37–41,75–79], but with additional knowledge of how the relationship between sleep duration and BMI has changed over time. That said, a variety of methodologies used in existing longitudinal studies have implications for what we can understand about the association. Some studies rely on longitudinal data collected at two time points [41,75–77], while another study captures the average of sleep duration across multiple successive periods of data collection [79], making it difficult to determine variations in sleep durations over time.

Two general patterns can be identified from extant longitudinal studies regarding how the association between short sleep duration and BMI is related to race. First, studies have considered how race influences the association between sleep and BMI change by including a race variable as a confounder. For instance, after controlling for race and other covariates, Krueger and colleagues found a dose-response association, such that greater exposure to short sleep over time increased the risks of having a higher BMI in adulthood [19]. This approach is credible since race has a relationship with sleep and BMI. Despite this, examining the interplay between race and short sleep durations, and how this interaction affects BMI may further reveal whether race moderates the longitudinal association between exposures to short sleep durations and BMI trajectories over time.

Second, I am aware of only one study that used longitudinal data, which attempted to explain whether disparities in exposures to sleep durations account for racial disparities in BMI [80]. However, the study combined sleep data from successive waves into a consolidated cross-sectional dataset, making it impossible to explain the effect of exposures to short sleep durations on Black-White disparities in BMI over time. Ultimately, the study's approach limits the ability to demonstrate prospective associations in the way that a longitudinal design would do.

In general, cross-sectional and longitudinal research has shown an association between short sleep duration and BMI. But one or a combination of methodological obstacles have so far prevented a thorough understanding of Black-White disparities in the association between short sleep duration and BMI trajectories. To reiterate, these limitations include a lack of prospective design; use of sleep data from only a few time points; and a failure to determine racial disparities in the association between exposures to short sleep durations and BMI changes. To my knowledge, no study has yet examined the association between short sleep durations and BMI changes over time, focusing on how the association varies by race, especially during the period between adolescence and adulthood. One of the objectives of my dissertation therefore was to advance knowledge of the association between short sleep durations and BMI changes in three ways by: (i) measuring exposures to short sleep duration using five successive waves of sleep data; (ii) analyzing the impact of exposures to short sleep on BMI changes; and (iii) examining differences in the association between Black and White adolescents.

Research Hypotheses

In my dissertation, I examined the following hypotheses which emanated from the explanations in the literature:

H_1: The effects of ACEs on BMI trajectories will be greater for Blacks than Whites during adolescence and early adulthood.

H_2: The effects of exposures to short sleep durations on BMI trajectories will be greater for Blacks than Whites during adolescence and early adulthood.

CHAPTER III

MATERIALS AND METHODS

Data source

Public-use datasets of the Add Health were used. The datasets are appropriate to address the study's research objectives as they provide repeated measures of key variables across multiple waves of data collection. Use of longitudinal data such as Add Health has an advantage in the current study because it enabled me to address the relationship between the exposures and trajectories of repeated BMIs. For this study, I used data from all five waves, including wave 1 (age 11-21 years in 1994-95), wave 2 (ages 13-22 years in 1996), wave 3 (ages 18-28 years in 2001-02), wave 4 (ages 24-34 years in 2008-09), and wave 5 (ages 32-43 years in 2016-18). Approximately one-third of the longitudinal sample of participants in the Add Health study is included in the public-use datasets, which are comprised of a robust representative sample of 6,504 adolescents at wave 1. Documentation of the Add Health study designs and implementation procedures of waves 1-5 is available on the Add Health website (www.cpc.unc.edu/addhealth).

Study population

Participants in the current study consisted of 5,438 Black and White adolescents who match the study's inclusion criteria. Participants must have at least one BMI measurement across the five waves to be included. Hispanics were excluded due to relatively small sample size.

Measures of variables

Outcome

The outcome measure is BMI, which was calculated in each wave of Add Health as weight in kilograms (kg) divided by height in meters, squared (m^2). Height and weight were self-reported by the participants in each of the five waves. Height and weight were measured by interviewers using standard instruments (e.g., weight scales) in waves 2, 3, and 4 in addition to being self-reported in those waves. Through visual examination of the data, many implausible BMI values were discovered to be present in the data, especially when weights and heights were self-reported. Failure to rid the data of implausible values can lead to anomalous patterns or oscillations when tracking BMI trajectories. To identify respondents whose height and weight measurements are very unlikely to accurately reflect biological reality, and to enhance the data quality, the datasets were evaluated. In particular, the BMI data for respondents under the age of 20 years were examined for any such weights and heights that are very improbable using functions for the 2000 Centers for Disease Prevention and Control growth curves [81]. Any heights beyond 7 feet or under 12 inches, and weights above the limit of the Add Health study's scale (i.e., weights > 330 pounds) were recoded as missing. Additionally, heights were flagged in the case of reductions of at least 2 cm between adjacent observations.

Potential measurement biases in BMI assessment were addressed in this study. As an initial step to understand the linear association and differences between self-report and direct measure, I compared self-reported to directly measured heights and weights at waves 2, 3, and 4 using correlations and paired t-tests (i.e., both self-report and direct measures are available only at waves 2, 3, and 4). Outputs for both correlations and paired t-tests are included in appendix A. The correlations between the self-reported and directly measured heights and weights were high ($r > 0.93$). Yet, the paired t-test shows there are significant differences in means between self-reported and directly measured heights and weights (p-value > 0.05). This procedure suggests there could be biases in the self-reported BMI measures. Even if there are strong correlations and no significant paired t-tests, these will not resolve any potential bias in the self-reported BMI.

To deal with potential measurement biases in the self-reported BMIs, correction equations were estimated from the interviewer-measured BMIs in waves 2, 3, and 4. Three correction equations – one from each of wave 2, 3, and 4 – were specified to include direct measure of BMI as dependent variable, self-reported BMI as independent variable, and race and sex as covariates. Each correction equation is denoted as follows:

$$BMI_m = \beta_0 + \ \beta_1(BMI_r) + \beta_2(Female) + \beta_3(Black) + \beta_4(Female \times Black)$$

Where BMI_m was the direct measure of BMI; BMI_r was the self-reported BMI; β_0 was the intercept; β_1, β_2, β_3, and β_4 were the regression coefficients of the independent variable and covariates; 'Female' and 'Black' were dummy variables for sex and race respectively; and '$Female \times Black$' was the interaction term between sex and race. The interaction term in the equation accounted for the race-and-sex specific differences in the amount of bias in reported BMI. The regression estimates (i.e., the intercept and slopes) for the three correction equations are presented in appendix B.

To illustrate how the regression estimates were used, the estimates obtained for β_0, β_1, β_2, β_3, and β_4 in the first correction equation were 0.697, 0.969, 0.227, -0.230, and 0.191 accordingly. An equation predicting estimates of measured BMI let's say in wave 1 with only self-reported BMI would then be written as follows:

$$BMI_{m1} = 0.697 + \ 0.969(BMI_{r1}) + 0.227(Female) - 0.230(Black) + 0.191(Female \times Black)$$

Where BMI_{m1} is an estimate of measured BMI in wave 1, BMI_{r1} is the self-reported BMI in wave 1, 'Female' and 'Black' are dummy variables for sex and race accordingly, and '$Female \times Black$' is the interaction term between sex and race. Suppose a White female respondent had a self-reported BMI of 35 kg/m^2 at wave 1, then her estimate of measured BMI using the first correction equation would be: $0.697 + 0.969(35) + 0.227(1) - 0.230(0) + 0.191(1 \times 0)$ = 34.84 kg/m^2. The regression estimates obtained from the second and third correction equations, as shown in appendix B, would be used in the same manner to derive estimates of measured BMI at wave 1 for the same respondent with self-reported BMI. Likewise, from the regression estimates from the three correction equations, three estimations of directly measured BMI at wave 5 will be obtained.

Exploratory analysis was carried out to compare the observed and estimated BMIs derived from the correction equations (see results also in appendix B). To summarize the results, there were very high correlations among the estimates from the correction equations. However, the estimates of measured BMIs were generally higher than the self-reported BMIs, suggesting underreporting of BMIs at waves 1 and 5. Repeated measures analysis of variance for the estimates from the correction equations indicated that the equations gave very different BMI values, thus taking the mean of the estimates from the correction equations was reasonable. Means over the three estimates of measured BMI for waves 1 and 5 were therefore computed. Thus, for the analysis in this study, directly measured BMI in waves 2, 3, and 4, as well as mean estimates of directly measured BMI in waves 1 and 5 were used.

Exposures

The main explanatory variables are ACEs and exposures to short sleep durations. As ACEs can only be experienced within a time window (i.e., before the age of 18 years), ACEs were assessed in this study as a time-invariant variable. Although specific questions pertaining to whether respondents had been exposed to ACEs were retrospectively asked at waves I, III, and IV of Add Health, all questions were meant to refer to the first 17 years of respondents' lives.

To measure ACEs in this study, three distinct steps were followed. As a first step, ten categories of ACEs were evaluated from the various question items in the same manner as Testa and Jackson [82], which include emotional abuse, physical abuse, sexual abuse, emotional neglect, physical neglect, community violence, substance abuse in the household, parental separation/divorce, suicide exposure, and incarcerated household member. I provide a complete list of the specific questions asked and explanations on how each ACE category was obtained in appendix C. The Centers for Disease Prevention and Control's Kaiser ACE research [83] and the most recent Behavioral Risk Factor Surveillance System ACE Module [84] served as resource materials to guide the creation of the ACE categories in this study. By combining the scores obtained for the 10 ACEs categories, the total number of ACEs exposure was calculated in the second step, with values ranging from 0 to 9. The respondents were then divided into four groups, depending on how much they were exposed to ACEs: 0 ACE, 1 ACE, 2 ACEs, and 3 or more ACEs.

Exposures to short sleep duration was assessed as a categorical time-variant variable. Sleep duration in hours was self-reported at waves 1, 2 and 5. In waves 3 and 4, respondents self-reported their weekday and weekend bedtimes and wakeup times in hours and minutes. Like Krueger and colleagues [19], I multiplied weekday sleep time by 5/7 and weekend sleep time by 2/7, then added the two results to create a weighted sleep duration variable during waves 3 and 4. In the waves 3 and 4 data files, a few respondents provided inconsistent sleep hours by reporting 12 noon as 12 midnight or vice versa. After correcting the inconsistencies in sleep reporting, short sleep duration was measured at each wave to reflect the National Sleep Foundation (NSF) and seven-hour age-specific standards for normal sleep. The NSF advises school-age children (6-13 years), teens (14-17 years), young adults (18-25 years), and adults (26-64 years) to get at least

9 hours, 8 hours, 7 hours, and 7 hours of night sleep accordingly. The seven-hour standard stipulates that everyone must get at least seven hours of sleep each night. As a result, each standard had a code for short sleep duration that was either '0' for respondents who satisfy the minimum requirement or '1' for respondents whose sleep duration is below the criterion. Finally, for the NSF and seven-hour standards, short sleep duration was assessed as time-varying in the long form or stacked data.

Confounders

Several potentially confounding variables were included in this study, informed by the body of existing research, to assess the extent to which they may influence the relationship between the exposures and racial differences in BMI growth. All the confounding variables were assessed at wave 1. These confounding factors include characteristics during infancy stage (i.e., birthweight and nativity status), childhood characteristics (i.e., duration of breastfeeding and health insurance coverage), parental obesity status, parental socioeconomic indicators (i.e., marital status, annual household income, educational attainment, and welfare receipt/public assistance), respondents' place of residence and religious service attendance.

Birthweight was self-reported by the adolescents' parents in terms of pounds and ounces. These were converted to grams and used to determine whether adolescents were born with low birthweight. Low birthweight is coded as '1 = yes' if birthweight is 2500 grams or less and coded as '0 = No' if birthweight is more than 2500 grams. Nativity status is coded as '1 = U.S. born' for respondents who were born in the United States and '2 = born outside of the U.S.' if otherwise.

Exclusive breastfeeding was coded as '1 = Yes' for respondents who had a minimum of 6-month duration of breastfeeding and '0 = No' if otherwise. Parents were asked about health insurance plans when the adolescents were young, including Medicare, Medicaid, group/ individual insurance coverage, prepaid insurance, or others. For the purposes of this dissertation, the range of health plans is 0 to 5, which indicates the number of health insurance plans. The number of health insurance plans was then used to categorize respondents into two groups (0 = had no insurance and 1 = had at least one insurance plan). Parental obesity status was coded as '1 = no' if both biological parents were reported as not obese and '2 = yes' if either of the two biological parents was obese.

There were five nominal categories for parents' marital status (1 = single/ never married, 2 = married, 3 = widowed, 4 = divorced, and 5 = separated). Household's total income was continuously measured per thousand dollars. Regarding parental education, participants either had one or two parents. For participants with single parents, parental education was determined by the highest level of education attained by the single parent. Among participants who had two parents, parental education was determined as the highest level of education between the two parents. In both situations, parental education was classified into 6 levels (1 = some high school or less; 2 = vocational training; 3 = high school graduate; 4 = some college or technical school; 5 = college graduate; and 6 = postgraduate).

Welfare receipt was measured from a set of questions that asked whether any household member received supplemental security income, aid to families with dependent children, food stamps, or a housing subsidy/public housing. The number of times they received assistance was counted and welfare receipt is divided into two categories as '0 = No' where household members did not receive any public assistance, and '1 = Yes' where household members obtained some assistance. Furthermore, respondents' religious service attendance was assessed as an ordinal measure with categories from ‘0 = never attends’ to ‘3 = once a week or more’. Location or place of residence was categorized into three groups (1 = rural, 2 = suburban, and 3 = urban).

Other Variables

Each respondent's date of birth and interview date were recorded for every wave of Add Health. Age in years was continuously measured for each wave as the difference between the interview date and the date of birth. Two categories were used to classify both race (1 = non-Hispanic White and 2 = non-Hispanic Black) and biological sex (1 = male and 2 = female).

Statistical analyses

Statistical analyses were carried out using R 4.1.1 [85]. In the analysis, addressing potential selection bias due to missing data was one of the important tasks. All the respondents who were included in the analytic sample had at least one BMI observation, even though the BMIs have missing data ranging from 9.0% in wave 1 to 34.8% in wave 5. Waves 1 through 5 include missing data ranging from 9.1% to 34.8% for sleep duration. Although the overall ACEs measure and some covariates measured at wave 1 did not have any missing values (e.g., sex, race, and health insurance plan, parental obesity status, and receipt of welfare support), place of residence had slightly missing data (1%) and there were other variables with large missing values such as low birthweight (19.1%), nativity status (21.1%), exclusive breastfeeding (13.9%), parental marital status (12.4%), parental education (12.4%), household income (22. 9%), and religious service attendance (13.8%). To determine that the data were missing at random, I conducted t-tests and chi-square tests between each variable with missing observations and other variables in the data. Significant p-values indicated that the missingness was related to the observed values of the other variables.

Multiple imputation technique was therefore implemented to address the missing data issue, thereby maintaining the qualities and variability of the data [86]. This technique produces a set of imputed datasets which consist of different missing value estimates, then analyzes the imputed datasets, and finally pools the point estimates obtained from various analyses together. Multiple imputation's basic assumption is that data is missing at random (MAR), meaning that the missing values are statistically correlated with the observed values on other variables in the data. Compared to the assumption for complete case analysis (i.e., missing completely at random or MCAR), this one is more tenable. Complete case analysis, which is overly constrictive, presupposes that the data are MCAR or that missingness does not depend on the observed values of variables in the data [87].

The multivariate imputation by chained equations (mice) package [88] was used to create 25 imputed datasets. I note that in this dissertation, multiple imputation was only used to address missingness for any exposure variable (i.e., sleep measures), covariates, or confounding variables with incomplete observations. To determine the most likely distribution of missing values, the imputation model took account of all the study variables as well as numerous auxiliary variables selected across the five waves of the datasets (see appendix D). To reiterate, the BMIs and ages were not imputed. The main statistical modeling approach employed in this research (i.e., growth curve modeling) would still generate reliable results when repeated BMI measures are partially missing [89]. Likewise, age was used as a time variable in the analysis for the beginning and end of the longitudinal data collection.

Descriptive summary statistics were calculated at baseline (i.e., wave 1) to describe the distribution of the respondents' characteristics. Frequency distributions of the categorical variables for each race-sex group were obtained, and measures of central tendency and dispersion for the quantitative variables were computed. T-tests were conducted to compare differences of means in the distributions of quantitative variables between the Black and White respondents, and chi-square tests (χ^2) were estimated for statistical dependence between the respondents' race and the categorical variables.

The observed BMI values (micro units) were nested within each participant (macro units). As a result, it is impossible to regard the BMI measurements as independent, necessitating the use of multilevel modeling for the analysis. Models like the repeated measures analysis of variance (RM ANOVA) are alternative techniques that have traditionally been used to assess differences between individuals in the outcomes measured in situations where multiple measurements are taken over time. However, there are some significant problems with ANOVA models when using longitudinal data. When working with longitudinal data, for instance, these rigorous assumptions—such as independence of observation and sphericity of data—are frequently violated. Additionally, employing RM ANOVA requires having complete data on respondents, which indicates that respondents with at least one missing value in the repeated measurements are disqualified [20,90]. The sample size would ultimately be reduced as a result, and crucial data would be lost. Therefore, rather than using RM ANOVA or other conventional longitudinal models, this study utilized multilevel modeling to estimate growth curve models to thoughtfully meet the study's objectives.

A growth curve model is a statistical model for repeated measures data which makes it possible to estimate between-individual differences and within-individual patterns of BMI change over time. The growth curve model estimates fixed effects, such as mean BMI intercept and mean BMI slope, that describe the pooling of the study participants' BMI trajectories, and random effects, such as variances of BMI intercepts and BMI slope, that show whether the parameters explaining the BMI trajectories are similar or different among the participants. The growth curve model as part of the larger multilevel modeling framework is estimated by nesting multiple repeated BMI measurements within each participant. Again, this analytic model produces valid estimates when repeated BMI measures are partially missing under the assumption that the data are missing at random or missing completely at random [90]. It remains unclear from previous studies how ACEs are associated with within-individual changes in BMI among Black and White respondents. Likewise, Black-White disparities in the association between exposures to short sheep over time and trajectories of BMI have not been sufficiently explored, making the growth curve model appropriate for addressing the limitations of previous studies in my dissertation.

For the purposes of my dissertation, multilevel growth curve models were estimated using ‘lme4’ package [91]. Beginning with a baseline model, I estimated a growth curve model of BMI trajectories which included age, age-squared, race, and ACEs (model 1). Next, an adjusted model of BMI trajectories was estimated by nesting the baseline model with interaction terms of race, ACEs, and age, as well as interaction terms of race, ACEs, and age-squared (model 2). Finally, the model 2 was stacked with all the confounding variables, producing an adjusted model that demonstrates the effects of race, ACEs, and age on BMI trajectories when all the factors are held constant (model 3). In all model specifications, time-varying covariates were grand mean centered to improve the interpretability of the model coefficients. The growth curve models were estimated with restricted maximum likelihood (REML). Model specifications for the relationship between exposures to short sleep durations and BMI followed similar modeling strategies used to examine the relationship between ACEs and BMI, i.e., models were estimated to include a baseline model (model 4), an adjusted model with interaction terms (model 5), and an adjusted model with interaction terms and confounding variables (model 6). Both p-values and confidence intervals of the estimates from the growth curve models were reported to enhance the interpretation of these estimates. Estimates considered statistically significant are those for which the confidence intervals did not include the null.

For each of the multilevel growth curve models, parameter estimates were derived from the 25 imputed datasets. Model performance indices – Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and log-likelihood – were compared across the models. Additionally, likelihood ratio tests (LRT) were used to compare model performance, showing whether the adjusted models were worth the complexity added. Rubin's rule was applied to pool the 25 sets of results to get a single set of results [92]. The Add Health survey design weights were applied to minimize potential effects of selection probabilities. Public health studies have shown that males and females have different health outcomes over the life course [93]. Hence, each of the growth curve models was estimated for female respondents separately from male respondents.

The complexity of the interactions included in the growth curve models did not allow straightforward interpretations of the model parameters. To further ease the interpretation of the parameter estimates for the complex interaction terms, plots were used to display the estimated marginal means (EMM) of BMI from the full models, and these plots were separated into panels to assess the potential for race to moderate the relationships between the exposure variables and BMI trajectories over age. As degrees of freedom and sample size complications preclude performing standard post-hoc pairwise t-tests (p-values), 95% confidence intervals for each EMM aid in determining statistical significance (degree of overlap).

CHAPTER IV

RESULTS AND INTERPRETATION

Respondents' characteristics

Table 1 provides the descriptive summary statistics of the respondents' characteristics at the baseline. Among female respondents, 69.9% of Blacks reported one or more ACEs as compared to 57.8% of Whites, $\chi^2(3) = 40.94, p < .001$. Similarly, among male respondents, 68.9% of Blacks reported one or more ACEs as compared to 56.5% of Whites, $\chi^2(3) = 38.73, p < .001$.

For each sex group, more than three-quarters of the respondents were U.S. born; these distributions did not vary statistically by race. Higher percentages among Black females than White females were born with low birthweight (8.4% and 4.8% accordingly), $\chi^2(1) = 20.99, p < .001$. Additionally, there were greater percentages among Black males than White males who had low birthweight (6.0% and 3.5% accordingly), $\chi^2(1) = 15.24, p < .001$. Proportions of respondents who had at least one obese parent were lower among Black females (16.4%) than White females (22.5%), $\chi^2(1) = 14.06, p < .001$, and equally lower among Black males (17.2%) than White males (21.0%), $\chi^2(1) = 5.25, p < .05$. Parents' self-reported breastfeeding duration indicates 20.6% of White female respondents received exclusive breastfeeding, compared to 8.7% of Black female respondents, $\chi^2(1) = 50.24, p < .001$. Similar results were revealed among White males (20.2%) compared to Black males (9.1%), $\chi^2(1) = 34.83, p < .001$, suggesting that Blacks had a poor indicator of childhood health.

During childhood, 73.6% of Black females were enrolled in at least one health insurance plan, as compared to 81.8% of White females, $\chi^2(1) = 24.23, p < .001$. Similar results were found among Black males (74.0%) compared to White males (82.5%), $\chi^2(1) = 24.54, p < .001$. Black respondents grew up in households with lower mean income per thousand than White respondents among both female, t = 7.13, p < .001, and male respondents, t = 4.77, p < .001. Higher percentages of Black respondents had household members who received public assistance or welfare support than White respondents among females, $\chi^2(1) = 128.18, p < .001$, and males, $\chi^2(1) = 83.21, p < .001$. By parental level of education, the highest percentages of respondents had parents with some college or technical school, followed by high school graduate and college graduate, yet the percentages of respondents who had parents with these qualifications were lower for Black females compared to White females, $\chi^2(5) = 56.20, p < .001$, as well as Black males compared to White males, $\chi^2(5) = 19.57, p < .01$.

In specific race-sex categories, considerable portions of the respondents were those whose parents were currently married. Nevertheless, greater percentage of Black females had parents who became divorced than White females (12.4% and 11.9% accordingly), and greater percentage of Black males had parents who became divorced than White males (15.2% and 14.3% accordingly). Similarly, parental separation was more likely to occur among Black females (9.2%) compared to White females (3.3%), $\chi^2(4) = 344.70, p < .001$, and among Black males (9.3%) relative to White males (2.3%), $\chi^2(4) = 312.45, p < .001$. The respondents varied according to their places of residence. Black respondents were more likely than White respondents to reside in urban locations among female (53.5% and 25.9% accordingly), $\chi^2(2) = 200.22, p < .001$, and male respondents (52.8% and 23.4% accordingly), $\chi^2(2) = 211.29, p < .001$. Percentages of Black respondents who attended religious service regularly were higher than their White counterparts. For instance, 52.4% of Black females attended religious service once a week or more as compared to 37.6% of White females, $\chi^2(3) = 82.13, p < .001$. Among Black males, 47.2% attended religious service once a week or more compared to 32.8% among White males, $\chi^2(3) = 66.13, p < .001$.

Table 2 provides the descriptive summary characteristics for the repeated exposure and outcome variables across Add Health waves 1 to 5. Despite observing that both Black females (M = 23.68, SD = 4.49) and White females (M = 22.26, SD = 3.72) had mean BMIs for normal weights at wave 1, Black females exhibited higher mean BMI than their White counterparts, t = 8.13, p < .001. Black females continued to exhibit higher mean BMI in subsequent waves compared to White females. As of wave 5, Black females had higher mean BMI of 33.48 kg/m^2, as compared to mean BMI of 29.59 kg/m^2 for White females, t = 10.0, p < .001. On the other hand, the distributions of BMIs between Black and White males were similar for the Add Health waves 1 to 4. Wave 5 was the only time when mean BMI was higher among Black males (M = 30.61, SD = 7.03) compared to White males (M = 29.84, SD = 5.89), t = 2.0, p < .05.

From waves 1 to 5, percentage distributions of female respondents who reported short sleep durations were generally higher for Blacks than Whites. For instance, at wave 1 and according to the NSF standard, 25.5% of Black females were short sleepers, compared to 22.9% of White females, $\chi^2(1) = 4.89, p < .05$. Exposures to short sleep durations were also statistically dependent on race at wave 3, 4, and 5. The only exception was at wave 2 where the percentages of Black females exposed to short sleep durations (21.9%) were similar to the percentages of White females (21.4%). Similar results were found among male respondents, showing that percentages of those who reported short sleep durations were higher for Blacks than Whites.

Assessing the impact of ACEs on BMI trajectories between Black and White populations.

Utilizing the multiple imputed Add Health waves 1 to 5, ACEs were significantly associated with BMI as shown in the baseline model for female respondents (see Model 1 in Table 3). Female respondents who reported 2 ACEs exhibited 0.66 points higher BMI (95% CI: 0.03, 1.28) and those who reported 3 or more ACEs had 0.98 points higher BMI (95% CI: 0.33, 1.64), on average, compared to those who did not report any ACE. The results from the baseline model show dose-response effects of ACEs on BMI. ACEs were found to also have a differential effect over time and additionally was moderated by race. These racial disparities were robust to covariate adjustment [Model 2 vs 3 LRT: $\chi^2(21)$ = 132.28, $p < .001$].

To understand this complex relationship, Figure 1 displays the pooled estimated marginal means of BMI trajectories for Model 3 among female respondents. Each panel displays BMI trajectories over age according to the number of ACEs reported. Within each panel, different lines trace the trajectories for each racial group. The broken line depicts BMI trajectories among Black females, who tended to exhibit transition from normal weights at younger ages to obesity at later ages. The solid line depicts BMI trajectories among White females, who tended to exhibit transition from normal weights at earlier ages to overweight at later ages. The Black-White gap in BMI was smaller at earlier ages, and then expanded at later ages in each of the panels for levels of exposure to ACEs. Focusing on the upper-left panel, female respondents who never reported any ACEs had nearly the same, healthy BMI on average at age 15 (Black: *EMM* = 23.07, [95% CI: 21.71, 24.42]; White: *EMM* = 22.29, 95% CI [21.02, 23.56]). By age 25, both races had moved into the overweight classification and a racial gap had started to form, such that Black respondents had higher mean BMIs by over 1.5 points (Black: *EMM* = 28.62, [95% CI: 27.27, 29.97]; White: *EMM* = 27.10, [95% CI: 25.84, 28.37]). The pattern of increasing BMI over age continued as racial disparity widened to 2.5 points by age 35, (Black: *EMM* = 32.00, 95% CI [30.63, 33.36]; White: *EMM* = 29.47, 95% CI [28.20, 30.74]).

A similar pattern but higher racial disparities over age were revealed in the rest of the panels, suggesting ACEs were associated with increase in Black-White gaps in BMI. For instance, by age 35, the racial disparity in BMI widened to 4.2 points for those with 1 ACE (Black: *EMM* = 33.55, 95% CI [32.25, 34.85]; White: *EMM* = 29.28, [95% CI: 27.99, 30.57]), 3.3 points for those with 2 ACEs (Black: *EMM* = 33.47, [95% CI: 32.03, 34.92]; White: *EMM* = 30.13, [95% CI: 28.81, 31.45]), and 2.6 points for those with 3 or more ACEs (Black: *EMM* = 33.24, [95% CI: 31.74, 34.73]; White: *EMM* = 30.62, [95% CI: 29.31, 31.94]), compared to 2.5 points for female respondents who never reported any ACEs (Black: *EMM* = 32.00, [95% CI : 30.63, 33.36]; White: *EMM* = 29.47, [95% CI: 28.20, 30.74]). This demonstrates that racial disparities in BMI were greater for female respondents with exposure to 1 ACE than those with 2 ACEs and those with 3 or more ACEs, so the results do not seem to represent a dose-response effect of ACEs on the Black-White disparities in BMI trajectories.

In the baseline model for male respondents, ACEs were not significantly associated with BMI trajectories (see Model 1 in Table 4). In addition, the relationship between ACEs and BMI trajectories over age was not robust to the adjustment for interactions and confounding variables as shown in Models 2 and 3 for male respondents.

Figure 2 illustrates the pooled estimated marginal means of BMI trajectories for Model 3 among male respondents. Each panel represents BMI trajectories over age by levels of exposure to ACEs. Similarly, the broken line depicts BMI trajectories among Black males, while the solid line shows BMI trajectories among White males. Examining the upper-left panel, male respondents who never reported any ACEs exhibited healthy mean BMI at age 15 and a minimal racial gap of 0.63 points was observed at this early age (Black: *EMM* = 22.39, [95% CI: 21.25, 23.53]); White: *EMM* = 21.76, [95% CI: 20.71, 22.80]). The racial gap in BMI only slightly increased to 0.84 points at age 25 (Black: *EMM* = 28.31, [95% CI : 27.16, 29.46]); White: *EMM* = 27.47, [95% CI: 26.43, 28.51]), before increasing to 1.74 points at age 35 (Black: *EMM* = 30.98, [95% CI : 29.81, 32.14]); White: *EMM* = 29.23, [95% CI: 28.19, 30.28]). The reverse was the case when considering the lower-right panel for male respondents who reported 3 or more ACEs. The racial gap in BMI trajectories over age steadily decreased. To illustrate, the racial gap in BMI decreased from 0.71 points at age 15 (Black: *EMM* = 22.46, [95% CI : 21.20, 23.73]); White: *EMM* = 21.75, [95% CI: 20.61, 22.89]) to 0.63 points at age 25 (Black: *EMM* = 27.46, [95% CI : 26.22, 28.70]); White: *EMM* = 26.83, [95% CI: 25.71, 27.95]), and further decreased to 0.48 points at age 35 (Black: *EMM* = 29.80, [95% CI : 28.53, 31.06]); White: *EMM* = 29.31, [95% CI: 28.18, 30.45]).

Focusing on the upper-right panel, Black males who reported 1 ACE initially had about the same mean BMI at age 15 than White counterparts with the same level of ACE (Black: *EMM* = 21.72, [95% CI : 20.59, 22.86]); White: *EMM* = 21.89, [95% CI: 20.85, 22.94]), but the mean BMI for Black males rose above the mean BMI for White males by age 25 (Black: *EMM* = 28.18, [95% CI : 27.06, 29.30]); White: *EMM* = 27.32, [95% CI: 26.28, 28.37]), followed by Black males having about the same mean BMI as White males by age 35 (Black: *EMM* = 29.86, [95% CI : 28.71, 31.01]); White: *EMM* = 29.39, [95% CI: 28.34, 30.44]). As indicated on the lower-left panel, Black males who reported 2 ACEs had about the same mean BMI at age 15 (Black: *EMM* = 21.86, [95% CI : 20.64, 23.08]); White: *EMM* = 21.92, [95% CI: 20.83, 23.01]), but the BMI levels for White males soon rose above the levels for Black males by age 25 (Black: *EMM* = 26.81, [95% CI : 25.60, 28.03]); White: *EMM* = 27.77, [95% CI: 26.69, 28.86]) and remained consistently higher throughout age 35 (Black: *EMM* = 29.00, [95% CI :27.75, 30.26]); White: *EMM* = 30.04, [95% CI: 28.95, 31.13]). Overall, mixed and inconsistent patterns of BMI trajectories were revealed in each panel, which further support no clear relationship between ACEs and BMI trajectories among male respondents according to race.

Sensitivity Analysis

Two sets of sensitivity analyses were carried out among female and male respondents. The first set of sensitivity analyses used the unadjusted BMI data (i.e., self-reported BMI in waves 1 and 5, combined with interviewer-measured BMI in waves 2, 3, and 4). The results for these analyses among female and male respondents were included in appendices E and F. The parameter estimates for all models estimated in the sensitivity analyses were consistent with the original analyses that used the adjusted BMI data.

In the second set of sensitivity analyses among female and male respondents, exposure and confounding variables were not imputed (appendices G and H). For both female and male respondents, the estimates obtained from the baseline models and adjusted models with interaction terms were similar. But when considering the adjusted model with interactions and confounders, there were discrepancies between the estimates obtained from the sensitivity analyses and the original models for this study. Perhaps the results from the original models could have been biased without consideration for the missing data as reflected in the second sensitivity analyses.

Assessing the impact of exposures to short sleep duration on BMI trajectories of Black and White populations.

Using the National Sleep Foundation standard to assess short sleep durations and the multiple imputed Add Health waves 1 to 5, female respondents exposed to short sleep durations across Add Health waves 1 to 5 were found to exhibit 0.21 points higher BMI (95% CI: 0.04, 0.39), on average, than those who did not report short sleep durations (see Model 4 in Table 5). The relationship between exposures to short sleep durations and BMI, however, was not statistically moderated by race as evidenced in the adjusted models (Models 5 and 6 in Table 5).

The absence of interaction between race and short sleep duration in Model 6 was further illustrated in Figure 3, showing the pooled estimated marginal means of BMI trajectories among female respondents. The left panel represents BMI trajectory patterns over age among White females, while the right panel displays BMI trajectory patterns over age among Black females. Within each panel, the broken line depicts BMI trajectories for respondents who were exposed to short sleep durations across waves 1 to 5, whereas the solid line depicts BMI trajectories for respondents not exposed to short sleep durations from waves 1 to 5. Focusing on the left panel, White females who were exposed to short sleep durations had almost the same healthy BMI, on average, by age 15 (*EMM* = 22.60, 95% CI: 21.40, 23.81) as those not exposed to short sleep durations (*EMM* = 22.30, 95% CI: 21.10, 23.50). With the mean BMI increasing to overweight at later ages, White females who were exposed to short sleep durations maintained nearly the same mean BMI as those not exposed to short sleep durations. For instance, by age 35, similar BMI, on average, was found among those who were exposed to short sleep durations (*EMM* = 29.49, 95% CI: 28.28, 30.70) and those not exposed to short sleep durations (*EMM* = 29.87, 95% CI: 29.70, 31.03).

The right panel for Black respondents resembles the BMI trajectory patterns shown among White respondents, except at later ages where Black respondents who reported short sleep durations displayed higher mean BMI than those not exposed to short sleep durations. For instance, by age 40 mean BMI was higher by 1.18 points for Black females exposed to short sleep durations (*EMM* = 34.30, 95% CI: 33.02, 35.59), relative to those not exposed to short sleep durations (*EMM* = 33.12, 95% CI: 31.82, 34.42). Likewise at age 42, mean BMI was higher by about 2 points for Black females exposed to short sleep durations (*EMM* = 34.72, 95% CI: 33.26, 36.18), compared to those not exposed to short sleep durations (*EMM* = 32.82, 95% CI: 31.37, 34.27). Aside from these differences observed for Black females at later ages, both Black and White female respondents who were exposed to short sleep durations similar BMI growth patterns as their counterparts who were not exposed to short sleep durations.

Male respondents who were exposed to short sleep durations in the Add Health waves 1 to 5 exhibited 0.16 points higher BMI (95% CI: 0.02, 0.31), on average, than those who did not report short sleep durations (see Model 4 in Table 6). However, models 5 and 6 that adjust for the interaction terms and confounders did not provide any evidence of racial differences in the relationship between exposures to sleep duration and BMI among male respondents.

To illustrate, Figure 4 displays the pooled estimated marginal means of BMI trajectories for the adjusted model (i.e., Model 6) among male respondents. BMI trajectory patterns for White males are shown in the left panel, while Black males BMI trajectory patterns are shown in the right panel. The broken line in each panel represents the BMI trajectories of respondents who experienced short sleep durations, whereas the solid line represents the BMI trajectories of respondents who did not experience short sleep durations from waves 1 to 5. Concentrating on the right panel, Black males who were exposed to short sleep durations exhibited nearly the same mean BMI over time as those not exposed to short sleep durations, except at later ages with some notable differences. By the age of 15, for example, Black respondents who reported short sleep durations had similar mean BMI (*EMM* = 22.68, 95% CI: 21.63, 23.74) as those not exposed to short sleep durations (*EMM* = 22.70, 95% CI: 21.65, 23.75). Black males continued to maintain similar BMI increase over age, until age 39 upward when there were notable differences in mean BMI between those exposed to short sleep durations and those not exposed to short sleep durations. For instance, differences in mean BMI were found to be 0.48 points at age 39, which steadily increased to 0.61 points at age 43 between those exposed to short sleep durations and those not exposed to short sleep durations. On the left panel are BMI trajectory patterns among White males. The results followed the same patterns shown among Black male respondents. Overall, similar BMI growth patterns were revealed for respondents who reported exposures to short sleep durations and those not exposed to short sleep durations among both Black and White males.

Based on the seven-hour standard for assessing short sleep durations and the multiple imputed Add Health waves 1 to 5, the baseline model (i.e., Model 7 of Table 7) indicates no significant association between exposures to short sleep durations and BMI among female respondents, and interactions between race and exposures to short sleep durations were absent in the adjusted models (i.e., Models 8 and 9).

Figure 5 displays the pooled estimated marginal means of BMI trajectories for Model 9 among female respondents. As depicted on the left panel, White females who were exposed to short sleep durations had similar mean BMIs at earlier ages compared to those not exposed to short sleep durations, and as BMI levels increased over age, they continued to maintain similar mean BMI. For instance, at age 15, White females who reported short sleep durations (*EMM* = 22.44, 95% CI: 21.18, 23.70) and those not exposed to short sleep durations (*EMM* = 22.43, 95% CI: 21.24, 23.63) had similar mean BMIs. By age 35, White females experienced increase in mean BMI but on the same level between those who were exposed to short sleep durations (*EMM* = 29.94, 95% CI: 28.73, 31.15) and those not exposed to short sleep durations (*EMM* =

29.81, 95% CI: 28.61, 31.01). The BMI trajectory patterns for Black females followed the patterns shown for White females, except at later ages. Put together, BMI growth patterns did not vary substantially among both Black and White females between respondents who reported short sleep durations and those not exposed to short sleep durations.

Among male respondents, those who reported short sleep durations experienced higher mean BMI by 0.21 points (95% CI: 0.05, 0.31), relative to those who did not report short sleep durations (Model 7 in Table 8). However, after adjusting for the interaction terms of race and short sleep durations, as well as confounders (Models 8 and 9), there was no evidence of racial disparities in the association between exposures to short durations and BMI.

The above results are further expatiated through the pooled estimated marginal means of BMI trajectories for Model 9 among male respondents (see Figure 6). Apart from some discernible differences at later ages, Black males who had experienced short sleep durations from waves 1 to 5 had mean BMI that was similar to of the BMI for those who did not report short sleep durations. For instance, by the age of 15, Black males who had short sleep durations experienced nearly the same BMI on the average (*EMM* = 22.91, 95% CI: 21.78, 24.04) as those who did not report short sleep durations (*EMM* = 22.65, 95% CI: 21.62, 23.69). Meanwhile, Black males continued to maintain comparable BMIs on the average until the age of 39 when noticeable differences in mean BMI were observed between Black males who reported short sleep durations (*EMM* = 31.17, 95% CI: 30.05, 32.29) and those not exposed to short sleep durations (*EMM* = 30.66, 95% CI: 29.52, 31.81).

On the flip side, some noticeable differences in mean BMI were found beginning at an early age of 11 between White males who reported short sleep durations (*EMM* = 18.78, 95% CI: 17.54, 20.02) and those not exposed to short sleep durations (*EMM* = 19.42, 95% CI: 18.37, 20.47). But as of the age of 19, White males who were exposed to short sleep durations (*EMM* = 24.67, 95% CI: 23.64, 25.71) and those not exposed to short sleep durations (*EMM* = 24.74, 95% CI: 23.72, 25.76) exhibited similar mean BMIs, which resembled the patterns shown among Black males. Subsequently, White males continued to experience similar increase in mean BMI until the age of 34 when noticeable differences in mean BMI were observed between White males who were exposed to short sleep durations (*EMM* = 30.13, 95% CI: 29.10, 31.17) and those not exposed to short sleep durations (*EMM* = 29.72, 95% CI: 28.69, 30.74). In sum, Black and White male respondents who reported short sleep durations and those who were not exposed to short sleep durations did not exhibit significantly different BMI growth patterns.

Sensitivity Analysis

Two sets of sensitivity analyses were carried out for analyses that used sleep measures assessed based on NSF standard and another two sets of sensitivity analyses were conducted for analyses that used sleep measures assessed according to the seven-hour standard. In the first set, unadjusted BMI data were used. Compared to the original models that used adjusted BMI data, estimates were not substantially different in all the models for female and male respondents. These hold true for both models that used sleep measures assessed according to the NSF and seven-hour standards (see appendices I, J, M, and N). In the second set of sensitivity analyses, exposure and confounding variables were not imputed. Estimates were considerably similar in the models, except for the adjusted model with interactions and confounders that showed some discrepancies in the estimates. These hold true for both models that used sleep measures assessed based on the NSF and seven-hour standards (see appendices K, L, O and P).

CHAPTER V

DISCUSSION

Discussion of findings

Many persistent obstacles identified from the previous literature – such as paucity of prospective research designs, the use of limited number of ACE categories, and insufficient consideration for the interplay between race and ACEs – have so far limited evidence about the association between ACEs and BMI. By addressing some of these obstacles in this dissertation, the evidence in this area is strengthened. As a first overarching aim, all the five waves of data from Add Health and quadratic growth curve model were used to assess Black-White disparities in the association between ACEs and BMI trajectories during adolescence and adulthood. Using these approaches, the study found evidence of the moderating effects of race in the association between ACEs and BMI trajectories among female respondents. Among female respondents, the Black-White gaps in BMI became wider between ages 11 and 43 for those who reported 1 or more ACEs compared to those with no exposure to ACE. Among male respondents, ACEs were not significantly associated with BMI trajectories; meanwhile mixed patterns were revealed in the relationship between ACEs and BMI trajectories according to race.

While being exposed to ACEs may pose health risks for all adolescents, it has been stated in previous research that the effects of ACEs may be greater among Blacks [58]. Studies have shown that, in the context of ACEs, Black youths had lower levels of access to protective resources (such as family meals together, parent and child communication, community engagement, or mentorship) that could lessen the detrimental effects associated with ACEs [56]. The current study showed that Black females exposed to 1 ACE had higher BMI during the study period than White females exposed to the same number of ACEs. But this finding did not hold in a dose-response fashion as one might expect. Instead, by the time 3 or more ACEs were reached, the gaps in BMI were virtually indistinguishable from those who did not report any ACE. Although it seems plausible that Black females exposed to ACEs may have experienced higher BMI because of various disadvantages (e.g., coping skills), the evidence to support this claim is mixed in my study.

Stress internalization has been identified by a large body of research as one of the mechanisms that propel the relationship between ACEs and BMI gains. This is particularly true for women, who are more likely than men to respond to traumatic events through depression, anxiety, or emotional eating [34]. Prior studies have found that stressful events contribute to emotional eating among Black women [94]. In connection with the current study, Black females who were exposed to ACEs may have shown higher levels of internalizing behaviors than White females who reported similar level of ACEs, leading to higher BMI among Black females. However, this interpretation of my findings should be tempered due to inconsistent gaps in BMI between Black and White females across the range of ACE categories.

Moreover, the impact of racism as a fundamental cause of health disparities could explain the higher BMI among Black female respondents, that resulted from experiencing early life trauma. Phelan and Link [95] argue racism is connected to the distribution of flexible resources (e.g., power, prestige, social connections, and wealth), all of which give White population structural advantages over Blacks and other minority racial-ethnic groups. For instance, research suggests that when Black adolescents were exposed to ACEs, school-based racial microaggressions further intensified the negative impact of ACEs on resilience building [59]. In addition, studies have raised concerns about racial biases and discrimination among healthcare professionals in mental health diagnosis for children exposed to ACEs [60]. It is plausible that

Black female adolescents with exposure to ACEs received fewer medical interventions, thus increasing the chances of developing long-term health issues, especially unhealthy BMI gains over the life course. As with previous interpretations, the caveat is that BMI gap between Black and White females was most pronounced with exposure to a single ACE, raising questions about the diminished racial gap at 2 and 3+ ACEs.

There is paucity of longitudinal research that has sought to explicate whether there is a dose-response relationship between ACEs and BMI trajectories, as I did in the current study. This study showed evidence that the Black-White gap in BMI for those who have experienced ACEs expanded at later ages, however the findings did not present a dose-response relationship between ACEs and BMI trajectories among females. Studies have demonstrated that although ACEs occur during 0-17 years, their effects can vary depending on the type and the specific timing of occurrence [96]. The pre-school (age 4-5) and pre-adolescent (8-9) years were highlighted by Schalinkli and colleagues [96] as particularly sensitive to the impact of some types of ACEs, such as physical abuse and emotional neglect. In a study among 3,586 Dutch, Riem and Karreman [36] found that effects of ACEs on BMI were stronger for those with exposure to ACEs in the early stage of adolescence. Although the Add Health data do not contain information regarding specific timing that the adversity occurred, perhaps some of the ACE categories assessed in the present study could have been experienced among respondents during less sensitive periods.

This study found null association between ACEs and BMI among male respondents, and there were no consistent trajectory patterns according to race. The statistical modeling employed in this study included the interaction terms of race and ACEs to examine racial disparities in the relationship between ACEs and BMI trajectories over age. As shown in this study’s descriptive statistics for BMI, there were no statistically significant differences observed in mean BMIs between Black and White male respondents across Add Health waves 1 to 4. However, since there are no substantive Black-White differences in the BMIs among males, then the information provided through the interaction terms might not be particularly useful [97]. Therefore, the absence of statistical interactions in the model among males may be explained by the nearly identical distributions of BMI between Black and White male respondents in this study.

While there are some established mechanisms explaining the association between ACEs and BMI, the finding among males could also indicate that the potential mechanisms by which ACEs affect BMI trajectories may be different among males and females. The Intersectionality theory is pertinent in illuminating the findings of this study, i.e., the inconsistent patterns among male respondents versus the higher BMI among Black females who have experienced ACEs, compared to White counterparts. According to the Intersectionality theory, social statuses are frequently connected to influence health outcomes differently than how an individual social status may affect health [98]. The experiences that people have that are specific to their race and gender may combine to further shape the trajectories of health over the life course. Even though they may experience racism, Black males are in a more advantageous position in the social hierarchy than Black females simply because of their gender. It is a possibility that Black males were more likely to use their coping and adaptive skills after being exposed to ACEs, which made ACEs less of a factor in BMI gains among Black males.

This dissertation is one of the few research studies to examine interactions between race and short sleep durations in explaining whether the relationship between short sleep durations and BMI trajectories differs by race, and I believe this is the first study to investigate such interactions through a longitudinal analysis of repeated sleep and BMI data collected during adolescence and adulthood. This study revealed that exposures to short sleep durations during adolescence and adulthood were associated with BMI among female and male respondents using the Add Health waves 1 to 5 and growth curve modeling. The relationship between exposures to short sleep durations and BMI did not, however, show any remarkable differences by race among female and male respondents.

Despite results from the descriptive statistics showing higher percentages of short sleepers and higher mean BMIs among Black females than White females, this study found that exposures to short sleep durations did not account for the Black-White disparities in BMI trajectories among female respondents. My results lend credence to the findings from Reither and colleagues [80] who sought to explain whether differences in exposures to sleep durations contribute to disparities in BMI among adolescents from diversity of ethnic groups in the U.S. The researchers did not find any evidence showing that differences in sleep durations were responsible for racial/ethnic disparities in BMI, even though their analysis of a pooled Add Health sample of 30,133 adolescents showed significant variations in the relationship between sleep duration and BMI by sex and ethnic groups.

According to Ward and colleagues [97], a holistic approach that looks at additional information from the descriptive statistics of the exposure and outcome is paramount when examining statistical interactions between race and exposure variables. The descriptive summary statistics in this study showed there are no substantial racial disparities in BMI among male respondents. This may further explain no significant interaction of race and short sleep duration in the growth curve models for BMI trajectories among male respondents. Overall, there is little to no empirical evidence yet to suggest that inequalities in sleep durations are related to racial differences in BMI.

Study limitations

The research design employed in this dissertation has some limitations. A robust sample of Black and White respondents is available in the public-use version of Add Heath datasets, but the datasets have insufficient numbers of respondents from other racial and ethnic groups, which limited the ability of this study to explain differences in BMI trajectories among other racial groups. Since several of the ACE measures in this study were reported retrospectively, recall bias may have had an impact on respondents' answers. However, studies have demonstrated that relationships between ACEs and negative life outcomes are consistent using both prospective and retrospective ACEs reports [99]. In this study, recalled ACE variables were used to overcome the difficulty of obtaining prospective ACE reports.

Use of self-reported data for sleep duration (in waves 1 to 5) presents another situation where recall bias may have affected respondents' answers. Although there is a moderate correlation between self-reported sleep duration and objectively measured sleep, prior research found that self-reported sleep duration was overstated by 20 to 30 minutes in comparison to objectively measured sleep duration via polysomnography and actigraphy [100]. Future studies using objectively measured data will allow researchers to improve on the current study.

Prior studies have demonstrated that the use of BMI as a measure of obesity is not without certain flaws. For instance, the fact that Asian populations had a larger percentage of body fat than Whites at the same BMI level is one of the concerns raised in prior research. Because of this and other issues, researchers have suggested that BMI results for obesity may need to be supplemented with results from a more precise algorithm like imaging techniques [101]. Unfortunately, there are both benefits and drawbacks to the several alternative algorithms that can be employed to determine body composition [102]. As observed by Gutin [103], it is common for researchers to trade-off accuracy for convenience when studying population health. Continued use of BMI as a primary anthropometric tool for obesity is due in part to its convenience, ease of interpretation, affordability, availability, less technical skill requirements, and safety [102,103]. In addition, BMI is a powerful tool because of its high ability to predict adverse outcomes [13].

Finally, considerable differences at baseline for a set of observed confounders by race indicate that the Black and White populations in the Add Health dataset might be systematically different with regard to observed and unobserved characteristics, which is often the case in observational datasets. Thus, the validity of estimates in this study could have been affected by the differences in population by race.

Sociological implications of the study

Important practical implications are drawn from the results of this study. Over the past few decades, the U.S. population health has improved on some levels, but body mass and other troubling health trends remain [3], with Blacks and other minoritized groups carrying greater burden of these outcomes. As a result, eradicating racial health disparities is emphasized in Healthy People 2030 as a crucial component of enhancing America's general health. Therefore, this work can aid the ongoing initiatives to achieve racial justice in the United States public health sectors.

Despite the caveat regarding the inconsistent Black-White gap in BMI among females at different levels of ACE exposure, this investigation has presented evidence that during adolescence and early adulthood years, Black females' BMI was higher than that of their White peers as a result of ACEs. To decrease the likelihood of Black females developing an unhealthy body mass in adulthood, interventions must focus on critical early life stages. Public initiatives that broaden access to protective resources at the family, school, and neighborhood levels can foster the development of adaptation and resilience in the face of adversity. For instance, having an adult mentor in one's life or community engagement can provide social and emotional support, which can improve the psychological wellness of Black females and other adolescents who have been exposed to ACEs, while increasing their ability to make wise, healthy decisions.

Efforts to address racial biases in the public health care system cannot be understated and will need to be intensified. Perhaps today more than ever, there is a pressing need for ACE victims to receive mental health services. Many Black females and other adolescents who experienced early life trauma will need to receive immediate diagnoses and treatment for any form of mental health conditions to reduce the risk of long-term health issues. Culturally appropriate initiatives, such as increasing the number of doctors of color, may be necessary to stop further under-identification of Blacks and other minority racial groups exposed to ACEs for mental health services. To illustrate, research has indicated that minority racial groups frequently regard doctors of color as being more respectful, accessible, informative, and attentive than doctors who are Whites [104]. Policies addressing health care disadvantages among Blacks, especially females, and other minority racial groups must take into account racialized experiences in health care.

Conclusions

This study found evidence of disproportionate impact of experiencing an ACE on BMI among Black females, compared to White females during adolescence and early adulthood. ACEs were not statistically associated with BMI among male respondents and mixed patterns were revealed in the relationship between ACEs and BMI according to race. There may be differences between females and males in the mechanisms that underlie the association between

ACEs and Black-White disparities in BMI. The results highlight the necessity of addressing the problem of ACEs through public agendas that are centered on assisting Black females in accessing protective resources and building resilience against early traumatic events. Similarly, persistent racial biases in the health care system will be effectively addressed through interventions aimed at eliminating structural disadvantages frequently experienced among Black adolescents. Even though ACEs have been related to many negative health outcomes in adulthood, in my speculation, there is a possibility that effects of ACEs could be washed away when people are grown up. Future studies may consider investigating how long individuals tend to face the consequences of early life adversities. Additionally, the present study found the relationship between exposures to short sleep durations and BMI did not vary by race.

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Table 1. Descriptive summary statistics of respondents' characteristics at baseline (non-imputed observed values only), Mean (SD) or %

Characteristics	Total (N = 5438)	Black female (N = 825)	White female (N = 1991)	t-test/χ^2	p-value	Black male (N = 745)	White Male (N = 1877)	t-test/ χ^2	p-value
ACEs*									
0 ACE	39.4	30.4	42.2	40.94	0.000	31.1	43.5	38.73	0.000
1 ACE	29.2	36.4	26.5			31.1	28.2		
2 ACEs	17.0	17.7	16.7			19.7	16.0		
3 or more ACEs	14.4	15.5	14.5			18.0	12.3		
NA	0	0	0			0	0		
Low birthweight									
No	75.9	65.8	79.2	20.99	0.000	65.5	80.9	15.24	0.000
Yes	5.0	8.4	4.8			6.0	3.5		
NA	19.1	25.8	16.1			28.5	15.6		
Nativity status									
U.S. born	77.1	78.5	75.7	3.12	0.077	78.7	77.3	0.74	0.389
Born outside of the U.S.	1.8	2.8	1.7			1.9	1.4		
NA	21.1	18.7	22.7			19.5	21.3		
Parental obesity									
No	79.5	83.6	77.4	14.06	0.000	82.8	79.0	5.25	0.022
Yes	20.5	16.4	22.7			17.2	21.0		
NA	0	0	0			0	0		
Exclusive breastfeeding									
Yes	17.1	8.7	20.6	50.24	0.000	9.1	20.2	34.83	0.000
No	69.0	73.0	67.1			70.3	68.6		
NA	13.9	18.3	12.3			20.5	11.2		
Household income	49.42 (57.95)	35.65 (33.37)	53.56 (60.30)	7.13	0.000	38.46 (54.15)	53.08 (62.58)	4.77	0.000
NA	22.9	30.3	20.9			29.7	19.0		
Health insurance coverage									
had no health insurance plan	20.3	26.4	18.2	24.23	0.000	26.0	17.5	24.54	0.000
had at least one health insurance plan	79.7	73.6	81.8			74.0	82.5		
NA	0	0	0			0	0		
Public assistance									
No	85.8	73.9	90.4	128.19	0.000	76.2	89.9	83.21	0.000
Yes	14.2	26.1	9.6			23.8	10.1		
NA	0	0	0			0	0		
Parental education									

Some high school or less	6.5	11.5	4.6	56.20	0.000	9.1	5.2	19.57	0.002
Vocational training	0.3	0.5	0.4			0.3	0.3		
High school graduate	22.9	21.6	23.4			21.2	23.5		
Some college or technical school	26.8	23.4	26.2			25.4	29.6		
College graduate	16.3	13.9	16.6			15.4	17.4		
Postgraduate	14.8	12.2	17.3			11.7	14.4		
NA	12.4	16.8	11.6			16.9	9.6		
Parental marital status									
Single/never married	5.4	16.4	1.8	344.70	0.000	13.0	1.3	312.45	0.000
Married	61.7	40.8	69.5			41.5	70.8		
Widowed	2.6	4.6	2.0			4.2	1.9		
Divorced	13.2	12.4	11.9			15.2	14.3		
Separated	4.7	9.2	3.3			9.3	2.3		
NA	12.4	16.6	11.7			16.9	9.5		
Place of residence									
Rural	30.0	19.5	34.6	200.22	0.000	20.7	33.5	211.29	0.000
Suburban	36.1	26.1	38.5			25.9	42.1		
Urban	32.9	53.5	25.9			52.8	23.4		
NA	1.0	1.0	1.1			0.7	1.0		
Religious service attendance									
Never attends	9.9	4.7	10.8	82.13	0.000	6.6	12.7	66.13	0.000
< once a month	17.1	11.2	19.9			11.4	18.9		
< once a week	19.7	21.5	17.6			22.4	20.0		
Once a week or more	39.5	52.4	37.6			47.2	32.8		
NA	13.8	10.3	14.1			12.3	15.7		

*Exposure to ACEs were retrospectively reported at waves I, III, and IV. NA = percentage of missing observations.

Table 2. Descriptive summary statistics of respondents' characteristics for the repeated exposure and outcome variables (non-imputed observed values only), Mean (SD) or %

Characteristics	Total (N = 5438)	Black female (N = 825)	White female (N = 1991)	t-test/χ^2	p-value	Black male (N = 745)	White Male (N = 1877)	t-test/χ^2	p-value
BMI (kg/m²)									
Wave 1	22.58 (3.75)	23.68 (4.49)	22.26 (3.72)	8.13	0.000	22.67 (3.51)	22.42 (3.45)	1.53	0.125
NA	9.0	13.2	7.9			10.6	7.7		
Wave 2	22.64 (4.39)	23.69 (5.17)	22.45 (4.54)	5.29	0.000	22.51 (3.83)	22.47 (3.96)	0.20	0.840
NA	30.1	32.0	27.7			35.2	29.8		
Wave 3	26.42 (6.00)	27.80 (7.29)	26.06 (6.32)	5.42	0.000	26.45 (5.40)	26.19 (5.02)	0.94	0.346
NA	29.6	27.9	26.5			36.9	30.7		
Wave 4	29.11 (7.49)	31.82 (9.12)	28.37 (7.59)	9.36	0.000	29.22 (7.35)	28.65 (6.21)	1.68	0.093
NA	21.0	18.2	16.8			31.7	22.5		
Wave 5	30.37 (7.27)	33.48 (8.52)	29.59 (7.52)	10.00	0.000	30.61 (7.03)	29.84 (5.89)	2.00	0.046
NA	34.8	33.3	25.3			56.1	37.0		
Short sleep (NSF standard) at wave 1									
No	43.0	38.2	43.4	4.89	0.027	38.7	46.4	18.62	0.000
Yes	22.6	25.5	22.9			26.3	19.6		
NA	34.4	36.4	33.7			35.0	34.0		

Short sleep (NSF standard) at wave 2									
No	37.5	33.3	37.4	1.54	0.215	32.9	41.1	3.46	0.063
Yes	19.0	21.9	21.4			16.4	16.1		
NA	43.6	44.7	41.2			50.7	42.8		
Short sleep (NSF standard) at wave 3									
No	54.8	55.6	61.4	19.38	0.000	43.5	51.8	8.98	0.003
Yes	15.4	17.9	11.8			19.6	16.4		
NA	29.8	26.4	26.8			36.9	31.8		
Short sleep (NSF standard) at wave 4									
No	57.6	57.7	66.8	31.91	0.000	39.3	55.1	31.05	0.000
Yes	18.4	20.5	12.6			26.6	20.3		
NA	24.0	21.8	20.6			34.1	24.6		
Short sleep (NSF standard) at wave 5									
No	38.1	31.5	48.4	51.04	0.000	18.5	37.7	32.75	0.000
Yes	27.1	35.0	26.3			25.4	25.2		
NA	34.8	33.5	25.3			56.1	37.1		
Short sleep (seven-hour standard) at wave 1									
No	76.9	66.3	78.9	31.78	0.000	72.2	81.2	21.82	0.000
Yes	14.0	20.4	13.1			17.2	10.9		
NA	9.1	13.3	8.0			10.6	7.8		

Short sleep (seven-hour standard) at wave 2									
No	57.5	51.4	60.1	11.61	0.001	51.3	59.9	7.73	0.005
Yes	13.2	17.1	13.4			13.8	11.1		
NA	29.3	31.5	26.6			34.9	29.0		
Short sleep (seven-hour standard) at wave 3									
No	56.8	57.3	63.6	19.53	0.000	45.9	53.8	8.66	0.003
Yes	16.1	18.5	12.4			20.7	17.2		
NA	27.1	24.1	24.0			33.4	29.0		
Short sleep (seven-hour standard) at wave 4									
No	60.5	61.1	70.5	34.02	0.000	41.3	57.2	33.72	0.000
Yes	19.2	21.8	13.4			27.9	20.8		
NA	20.3	17.1	16.2			30.7	22.1		
Short sleep (seven-hour standard) at wave 5									
No	38.1	31.5	48.4	51.04	0.000	18.5	37.7	32.75	0.000
Yes	27.1	35.0	26.3			25.4	25.2		
NA	34.8	33.5	25.3			56.1	37.1		

NA = percentage of missing observations

Table 3. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Female Respondents using the Multiple Imputed Dataset.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.25 (0.190) ***	[25.87, 26.62]	26.31 (0.215) ***	[25.88, 26.73]	28.47 (0.846) ***	[26.81, 30.13]
Age	0.430 (0.005) ***	[0.420, 0.440]	0.387 (0.010) ***	[0.368, 0.406]	0.386 (0.010) ***	[0.367, 0.405]
Age²	-0.013 (0.001) ***	[-0.014, -0.012]	-0.012 (0.001) ***	[-0.015, -0.010]	-0.012 (0.001) ***	[-0.015, -0.010]
Race (ref. = White)						
Black	2.31 (0.243) ***	[1.84, 2.79]	1.75 (0.45) ***	[0.867, 2.635]	1.42 (0.455) **	[0.533, 2.32]
ACEs (ref. = 0 ACE)						
1 ACE	0.424 (0.270)	[-0.106, 0.953]	0.154 (0.345)	[-0.522, 0.829]	-0.053 (0.337)	[-0.713, 0.607]
2 ACEs	0.657 (0.319) *	[0.033, 1.28]	0.311 (0.40)	[-0.474, 1.095]	0.002 (0.399)	[-0.779, 0.784]
3 or more ACEs	0.983 (0.334) **	[0.329, 1.64]	1.15 (0.419) **	[0.331, 1.975]	0.935 (0.435) *	[0.082, 1.789]
Two-way interactions						
Black × Age			0.085 (0.020) ***	[0.045, 0.124]	0.084 (0.020) ***	[0.044, 0.124]
Black × Age²			0.001 (0.002)	[-0.003, 0.006]	0.001 (0.002)	[-0.003, 0.006]
Black × 1 ACE			1.304 (0.637) *	[0.057, 2.55]	1.48 (0.615) *	[0.277, 2.689]
Black × 2 ACEs			1.13 (0.759)	[-0.354, 2.62]	1.41 (0.734)	[-0.030, 2.85]
Black × 3 or more ACEs			0.317 (0.792)	[-1.23, 1.87]	0.414 (0.766)	[-1.09, 1.92]
1 ACE × Age			-0.008 (0.015)	[-0.038, 0.023]	-0.008 (0.015)	[-0.038, 0.023]
2 ACE × Age			0.023 (0.017)	[-0.011, 0.057]	0.023 (0.017)	[-0.011, 0.057]
3 or more ACE × Age			0.062 (0.018) **	[0.026, 0.098]	0.064 (0.018) ***	[0.028, 0.099]
1 ACE × Age²			-0.000 (0.002)	[-0.004, 0.003]	-0.000 (0.002)	[-0.004, 0.003]
2 ACE × Age²			0.003 (0.002)	[-0.001, 0.008]	0.003 (0.002)	[-0.001, 0.007]
3 or more ACE × Age²			-0.004 (0.002)	[-0.008, 0.001]	-0.004 (0.002)	[-0.008, 0.0004]
Three-way interactions						
Black × 1 ACE × Age			0.074 (0.029) *	[0.017, 0.131]	0.076 (0.029) **	[0.019, 0.133]
Black × 2 ACE × Age			0.053 (0.034)	[-0.014, 0.120]	0.054 (0.034)	[-0.012, 0.121]
Black × 3 or more ACE × Age			-0.036 (0.035)	[-0.104, 0.032]	-0.036 (0.035)	[-0.105, 0.032]
Black × 1 ACE × Age²			-0.005 (0.003)	[-0.012, 0.002]	-0.005 (0.003)	[-0.012, 0.002]
Black × 2 ACE × Age²			-0.010 (0.004) *	[-0.018, -0.002]	-0.010 (0.004) *	[-0.018, -0.002]
Black × 3 or more ACE × Age²			0.001 (0.004)	[-0.008, 0.009]	0.001 (0.004)	[-0.008, 0.009]
Low birthweight (ref. = No)						
Yes					-0.237 (0.454)	[-1.13, 0.656]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.82 (0.726) *	[-3.24, -0.393]

Parental obesity (ref. = No)				
Yes			3.50 (0.264) ***	[2.98, 4.01]
Exclusive breastfeeding (ref. = Yes)				
No			0.377 (0.308)	[-0.228, 0.982]
Household income			-0.005 (0.002) *	[-0.009, -0.0002]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			-0.587 (0.278) *	[-1.13, -0.042]
Public assistance (ref. = No)				
Yes			-0.732 (0.344) *	[-1.41, -0.058]
Parental education (ref. = Some high school or less)				
Vocational training			-1.96 (1.81)	[-5.52, 1.61]
High school graduate			-1.06 (0.511) *	[-2.07, -0.057]
Some college or technical school			-1.68 (0.508) **	[-2.67, -0.678]
College graduate			-1.95 (0.542)	[-3.01, -0.887]
Postgraduate			-2.62 (0.563)	[-3.72, -1.51]
Parental marital status (ref. = Single/never married)				
Married			-0.608 (0.531)	[-1.65, 0.437]
Widowed			-0.323 (0.818)	[-1.93, 1.29]
Divorced			-1.12 (0.579)	[-2.25, 0.019]
Separated			-0.316 (0.654)	[-1.60, 0.968]
Place of residence (ref. = Rural)				
Suburban			-0.833 (0.270) **	[-1.36, -0.304]
Urban			0.034 (0.275)	[-0.505, 0.573]
Religious service attendance (ref. = Never attends)				
< once a month			0.020 (0.417)	[-0.798, 0.838]
< once a week			-0.198 (0.424)	[-1.03, 0.635]
Once a week or more			0.322 (0.379)	[-0.422, 1.065]
Random effects (variances)				
Participants intercepts	30.15	30.04	27.11	
Residual error	12.54	12.35	12.35	
Model fit				
AIC	65,420.09	65,414.83	65,192.28	
BIC	65,485.82	65,604.73	65,535.55	
-2log-likelihood	65,402.08	65,362.84	65,098.28	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Table 4. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Male Respondents using the Multiple Imputed Dataset.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.67 (0.157) ***	26.36, 26.97	26.68 (0.177) ***	[20.63, 27.03]	25.63 (0.716) ***	[24.23, 27.04]
Age	0.429 (0.005) ***	[0.419, 0.438]	0.427 (0.008) ***	[-0.410, 0.444]	0.427 (0.008) ***	[0.410, 0.443]
Age²	-0.014 (0.001)	[-0.015, -0.013]	-0.016 (0.001) ***	[-0.018, -0.015]	-0.016 (0.001) ***	[-0.018, -0.015]
Race (ref. = White)						
Black	0.359 (0.207)	[-0.047, 0.764]	0.752 (0.384)	[0.00001, 1.50]	0.793 (0.390) *	[0.029, 1.56]
ACEs (ref. = 0 ACE)						
1 ACE	0.045 (0.226)	[-0.379, 0.488]	-0.021 (0.281)	[-0.571, 0.529]	-0.148 (0.280)	[-0.697, 0.401]
2 ACEs	0.083 (0.267)	[-0.440, 0.606]	0.474 (0.366)	[-0.185, 1.132]	0.240 (0.341)	[-0.429, 0.909]
3 or more ACEs	-0.122 (0.288)	[-0.686, 0.441]	-0.483 (0.370)	[-1.208, 0.242]	0.661 (0.392)	[-1.429, 0.107]
Two-way interactions						
Black × Age			0.045 (0.019) *	[0.008, 0.082]	0.045 (0.019) *	[0.009, 0.081]
Black × Age²			0.004 (0.002) *	[0.0002, 0.0086]	0.004 (0.002) *	[0.0001, 0.0085]
Black × 1 ACE			0.000 (0.553)	[-1.08, 1.08]	0.030 (0.542)	[-1.029, 1.095]
Black × 2 ACEs			-1.93 (0.635) **	[-3.17, -0.680]	-1.660 (0.625) **	[-2.88, -0.435]
Black × 3 or more ACEs			-0.254 (0.660)	[-1.548, 1.041]	0.116 (0.652)	[-1.39, 1.16]
1 ACE × Age			-0.010 (0.014)	[-0.037, 0.016]	-0.009 (0.014)	[0.035, 0.018]
2 ACE × Age			0.026 (0.016)	[-0.005, 0.057]	0.027 (0.016)	[-0.004, 0.057]
3 or more ACE × Age			-0.015 (0.017)	[-0.049, 0.018]	-0.016 (0.017)	[-0.049, 0.018]
1 ACE × Age²			0.003 (0.002) *	[0.0001, 0.0061]	0.003 (0.002) *	[0.00002, 0.006]
2 ACE × Age²			0.002 (0.002)	[-0.0014, 0.006]	0.002 (0.002)	[-0.001, 0.006]
3 or more ACE × Age²			0.007 (0.002) ***	[0.0032, 0.011]	0.007 (0.002) ***	[0.003, 0.011]
Three-way interactions						
Black × 1 ACE × Age			0.001 (0.028)	[-0.054, 0.056]	0.001 (0.028)	[-0.054, 0.056]
Black × 2 ACE × Age			-0.113 (0.031) ***	[-0.174, -0.052]	-0.112 (0.031) ***	[-0.173, -0.051]
Black × 3 ACE or more × Age			-0.065 (0.032) *	[-0.127, -0.002]	-0.064 (0.032) *	[-0.127, -0.001]
Black × 1 ACE × Age²			-0.011 (0.003) ***	[-0.017, -0.005]	-0.011 (0.003)**	[-0.017, -0.005]
Black × 2 ACE × Age²			0.000 (0.004)	[-0.007, 0.007]	0.000 (0.004)	[-0.007, 0.007]
Black × 3 ACE or more × Age²			-0.004 (0.004)	[-0.011, 0.003]	-0.004 (0.004)	[-0.011, 0.003]
Low birthweight (ref. = No)						
Yes					0.265 (0.437)	[-0.594, 1.124]
Nativity status (ref. = U.S. born)						

Born outside of the U.S.			-0.783 (0.683)	[-2.124, 0.557]
Parental obesity (ref. = No)				
Yes			2.75 (0.228) ***	[2.30, 3.19]
Exclusive breastfeeding (ref. = Yes)				
No			0.097 (0.246)	[-0.385, 0.578]
Household income			-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			0.329 (0.240)	[-0.141, 0.799]
Public assistance (ref. = No)				
Yes			-0.623 (0.297) *	[-1.204, -0.041]
Parental education (ref. = Some high school or less)				
Vocational training			0.088 (1.65)	[-3.15, 3.23]
High school graduate			0.097 (0.399)	[-0.686, 0.880]
Some college or technical school			-0.232 (0.408)	[-1.032, 0.567]
College graduate			-0.453 (0.456)	[-1.35, 0.443]
Postgraduate			-0.611 (0.477)	[-1.55, 0.324]
Parental marital status (ref. = Single/never married)				
Married			0.298 (0.472)	[-0.627, 1.223]
Widowed			0.752 (0.674)	[-0.568, 2.07]
Divorced			0.385 (0.501)	[-0.598, 1.369]
Separated			0.280 (0.615)	[-0.926, 1.484]
Place of residence (ref. = Rural)				
Suburban			-0.437 (0.227)	[-0.881, 0.007]
Urban			-0.191 (0.239)	[0.660, 0.278]
Religious service attendance (ref. = Never attends)				
< once a month			0.347 (0.356)	[-0.351, 1.05]
< once a week			0.568 (0.344)	[-0.107, 1.24]
Once a week or more			0.569 (0.322)	[-0.064, 1.201]
Random effects				
Participants intercepts	19.81	19.72	18.45	
Residual error	7.53	7.49	7.49	
Model fit				
AIC	57,911.97	51,996.47	51,883.19	
BIC	57,976.35	52,182.46	52,219.38	
-2log-likelihood	57,902.82	51,893.98	51,789.18	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Table 5. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Female Respondents using the Multiple Imputed Dataset.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.58 (0.138) ***	[26.31, 26.85]	26.57 (0.143) ***	[26.29, 26.86]	28.60 (0.826) ***	[26.98, 30.22]
Age	0.432 (0.005) ***	[0.422, 0.443]	0.404 (0.008) ***	[0.389, 0.419]	0.404 (0.008) ***	[0.389, 0.420]
Age²	-0.013 (0.001) ***	[-0.015, -0.012]	-0.013 (0.001) ***	[-0.015, -0.012]	-0.013 (0.001) ***	[-0.015, -0.011]
Race (ref. = White)						
Black	2.35 (0.242) ***	[1.881, 2.828]	2.63 (0.270) ***	[2.11, 3.16]	2.36 (0.293) ***	[1.79, 2.94]
Below NSF standard (ref. = No)						
Yes	0.214 (0.090) *	[0.038, 0.391]	0.029 (0.181)	[-0.325, 0.384]	0.023 (0.181)	
Two-way interactions						
Black × Age			0.116 (0.015) ***	[0.086, 0.147]	0.116 (0.015) ***	[0.086, 0.146]
Black × Age²			-0.004 (0.002) *	[-0.008, -0.001]	-0.004 (0.002) *	[-0.008, -0.0008]
Black × Below NSF standard			-0.405 (0.307)	[-1.01, 0.197]	-0.378 (0.307)	[-0.980, 0.224]
Below NSF standard × Age			-0.012 (0.014)	[-0.041, 0.016]	-0.015 (0.014)	[-0.043, 0.013]
Below NSF standard × Age²			0.002 (0.002)	[-0.002, 0.005]	0.002 (0.002)	[-0.002, 0.005]
Three-way interactions						
Black × Below NSF standard × Age			-0.012 (0.026)	[-0.063, 0.040]	-0.010 (0.026)	[-0.062, 0.041]
Black × Below NSF standard × Age²			0.006 (0.003)	[-0.001, 0.012]	0.006 (0.003)	-0.001, 0.012
Low birthweight (ref. = No)						
Yes					-0.218 (0.454)	[-1.11, 0.675]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.78 (0.727) *	[-3.20, -0.348]
Parental obesity (ref. = No)						
Yes					3.49 (0.264) ***	[2.98, 4.01]
Exclusive breastfeeding (ref. = Yes)						
No					0.378 (0.309)	[-0.228, 0.984]
Household income					-0.005 (0.002) *	[-0.009, -0.0003]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					-0.559 (0.278) *	[-1.10, -0.014]
Public assistance (ref. = No)						
Yes					-0.637 (0.341)	[-1.31, 0.031]
Parental education (ref. = Some high school or less)						
Vocational training					-2.03 (1.798)	[-5.57, 1.51]

High school graduate			-1.10 (0.511) *	[-2.10, -0.092]
Some college or technical school			-1.69 (0.507) **	[-2.69, -0.697]
College graduate			-2.00 (0.540) ***	[-3.064, -0.943]
Postgraduate			-2.71 (0.562) ***	[-3.811, -1.604]
Parental marital status (ref. = Single/never married)				
Married			-0.621 (0.530)	[-1.66, 0.422]
Widowed			-0.323 (0.817)	[-1.93, 1.29]
Divorced			-0.896 (0.572)	[-2.02, 0.229]
Separated			-0.094 (0.644)	[-1.36, 1.17]
Place of residence (ref. = Rural)				
Suburban			-0.825 (0.270) **	[1.35, -0.30]
Urban			0.061 (0.275)	[-0.477, 0.600]
Religious service attendance (ref. = Never attends)				
< once a month			0.023 (0.418)	[-0.796, 0.843]
< once a week			-0.241 (0.424)	[-1.07, 0.843]
Once a week or more			0.272 (0.378)	[-0.470, 1.01]
Random effects (variances)				
Participants intercepts	30.23	30.16	27.18	
Residual error	12.54	12.37	12.37	
Model fit				
AIC	65,421.73	65,366.94	65,141.23	
BIC	65,472.86	65,469.19	65,396.85	
-2log-likelihood	65,407.74	65,338.94	65,071.22	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Table 6. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Male Respondents using the Multiple Imputed Dataset.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.64 (0.115) ***	[26.41, 26.86]	26.66 (0.121) ***	[26.44, 26.90]	25.53 (0.693) ***	[24.17, 26.88]
Age	0.429 (0.005) ***	[0.420, 0.438]	0.420 (0.007) ***	[0.406, 0.433]	0.420 (0.007) ***	[0.407, 0.433]
Age^2	-0.014 (0.001) ***	[-0.015, -0.013]	-0.015 (0.001) ***	[-0.016, -0.013]	-0.015 (0.001) ***	[-0.016, -0.013]
Race (ref. = White)						
Black	0.338 (0.205)	[-0.064, 0.739]	0.276 (0.236)	[-0.186, 0.739]	0.403 (0.254)	[-0.095, 0.901]
Below NSF standard **(ref. = No)**						
Yes	0.162 (0.073) *	[0.018, 0.306]	0.150 (0.131)	[-0.107, 0.406]	0.135 (0.131)	[-0.122, 0.391]
Two-way interactions						
Black × Age			0.007 (0.015)	[-0.022, 0.036]	0.006 (0.015)	[-0.023, 0.035]
Black × Age^2			0.001 (0.002)	[-0.002, 0.004]	-0.001 (0.002)	[-0.002, 0.004]
Black × Below NSF standard			0.004 (0.246)	[-0.479, 0.486]	0.020 (0.246)	[-0.462, 0.502]
Below NSF standard × Age			0.021 (0.013)	[-0.004, 0.046]	0.020 (0.013)	[0.006, 0.045]
Below NSF standard × Age^2			0.000 (0.001)	[-0.003, 0.003]	0.000 (0.001)	[-0.003, 0.003]
Three-way interactions						
Black × Below NSF standard × Age			-0.001 (0.024)	[-0.049, 0.046]	0.001 (0.024)	[-0.046, 0.049]
Black × Below NSF standard × Age^2			0.000 (0.003)	[-0.005, 0.006]	0.000 (0.003)	[-0.005, 0.005]
Low birthweight (ref. = No)						
Yes					0.237 (0.435)	[-0.618, 1.09]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-0.764 (0.682)	[-2.10, 0.574]
Parental obesity (ref. = No)						
Yes					2.76 (0.228) ***	[2.31, 3.20]
Exclusive breastfeeding (ref. = Yes)						
No					0.095 (0.246)	[-0.388, 0.578]
Household income					-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					0.313 (0.239)	[-0.156, 0.782]
Public assistance (ref. = No)						
Yes					-0.652 (0.295) *	[-1.230, -0.074]
Parental education (ref. = Some high school or less)						
Vocational training					0.162 (1.64)	[-3.060, 3.38]

High school graduate			0.119 (0.398)	[-0.662, 0.900]
Some college or technical school			-0.213 (0.407)	[-1.011, 0.585]
College graduate			-0.421 (0.455)	[-1.313, 0.471]
Postgraduate			-0.587 (0.476)	[-1.520, 0.346]
Parental marital status (ref. = Single/never married)				
Married			0.305 (0.470)	[-0.617, 1.23]
Widowed			0.780 (0.673)	[-0.540, 2.10]
Divorced			0.295 (0.492)	[-0.670, 1.26]
Separated			0.116 (0.602)	[-1.066, 1.30]
Place of residence (ref. = Rural)				
Suburban			-0.439 (0.226)	[-0.882, 0.005]
Urban			-0.212 (0.239)	[-0.680, 0.257]
Religious service attendance (ref. = Never attends)				
< once a month			0.356 (0.354)	[-0.339, 1.05]
< once a week			0.567 (0.343)	[-0.105, 1.24]
Once a week or more			0.571 (0.319)	[-0.054, 1.20]
Random effects				
Participants intercepts	19.73	19.71	18.43	
Residual error	7.54	7.54	7.53	
Model fit				
AIC	51,904.02	51,964.88	51,849.73	
BIC	51,954.09	52,065.02	52,100.09	
-2log-likelihood	51,890.02	51,936.88	51,779.72	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Table 7. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Female Respondents using the Multiple Imputed Dataset.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.59 (0.138) ***	[26.34, 26.87]	26.56 (0.143) ***	[26.28, 26.84]	28.57 (0.825) ***	[26.95, 30.19]
Age	0.429 (0.005) ***	[0.419, 0.440]	0.397 (0.007) ***	[0.383, 0.410]	0.396 (0.007) ***	[0.383, 0.410]
Age^2	-0.013 (0.001) ***	[-0.014, -0.012]	-0.013 (0.001) ***	[-0.014, -0.011]	-0.012 (0.001) ***	[-0.014, -0.011]
Race (ref. = White)						
Black	2.36 (0.242) ***	[1.89, 2.83]	2.61 (0.269) ***	[2.08, 3.13]	2.34 (0.292) ***	[1.76, 2.91]
Below seven-hour standard (ref. = No)						
Yes	0.114 (0.101)	[-0.083, 0.311]	0.120 (0.189)	[-0.249, 0.490]	0.106 (0.188)	[-0.263, 0.475]
Two-way interactions						
Black × Age			0.109 (0.014) ***	[0.082, 0.136]	0.109 (0.014) ***	[0.082, 0.136]
Black × Age^2			-0.004 (0.002) *	[-0.007, -0.0002]	-0.004 (0.002) *	[-0.007, -0.0002]
Black × Below seven-hour standard			-0.370 (0.316)	[-0.988, 0.249]	-0.337 (0.315)	[-0.955, 0.281]
Below seven-hour standard × Age			0.009 (0.020)	[-0.029, 0.047]	0.007 (0.019)	[-0.031, 0.045]
Below seven-hour standard × Age^2			-0.000 (0.002)	[-0.005, 0.004]	-0.000 (0.002)	[-0.005, 0.004]
Three-way interactions						
Black × Below seven-hour standard × Age			0.005 (0.032)	[-0.058, 0.069]	0.006 (0.032)	[-0.058, 0.069]
Black × Below seven-hour standard × Age^2			0.004 (0.004)	[-0.003, 0.011]	0.004 (0.004)	[-0.003, 0.011]
Low birthweight (ref. = No)						
Yes					-0.215 (0.454)	[-1.11, 0.678]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.76 (0.726) *	[-3.19, -0.337]
Parental obesity (ref. = No)						
Yes					3.50 (0.263) ***	[2.98, 4.01]
Exclusive breastfeeding (ref. = Yes)						
No					0.379 (0.308)	[-0.227, 0.984]
Household income					-0.005 (0.002) *	[-0.009, -0.0003]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					-0.557 (0.278) *	[-1.10, -0.012]
Public assistance (ref. = No)						
Yes					-0.637 (0.341)	[-1.30, 0.032]
Parental education (ref. = Some high school or less)						
Vocational training					-2.00 (1.80)	[-5.54, 1.54]

High school graduate			-1.10 (0.511) *	[-2.10, -0.092]
Some college or technical school			-1.69 (0.507) **	[-2.69, -0.693]
College graduate			-2.00 (0.540) ***	[-3.06, -0.939]
Postgraduate			-2.69 (0.562) ***	[-3.80, -1.59]
Parental marital status (ref. = Single/never married)				
Married			-0.619 (0.530)	[-1.66, 0.423]
Widowed			-0.312 (0.818)	[-1.92, 1.30]
Divorced			-0.892 (0.572)	[-2.02, 0.233]
Separated			-0.083 (0.644)	[-1.35, 1.18]
Place of residence (ref. = Rural)				
Suburban			-0.818 (0.270) **	[-1.35, -0.289]
Urban			0.063 (0.275)	[-0.476, 0.601]
Religious service attendance (ref. = Never attends)				
< once a month			0.027 (0.418)	[-0.792, 0.847]
< once a week			-0.237 (0.424)	[-1.069, 0.594]
Once a week or more			0.273 (0.378)	[-0.468, 1.014]
Random effects (variances)				
Participants intercepts	30.23	30.12	27.16	
Residual error	12.54	12.39	12.39	
Model fit				
AIC	65,425.92	65,372.84	65,147.87	
BIC	65,477.04	65,475.09	65,403.50	
-2log-likelihood	65,411.92	65,344.84	65,077.88	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Table 8. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Male Respondents using the Multiple Imputed Dataset.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.63 (0.116) ***	[26.40, 26.85]	26.65 (0.121) ***	[26.41, 26.89]	25.53 (0.692) ***	[24.17, 26.89]
Age	0.426 (0.005) ***	[0.416, 0.435]	0.417 (0.006) ***	[0.405, 0.430]	0.418 (0.006) ***	[0.405, 0.430]
Age²	-0.014 (0.001) ***	[-0.015, -0.013]	-0.014 (0.001) ***	[-0.016, -0.013]	-0.014 (0.001) ***	[-0.016, -0.013]
Race (ref. = White)						
Black	0.335 (0.205)	[-0.067, 0.737]	0.268 (0.235)	[-0.193, 0.729]	0.393 (0.253)	[-0.104, 0.890]
Below seven-hour standard (ref. = No)						
Yes	0.209 (0.082) *	[0.047, 0.307]	0.182 (0.134)	[-0.080, 0.445]	0.165 (0.134)	[-0.097, 0.427]
Two-way interactions						
Black × Age			0.012 (0.013)	[-0.014, 0.039]	0.012 (0.013)	[-0.015, 0.038]
Black × Age²			0.001 (0.002)	[-0.003, 0.004]	0.001 (0.002)	[-0.003, 0.004]
Black × Below seven-hour standard			0.038 (0.251)	[-0.455, 0.530]	0.056 (0.251)	[-0.435, 0.548]
Below seven-hour standard × Age			0.044 (0.018) *	[0.009, 0.078]	0.042 (0.018) *	[0.008, 0.077]
Below seven-hour standard × Age²			-0.002 (0.002)	[-0.005, 0.001]	-0.002 (0.002)	[-0.005, 0.002]
Three-way interactions						
Black × Below seven-hour standard × Age			-0.040 (0.030)	[-0.100, 0.019]	-0.038 (0.030)	[-0.097, 0.021]
Black × Below seven-hour standard × Age²			0.003 (0.003)	[-0.003, 0.009]	0.003 (0.003)	[-0.003, 0.009]
Low birthweight (ref. = No)						
Yes					0.237 (0.435)	[-0.617, 1.091]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-0.759 (0.682)	[-2.10, 0.579]
Parental obesity (ref. = No)						
Yes					2.76 (0.227) ***	[2.31, 3.20]
Exclusive breastfeeding (ref. = Yes)						
No					0.094 (0.246)	[-0.389, 0.576]
Household income					-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					0.310 (0.239)	[-0.159, 0.779]
Public assistance (ref. = No)						
Yes					-0.654 (0.295) *	[-1.23, -0.076]
Parental education (ref. = Some high school or less)						
Vocational training					0.166 (1.64)	[-3.06, 3.39]

High school graduate			0.118 (0.398)	[-0.663, 0.899]
Some college or technical school			-0.213 (0.407)	[-1.01, 0.585]
College graduate			-0.422 (0.455)	[-1.31, 0.471]
Postgraduate			-0.591 (0.476)	[-1.52, 0.341]
Parental marital status (ref. = Single/never married)				
Married			0.299 (0.470)	[-0.623, 1.22]
Widowed			0.775 (0.673)	[-0.545, 2.09]
Divorced			0.291 (0.492)	[-0.674, 1.257]
Separated			0.112 (0.602)	[-1.07, 1.29]
Place of residence (ref. = Rural)				
Suburban			-0.440 (0.226) *	[-0.884, 0.003]
Urban			-0.210 (0.239) *	[-0.678, 0.258]
Religious service attendance (ref. = Never attends)				
< once a month			0.355 (0.354)	[-0.340, 1.05]
< once a week			0.564 (0.342)	[-0.108, 1.24]
Once a week or more			0.569 (0.318)	[-0.056, 1.194]
Random effects				
Participants intercepts	19.73	19.7	18.43	
Residual error	7.53	7.53	7.53	
Model fit				
AIC	51,902.22	51,959.79	51,844.76	
BIC	51,952.29	52,059.94	52,095.12	
-2log-likelihood	51,888.22	51,931.80	51,774.76	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Figure 1. Marginal Population Mean Predicted Values for a Multilevel Model of Race, ACEs, and BMI among Female Respondents. The dotted lines indicate BMI trajectories among Black respondents, while the solid lines represent BMI trajectories among White respondents. The plot is separated into several panels of categories of ACEs to investigate the potential dose-response effects of ACEs on Black-White disparities in BMI.

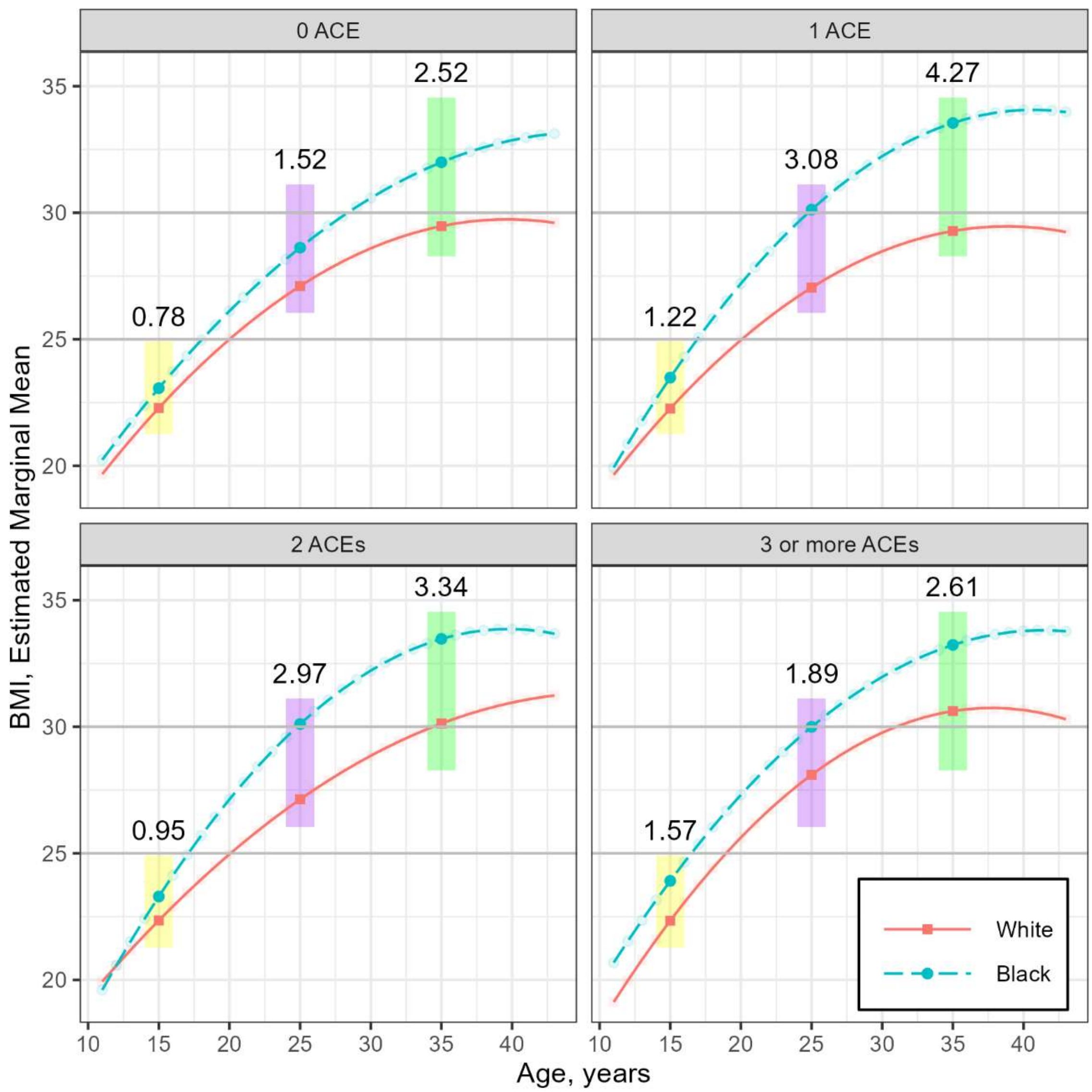


Figure 2. Marginal Population Mean Predicted Values for a Multilevel Model of Race, ACEs, and BMI among Male Respondents. The dotted lines indicate BMI trajectories among Black respondents, while the solid lines represent BMI trajectories among White respondents. The plot is separated into several panels of categories of ACEs to investigate the potential dose-response effects of ACEs on Black-White disparities in BMI.

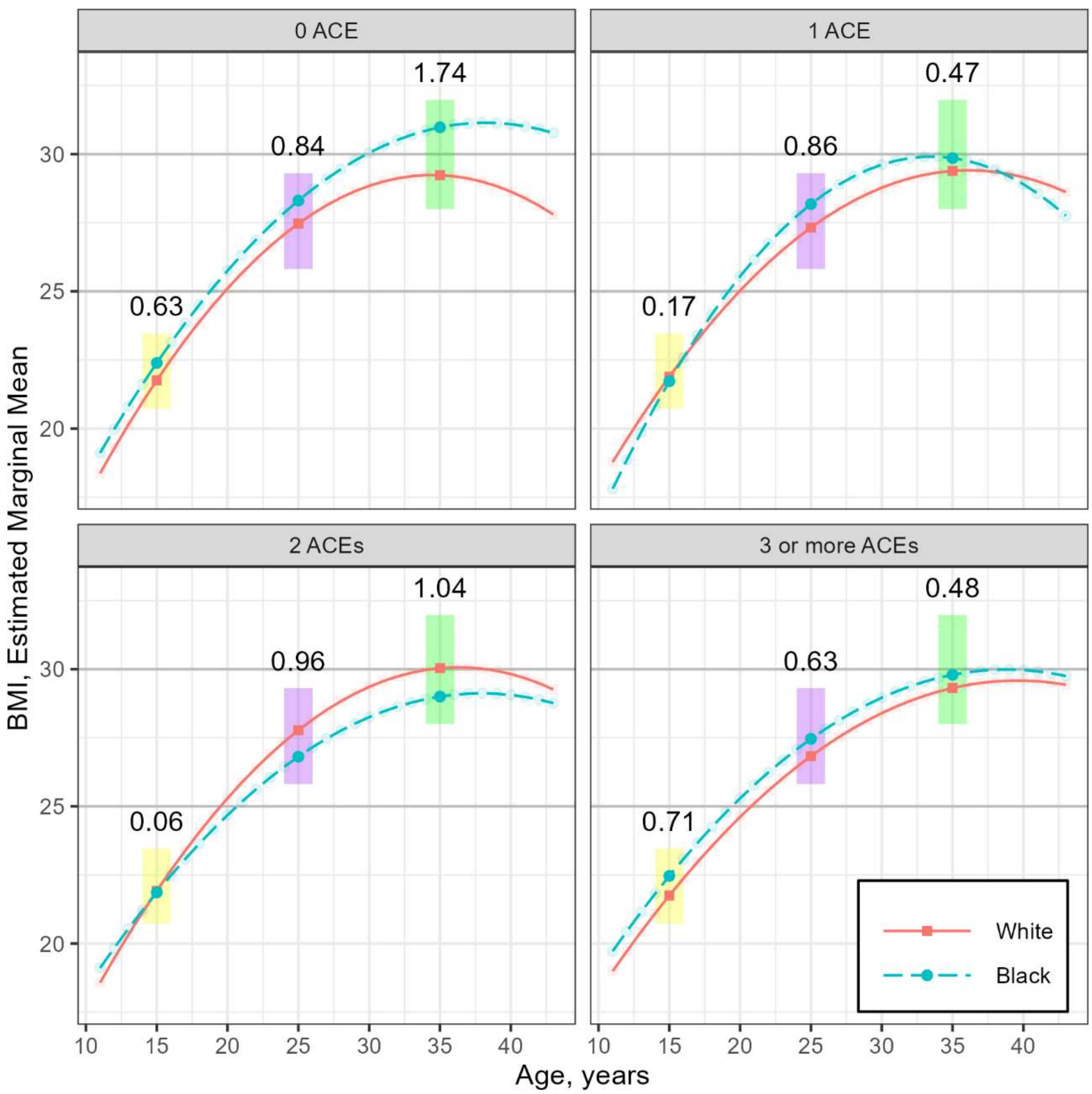


Figure 3. Marginal Population Mean Predicted Values for a Multilevel Model of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Female Respondents.

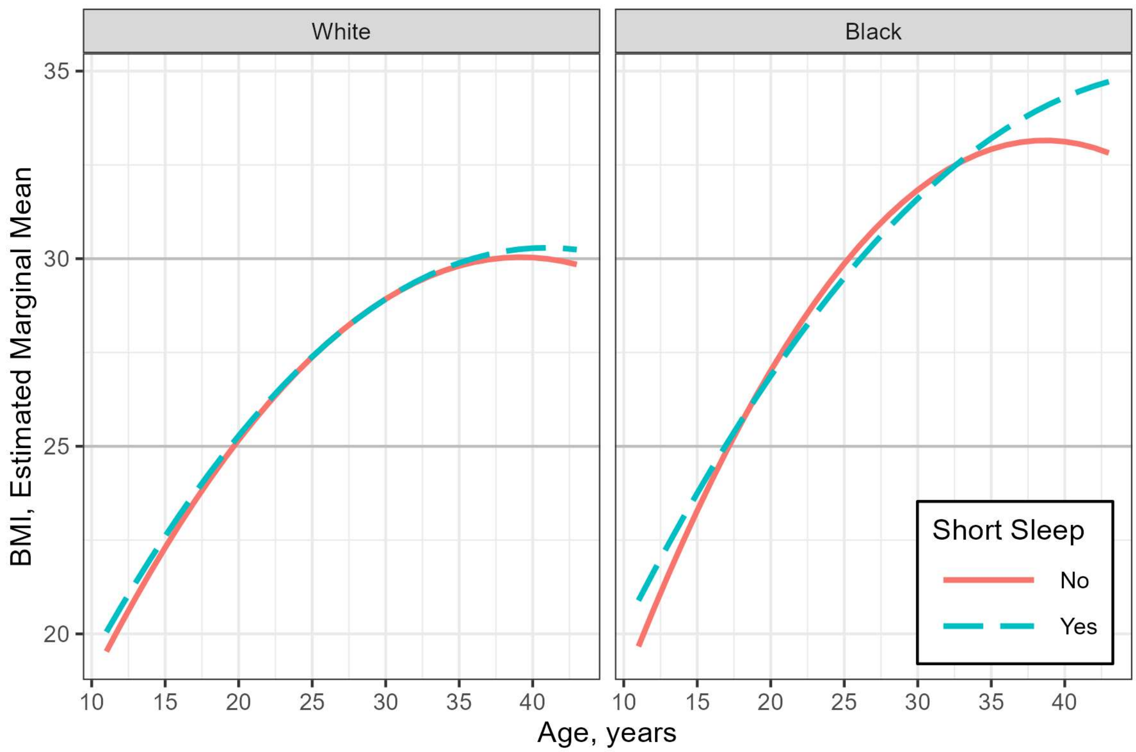


Figure 4. Marginal Population Mean Predicted Values for a Multilevel Model of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Male Respondents.

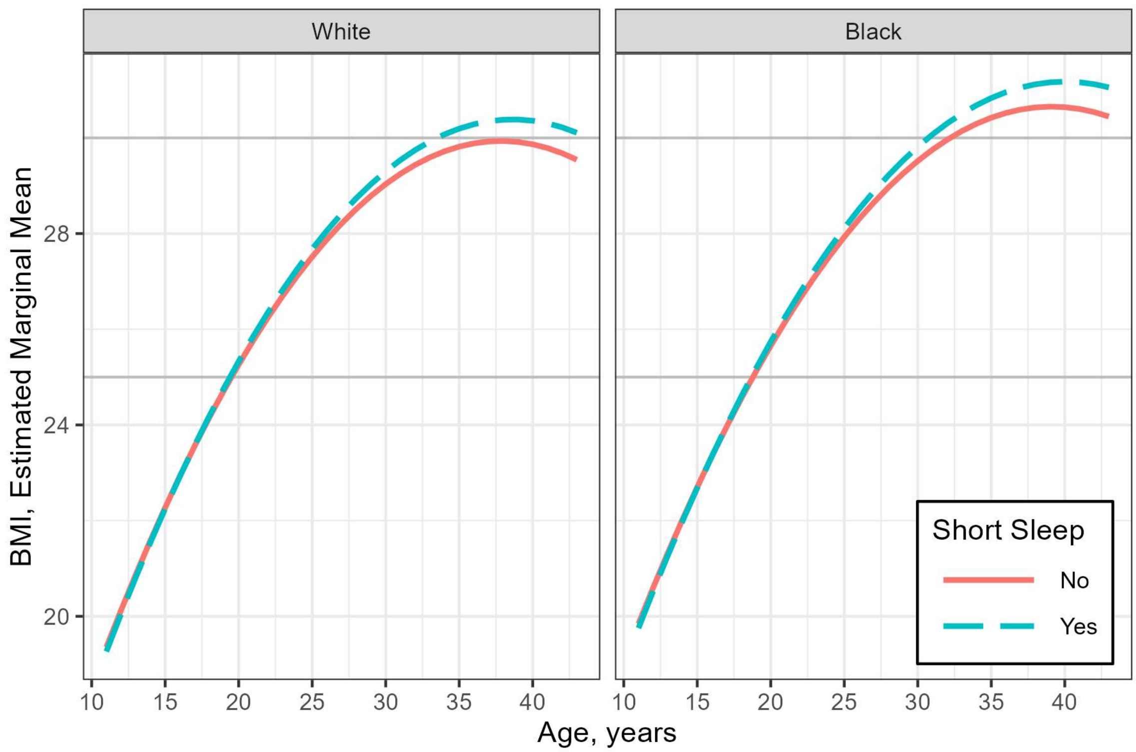


Figure 5. Marginal Population Mean Predicted Values for a Multilevel Model of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Female Respondents.

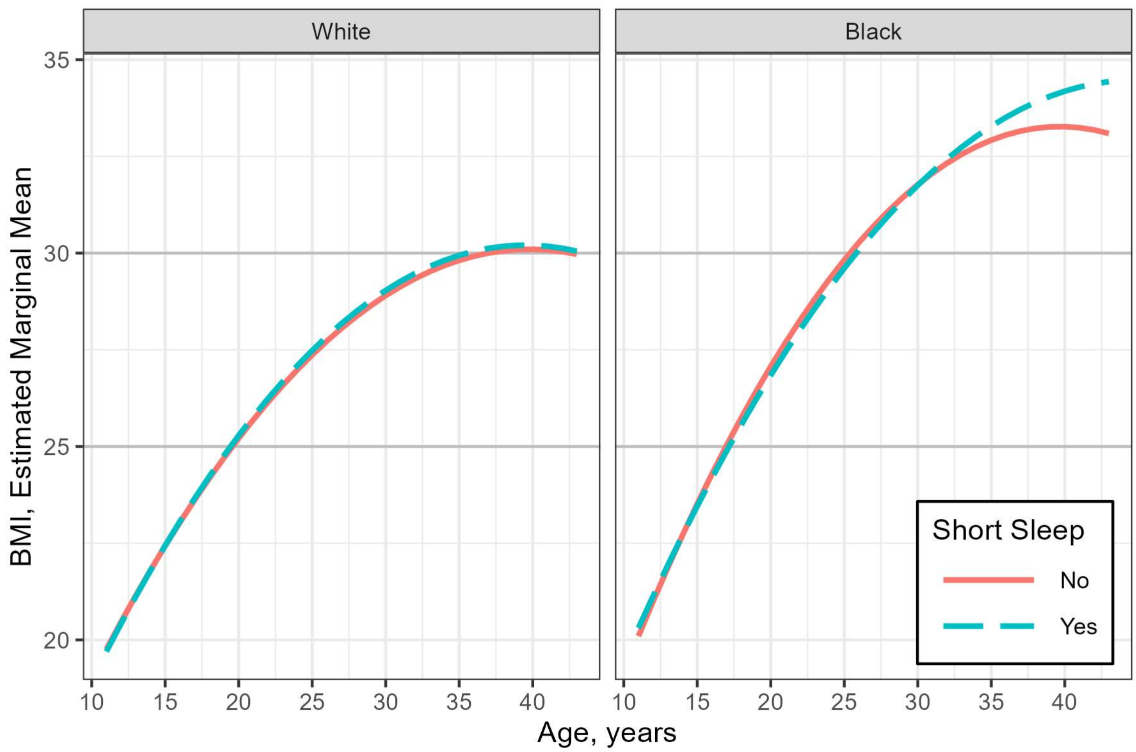
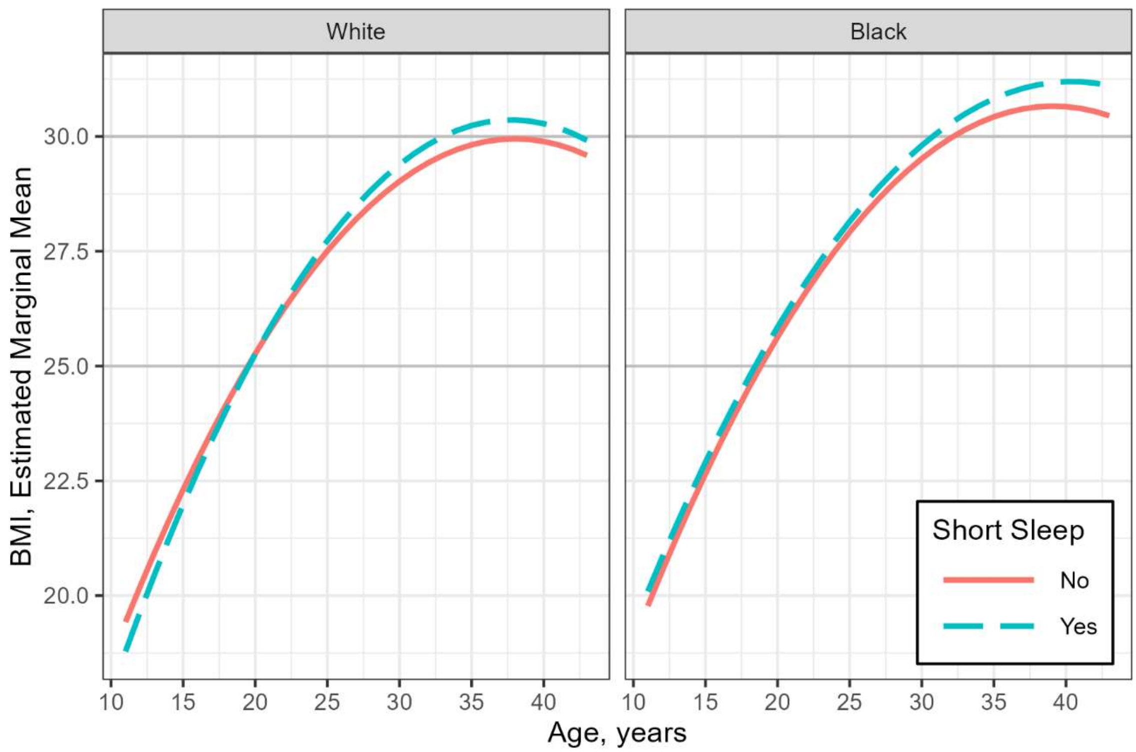


Figure 6. Marginal Population Mean Predicted Values for a Multilevel Model of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Male Respondents.



APPENDICES

Appendix A. Assessments to Understand Linear Association and Differences Between Self-Report and Direct Measures of Height and Weight at Waves 2-4

(I) Pearson's product-moment correlations of self-reported and directly measured heights.

	Correlation coefficient	degree of freedom	t	p-value
wave 2	0.9420	3795	172.96	<0.0001
wave 3	0.9583	3883	209.04	<0.0001
wave 4	0.9376	4313	177.08	<0.0001

(II) Pearson's product-moment correlations of self-reported and directly measured weights.

	Correlation coefficient	degree of freedom	t	p-value
wave 2	0.9389	3752	167.04	<0.0001
wave 3	0.9713	3791	251.25	<0.0001
wave 4	0.9635	4233	234.27	<0.0001

(III) Paired t-test of self-reported and directly measured heights.

	Mean of the difference	degree of freedom	t	p-value
wave 2	-0.2763	3796	-5.093	<0.0001
wave 3	1.2690	3884	26.354	<0.0001
wave 4	1.0224	4314	18.551	<0.0001

(IV) Paired t-test of self-reported and directly measured weights.

	Mean of the difference	degree of freedom	t	p-value
wave 2	-0.5041	3753	-6.2823	<0.0001
wave 3	-1.1787	3792	-16.098	<0.0001
wave 4	-1.2169	4234	-12.79	<0.0001

Appendix B. Exploratory Analysis of the Estimates of Directly Measured BMI at Waves 1 and 5.

(I) Estimates obtained from the regression models of measured BMI on self-reported BMI, sex, and racial categories. Models 1, 2, and 3 included dependent variable as measured BMI in waves 2, 3, and 4 accordingly.

	Model 1	Model 2	Model 3
	Beta (SE)	Beta (SE)	Beta (SE)
Intercept	0.697 (0.184) ***	0.002 (0.144)	0.076 (0.175)
Self-reported BMI (wave 2)	0.969 (0.008) ***		
Self-reported BMI (wave 3)		1.027 (0.005) ***	
Self-reported BMI (wave 4)			1.024 (0.006) ***
Female	0.227 (0.071) **	0.285 (0.065) ***	-0.015 (0.088)
Black	-0.230 (0.095) *	-0.266 (0.091) **	0.096 (0.124)
Female × Black	0.191 (0.149)	0.023 (0.139)	0.241 (0.188)
R^2	0.803	0.906	0.878
Adj. R^2	0.803	0.906	0.878
N	3732	3762	4231

P-values: * < .05, ** < .01, *** < .001.

(II) Correlation matrices of the estimates for directly measured BMI from the correction equations.

Wave 1

	Eq 1	Eq 2	Eq 3	Adj	Report
Eq 1	1	0.999857	0.998611	0.999887	0.999047
Eq 2	0.999857	1	0.997908	0.999651	0.998837
Eq 3	0.998611	0.997908	1	0.999254	0.999549
Adj	0.999887	0.999651	0.999254	1	0.999555
Report	0.999047	0.998837	0.999549	0.999555	1

Eq * = Estimates of measured BMI; Adj = Mean estimates of the measured BMI; Report = self-reported BMI

Wave 5

	Eq 1	Eq 2	Eq 3	Adj	Report
Eq 1	1	0.99996	0.999666	0.999975	0.999782
Eq 2	0.99996	1	0.999469	0.999909	0.999723
Eq 3	0.999666	0.999469	1	0.999815	0.999874
Adj	0.999975	0.999909	0.999815	1	0.999896
Report	0.999782	0.999723	0.999874	0.999896	1

Eq * = Estimates of measured BMI; Adj = Mean estimates of the measured BMI; Report = self-reported BMI

(III) Descriptive summary statistics of self-reported and estimated BMI, Mean (SD)

	wave 1	wave 5
Self-reported	22.10 (3.73)	29.83 (7.22)
Estimated BMI	22.58 (3.75)	30.37 (7.27)

(IV) Repeated measures analysis of variance of the estimates derived from the correction equations.

	Effect	df	MSE	F-statistic	Effect size (η2)
wave 1	1.77	8749.13	0.04	16738.51 ***	0.005
wave 5	1.44	5110.08	0.10	16284.75 ***	0.004

P-value: *** < .001.

$\eta^2 = 0.01$ indicates a small effect

$\eta^2 = 0.06$ indicates a medium effect

$\eta^2 = 0.14$ indicates a large effect

Appendix C: List of Ten Categories of ACEs and their Descriptions

Measure	Description	Original Response Range	Recode
Emotional Abuse	Before your 18th birthday, how often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved? (Wave IV)	0 = never happened, 5 = more than 10 times	0 = never or once, 1 = more than once
Physical Abuse	Before your 18th birthday, how often did a parent or adult caregiver hit you with a fist, kick you, or throw you down on the floor, into a wall, or downstairs? (Wave IV)	0 = never happened, 5 = more than 10 times	0 = never or once, 1 = more than once
Sexual Abuse	Before 6th grade, how often had one of your parents or other adult caregivers touched you in a sexual way, forced you to touch him or her in a sexual way, or forced you to have sexual relations? (Wave III) Before your 18th birthday how often had one of your parents or other adult caregivers touched you in a sexual way, forced you to touch him or her in a sexual way, or forced you to have sexual relations? (Wave IV)	0 = never happened, 5 = more than 10 times	0 = never at both waves, 1 = at least once
Emotional Neglect	(Wave I) Do you agree or disagree with the following statement? • Most of the time, your father is warm and loving toward you • Most of the time, your mother is warm and loving toward you • Overall, you are satisfied with your relationship with your father	1 = strongly agree; 5 = strongly disagree	Average of relevant items, then 0 = bottom 80% of low warmth; 1 = top 20% of low warmth

	• Overall, you are satisfied with your relationship with your mother • You are satisfied with the way your mother and you communicate with each other • You are satisfied with the way your father and you communicate with each other.		
Physical Neglect	How often had your parents or other adult caregivers not taken care of your basic needs, such as keeping you clean or providing food or clothing? (Wave III)	0 = never happened, 5 = more than 10 times	0 = never or once, 1 = more than once
Community Violence	(Wave I) During the past 12 months, how often did you see someone shoot or stab another person? During the past 12 months, how often did someone pull a knife or gun on you? During the past 12 months, how often did someone shoot or stab you? During the past 12 months, how often did someone cut or stab you?	0 = never, 2 = more than once	0 = no exposure, 1 = any exposure
Parental separation or divorce	What is your current marital status? (Wave I, Parent Survey)	1 = single, never married; 2 = married; 3 = widowed, 4 = divorced, 5 = separated	0 = not divorced or separated; 1 = divorced or separated
Substance Abuse in the Household	Does respondent's biological mother currently have the following health problem: Alcoholism? (Wave I, Parent Survey) Does respondent's biological mother currently have the following health problem: Alcoholism? (Wave I, Parent Survey) Are illegal drugs easily available to you in your home? (Wave I)	Yes, No	0 = no, 1 = yes

Suicide exposure	Have any of your family members succeeded in committing suicide in the past 12 months? (Wave I)	Yes, No	0 = no, 1 = yes
Incarcerated household member	(Has/did) your (biological mother/ biological father/mother figure/father figure) ever (spent/spend) time in jail or prison? (Wave IV)	Yes, No	0 = no parent or guardian incarcerated prior to age 18; 1 = Yes, parent or guardian incarcerated prior to age 18

Appendix D. List of Auxiliary Variables

Variables	Levels	Waves	Notes
What language is usually spoken in your home?	English (1), Spanish (2), Other (3)	1	nominal categories
In general, how is your health?	Excellent (1) to Poor (5)	1	five ordinal levels
When did you last have a physical examination by a doctor or nurse?	Less than a year ago (1) to Never (4)	1	four ordinal levels
During the past 12 months, have you ever spent the night away from home without permission?	Yes vs No	1	
In the past year have you had a routine physical examination?	Yes vs No	1	
In the past year, have you received psychological or emotional counseling?	Yes vs No	1	
Compared with other people your age, how intelligent are you?	Moderately below average (1) to Extremely above average (6)	1	
Have you ever tried cigarette smoking, even just 1 or 2 puffs?	Yes vs No	1	
Have you had a drink of beer, wine, or liquor—not just a sip or a taste of someone else's drink—more than 2 or 3 times in your life?	Yes vs No	1	
Of your 3 best friends, how many drink alcohol at least once a month?	No friends (0) to Three friends (3)	1	
Of your 3 best friends, how many use marijuana at least once a month?	No friends (0) to Three friends (3)	1	
Are cigarettes easily available to you in your home?	Yes vs No	1	
Is alcohol easily available to you in your home?	Yes vs No	1	
Are illegal drugs easily available to you in your home?	Yes vs No	1	
You felt depressed	Never/rarely (0) to Most or all of the time (3)	1	
During the past week, how many times did you work around the house, such as cleaning, cooking, doing laundry, doing yardwork, or caring for a pet?	Not at all (0) to 5 or more times (3)	2	
In general, how is your health?	Excellent(1) to Poor(5)	2	
During the past 12 months, have you ever spent the night away from home without permission?	Yes vs No	2	
Did you drink milk, including milk poured on cereal or dessert?	Yes vs No	2	
Do you currently take vitamins or minerals?	Yes vs No	2	
During a typical summer week, how many hours do you spend outdoors in the sun during the day?	range 0 to 115 hours	2	
Compared with other people your age, how intelligent are you?	Moderately below average (1) to Extremely above average (6)	2	
You were bothered by things that usually don't bother you	Never/rarely (0) to Most or all of the time (3)	2	
You seldom get sick	Strongly agree (1) to Strongly disagree (5)	2	

How much would you like to have a romantic relationship in the next year?	Not at all (1) to Very much (5)	2	
In the past 12 months, how often did you paint graffiti or signs on someone else's property or in a public place?	Never (0) to 5 or more times (3)	2	
You saw someone shoot or stab another person	Never (0) to More than once (2)	2	
During the past 12 months, did you ever seriously think about committing suicide?	Yes vs No	2	
How many hours do you spend working for pay in a typical nonsummer week?	range 0 to 110 hours	2	
What language do you use most with your family and close relatives?	English (1) to Other (7)	3	7 distinct languages; nominal categories
Have you ever run away from home?	Yes vs No	3	
Have you ever been homeless for a week or longer	Yes vs No	3	
You felt "on the go " or "driven by a motor."	Never or rarely (0) to Very often (3)	3	
Have you ever been expelled from school?	Yes vs No	3	
Have you ever been in the military reserves?	Yes vs No	3	
In the past seven days, how many times did you go to an exercise or fitness center to exercise or work out?	0 to 20 times	3	
On how many of the past seven days did you eat breakfast?	No day (0) to Seven days (7)	3	
Has there been any time in the past 12 months when you thought you should get medical care, but you did not?	Yes vs No	3	
In the past 12 months, how often have you laughed a lot?	Never (0) to Ever day (4)	3	
Other than your parents or step-parents, has an adult made an important posit ive difference in your life at any time since you were 14 years old ?	Yes vs No	3	
In terms of social maturity, would you say you grew up faster , slower, or at about the same rate as other people your age?	Faster (1) to Slower (3)	3	3 ordinal levels
How often do you think of yourself as an adult?	Never (0) to All of the time (4)	3	
Is your biological mother still alive?	Yes vs No	4	
In general, how is your health?	Excellent(1) to Poor(5)	4	
Did you drink a caffeinated beverage (e.g., coffee, tea or soda) in the past 24 hours?	Yes vs No	4	
Has there been a time in the past 12 months when you thought you should get medical care, but you did not?	Yes vs No	4	
How long ago did you last have a routine check-up?	Within the past 3 months (1) to Never (7)	4	7 ordinal levels
Where do you live now?	Your parents' home (1) to Other (6)	4	6 different types of homes; nominal categories
Have you ever been in the military?	Yes vs No	4	

In the past 12 months, was there a time when {YOU/YOUR HOUSEHOLD} were evicted from your house or apartment for not paying the rent or mortgage?	Yes vs No	4	
How important (if at all) is your religious faith to you?	Not important (1) to More important than anything else (4)	4	
Compared to other people your age, how intelligent are you?	Moderately below average (1) to Extremely above average (6)	4	
How attractive are you?	Very attractive (1) to Not at all attractive (4)	4	
You were bothered by things that usually don't bother you	Never or rarely (0) to Most of the time or all of the time (3)	4	
During the past 12 months, have you ever seriously thought about committing suicide?	Yes vs No	4	
In the past 12 months, how often did you deliberately damage property that didn't belong to you?	Never (0) to 5 or more times (3)	4	
Have you ever smoked an entire cigarette?	Yes vs No	4	
In the past seven days, how many hours did you watch television or videos, including VHS, DVDs or music videos?	0 to 150 hours	4	
I have frequent mood swings	Strongly agree (1) to Strongly disagree (5)	4	
What is the highest level of education that you have achieved to date?	Some high school (2) to completed a post baccalaureate professional degree (16)	5	15 ordinal levels
Have you ever served in the military?	Yes vs No	5	
How many total hours a week do you usually spend at [your job/all your jobs]?	0 to 90	5	unit in hours; 90 means 90 hours or more
Since 2008, have you experienced a foreclosure procedure, eviction, or repossession of something?	Yes vs No	5	
In general, how is your health?	Excellent(1) to Poor(5)	5	
During the past 30 days, on how many days did you smoke cigarettes?	0 to 30	5	
Delayed speech or other problems with speaking or understanding	Yes vs No	5	
Because of a health condition, did you ever miss school for one month or more?	Yes vs No	5	
I am always optimistic about my future	strongly agree (1) to strongly disagree (5)	5	
During the past 7 days, I felt that I could not shake off the blues, even with help from my family and friends	never or rarely (1) to most or all of the time (4)	5	
In the past 12 months, about how many hours did you spend on volunteer or community service work?	0 hour (1) to 160 hours or more (6)	5	6 ordinal levels

How important (if at all) is your religious faith to you?	not important (1) to more important than anything else (4)	5	
In the past 30 days, how often have you felt that you were unable to control the important things in your life?	never (1) to very often (5)	5	
You saw someone shoot or stab another person	Yes vs No	5	
How many different persons have you ever married?	0 to 3	5	0 for never married; 3 for 3 or more

Appendix E. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Female Respondents using the unadjusted BMI data.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.24 (0.189) ***	[25.86, 26.61]	26.28 (0.215) ***	[25.86, 26.70]	28.43 (0.845) ***	[26.77, 30.09]
Age	0.439 (0.005) ***	[0.429, 0.450]	0.396 (0.010) ***	[0.377, 0.414]	0.395 (0.010) ***	[0.376, 0.413]
Age^2	-0.017 (0.001) ***	[-0.018, -0.016]	-0.016 (0.001) ***	[-0.018, -0.014]	-0.016 (0.001) ***	[-0.018, -0.014]
Race (ref. = White)						
Black	2.30 (0.242) ***	[1.83, 2.78]	1.76 (0.450) ***	[0.877, 2.64]	1.43 (0.454) **	[0.544, 2.32]
ACEs (ref. = 0 ACE)						
1 ACE	0.423 (0.270)	[-0.106, 0.951]	0.162 (0.344)	[-0.513, 0.836]	-0.043 (0.336)	[-0.702, 0.616]
2 ACEs	0.657 (0.318) *	[-0.034, 1.28]	0.321 (0.400)	[-0.462, 1.10]	0.015 (0.398)	[-0.765, 0.796]
3 or more ACEs	0.998 (0.334) **	[0.344, 1.65]	1.18 (0.419) **	[0.363, 2.00]	0.970 (0.435) *	[0.118, 1.82]
Two-way interactions						
Black × Age			0.084 (0.020) ***	[0.045, 0.124]	0.084 (0.020) ***	[0.044, 0.123]
Black × Age^2			0.001 (0.002)	[-0.004, 0.006]	0.001 (0.002)	[-0.004, 0.006]
Black × 1 ACE			1.30 (0.636) *	[0.055, 2.55]	1.48 (0.614) *	[0.274, 2.683]
Black × 2 ACEs			1.12 (0.758)	[-0.364, 2.61]	1.40 (0.733)	[-0.040, 2.83]
Black × 3 or more ACEs			0.305 (0.790)	[-1.24, 1.85]	0.40 (0.765)	[-1.10, 1.90]
1 ACE × Age			-0.006 (0.015)	[-0.036, 0.024]	-0.006 (0.015)	[-0.037, 0.024]
2 ACE × Age			0.023 (0.017)	[-0.011, 0.057]	0.023 (0.017)	[-0.011, 0.057]
3 or more ACE × Age			0.062 (0.018) **	[0.026, 0.098]	0.064 (0.018) ***	[0.028, 0.100]
1 ACE × Age^2			-0.001 (0.002)	[-0.004, 0.003]	-0.001 (0.002)	[-0.004, 0.003]
2 ACE × Age^2			0.003 (0.002)	[-0.001, 0.007]	0.003 (0.002)	[-0.001, 0.007]
3 or more ACE × Age^2			-0.004 (0.002)	[-0.008, 0.0003]	-0.004 (0.002)	[-0.009, 0.0002]
Three-way interactions						
Black × 1 ACE × Age			0.077 (0.029) **	[0.019, 0.134]	0.078 (0.029) **	[0.021, 0.135]
Black × 2 ACE × Age			0.056 (0.034)	[-0.010, 0.123]	0.057 (0.034)	[-0.009, 0.124]
Black × 3 or more ACE × Age			-0.034 (0.035)	[-0.103, 0.034]	-0.035 (0.035)	[-0.103, 0.033]
Black × 1 ACE × Age^2			-0.005 (0.003)	[-0.012, 0.002]	-0.005 (0.003)	[-0.012, 0.002]
Black × 2 ACE × Age^2			-0.010 (0.004) *	[-0.018, -0.002]	-0.010 (0.004) *	[-0.018, -0.002]
Black × 3 or more ACE × Age^2			0.001 (0.004)	[-0.008, 0.009]	0.001 (0.004)	[-0.008, 0.009]
Low birthweight (ref. = No)						
Yes					-0.242 (0.453)	[-1.133, 0.645]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.83 (0.725) *	[-3.25, -0.403]
Parental obesity (ref. = No)						

Yes			3.49 (0.263) ***	[2.98, 4.01]
Exclusive breastfeeding (ref. = Yes)				
No			0.374 (0.308)	[-0.230, 0.978]
Household income			-0.005 (0.002) *	[-0.009, -0.0002]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			-0.574 (0.278) *	[-1.12, -0.030]
Public assistance (ref. = No)				
Yes			-0.719 (0.343) *	[-1.39, -0.047]
Parental education (ref. = Some high school or less)				
Vocational training			-1.95 (1.81)	[-5.506, 1.606]
High school graduate			-1.06 (0.510) *	[-2.07, -0.058]
Some college or technical school			-1.68 (0.507) **	[-2.67, -0.681]
College graduate			-1.95 (0.541) ***	[-3.01, -0.891]
Postgraduate			-2.61 (0.562) ***	[-3.72, -1.51]
Parental marital status (ref. = Single/never married)				
Married			-0.599 (0.530)	[-1.64, 0.445]
Widowed			-0.318 (0.817)	[-1.93, 1.29]
Divorced			-1.11 (0.578)	[-2.25, 0.022]
Separated			-0.326 (0.652)	[-1.606, 0.955]
Place of residence (ref. = Rural)				
Suburban			-0.833 (0.269)	[-1.36, -0.305]
Urban			0.035 (0.275)	[-0.503, 0.573]
Religious service attendance (ref. = Never attends)				
< once a month			-0.012 (0.416)	[-0.804, 0.829]
< once a week			-0.200 (0.424)	[-1.03, 0.630]
Once a week or more			0.327 (0.379)	[-0.415, 1.07]
Random effects (variances)				
Participants intercepts	30.03	29.93	27.01	
Residual error	12.55	12.36	12.35	
Model fit				
AIC	65,413.13	65,406.20	65,183.68	
BIC	65,478.86	65,596.10	65,526.95	
-2log-likelihood	65,395.12	65,354.20	65,089.68	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix F. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Male Respondents using the unadjusted BMI data.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.64 (0.157) ***	[26.34, 26.95]	26.67 (0.176) ***	[26.33, 27.02]	25.62 (0.714) ***	[24.22, 27.03]
Age	0.438 (0.005) ***	[0.429, 0.447]	0.437 (0.008) ***	[0.420, 0.454]	0.436 (0.008) ***	[0.420, 0.453]
Age²	-0.017 (0.001) ***	[-0.018, -0.016]	-0.019 (0.001) ***	[-0.021, -0.017]	-0.019 (0.001) ***	[-0.021, -0.017]
Race (ref. = White)						
Black	0.414 (0.206) *	[0.010, 0.818]	0.754 (0.383) *	[0.004, 1.50]	0.797 (0.389) *	[0.034, 1.56]
ACEs (ref. = 0 ACE)						
1 ACE	0.044 (0.225)	[-0.398, 0.485]	-0.021 (0.280)	[-0.570, 0.528]	-0.147 (0.280)	[-0.696, 0.401]
2 ACEs	0.089 (0.266)	[-0.433, 0.611]	0.484 (0.335)	[-0.173, 1.14]	0.252 (0.341)	[-0.416, 0.920]
3 or more ACEs	-0.120 (0.287)	[-0.682, 0.443]	-0.469 (0.369)	[-1.19, 0.254]	-0.644 (0.391)	[-1.41, 0.122]
Two-way interactions						
Black × Age			0.041 (0.019) *	[0.004, 0.077]	0.040 (0.019) *	[0.004, 0.077]
Black × Age²			0.005 (0.002) *	[0.001, 0.009]	0.005 (0.002) *	[0.001, 0.009]
Black × 1 ACE			0.001 (0.552)	[-1.08, 1.08]	0.034 (0.541)	[-1.03, 1.09]
Black × 2 ACEs			-1.92 (0.634) **	[-3.16, -0.681]	-1.658 (0.624) **	[-2.88, -0.436]
Black × 3 or more ACEs			-0.258 (0.659)	[-1.55, 1.04]	-0.120 (0.651)	[-1.40, 1.16]
1 ACE × Age			-0.009 (0.013)	[-0.036, 0.017]	-0.008 (0.013)	[-0.034, 0.018]
2 ACE × Age			0.026 (0.016)	[-0.005, 0.057]	0.026 (0.016	[-0.004, 0.057]
3 or more ACE × Age			-0.016 (0.017)	[-0.049, 0.018]	-0.016 (0.017)	[-0.049, 0.018]
1 ACE × Age²			0.003 (0.002) *	[0.0002, 0.006]	0.003 (0.002) *	[0.00004, 0.006]
2 ACE × Age²			0.002 (0.002)	[-0.001, 0.006]	0.002 (0.002)	[-0.001, 0.006]
3 or more ACE × Age²			0.007 (0.002) ***	[0.003, 0.011]	0.007 (0.002) ***	[0.003, 0.011]
Three-way interactions						
Black × 1 ACE × Age			0.003 (0.028)	[-0.051, 0.058]	0.003 (0.028)	[-0.051, 0.058]
Black × 2 ACE × Age			-0.111 (0.031) ***	[-0.172, -0.049]	-0.110 (0.031) ***	[-0.171, -0.049]
Black × 3 or more ACE × Age			-0.061 (0.032)	[-0.124, 0.001]	-0.061 (0.032)	[-0.123, 0.002]
Black × 1 ACE × Age²			-0.011 (0.003) ***	[-0.017, -0.005]	-0.011 (0.003) ***	[-0.017, -0.005]
Black × 2 ACE × Age²			0.000 (0.004)	[-0.007, 0.007]	0.000 (0.004)	[-0.007, 0.007]
Black × 3 or more ACE × Age²			-0.004 (0.004)	[-0.011, 0.003]	-0.004 (0.004)	[-0.011, 0.003]
Low birthweight (ref. = No)						
Yes					0.260 (0.437)	[-0.598, 1.12]
Nativity status (ref. = U.S. born)						

Born outside of the U.S.			-0.802 (0.682)	[-2.14, 0.536]
Parental obesity (ref. = No)				
Yes			2.74 (0.227) ***	[2.30, 3.20]
Exclusive breastfeeding (ref. = Yes)				
No			0.091 (0.245)	[-0.390, 0.572]
Household income			-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			0.340 (0.239)	[-0.129, 0.810]
Public assistance (ref. = No)				
Yes			-0.616 (0.296)	[-1.20, -0.036]
Parental education (ref. = Some high school or less)				
Vocational training			0.096 (1.64)	[-3.13, 3.32]
High school graduate			0.100 (0.398)	[-0.681, 0.882]
Some college or technical school			-0.226 (0.407)	[-1.02, 0.572]
College graduate			-0.443 (0.455)	[-1.34, 0.450]
Postgraduate			-0.604 (0.476)	[-1.54, 0.329]
Parental marital status (ref. = Single/never married)				
Married			0.289 (0.471)	[-0.634, 1.21]
Widowed			0.745 (0.672)	[-0.574, 2.06]
Divorced			0.373 (0.501)	[-0.609, 1.35]
Separated			0.259 (0.614)	[-0.944, 1.46]
Place of residence (ref. = Rural)				
Suburban			-0.437 (0.226)	[-0.880, 0.006]
Urban			-0.194 (0.239)	[-0.662, 0.274]
Religious service attendance (ref. = Never attends)				
< once a month			0.338 (0.355)	[-0.359, 1.035]
< once a week			0.562 (0.343)	[-0.113, 1.236]
Once a week or more			0.564 (0.322)	[-0.067, 1.20]
Random effects (variances)				
Participants intercepts	19.74	19.66	18.39	
Residual error	7.49	7.45	7.45	
Model fit				
AIC	51,867.49	51,951.48	51,837.60	
BIC	51,931.87	52,137.46	52,173.80	
-2log-likelihood	51,849.48	51,899.48	51,743.60	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix G. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Female Respondents using unimputed Exposure and confounding variables.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.25 (0.190) ***	[25.87, 26.62]	26.31 (0.215) ***	[25.88, 26.73]	28.82 (1.16) ***	[26.56, 31.08]
Age	0.430 (0.005) ***	[0.420, 0.440]	0.387 (0.010) ***	[0.368, 0.406]	0.389 (0.013) ***	[0.363, 0.415]
Age²	-0.013 (0.001) ***	[-0.014, -0.012]	-0.012 (0.001) ***	[-0.015, -0.010]	-0.012 (0.002) ***	[-0.015, -0.009]
Race (ref. = White)						
Black	2.31 (0.243) ***	[1.84, 2.79]	1.75 (0.451) ***	[0.868, 2.63]	1.35 (0.669) *	[0.05, 2.65]
ACEs (ref. = 0 ACE)						
1 ACE	0.424 (0.270)	[-0.106, 0.953]	0.154 (0.345)	[-0.521, 0.829]	0.043 (0.461)	[-0.851, 0.938]
2 ACEs	0.657 (0.319) *	[0.033, 1.28]	0.311 (0.400)	[-0.473, 1.09]	0.592 (0.546)	[-0.469, 1.65]
3 or more ACEs	0.983 (0.334) **	[0.329, 1.64]	1.15 (0.419) **	[0.332, 1.97]	1.24 (0.603) *	[0.070, 2.41]
Two-way interactions						
Black × Age			0.085 (0.020) ***	[0.045, 0.124]	0.096 (0.030) **	[0.037, 0.155]
Black × Age²			0.001 (0.002)	[-0.003, 0.006]	0.005 (0.004)	[-0.002, 0.012]
Black × 1 ACE			1.30 (0.637) *	[0.058, 2.55]	1.05 (0.889)	[-0.676, 2.78]
Black × 2 ACEs			1.13 (0.759)	[-0.352, 2.62]	1.91 (1.03)	[-0.088, 3.90]
Black × 3 or more ACEs			0.317 (0.792)	[-1.23, 1.87]	-0.421 (1.11)	[-2.59, 1.74]
1 ACE × Age			-0.008 (0.015)	[-0.038, 0.023]	-0.011 (0.021)	[-0.051, 0.030]
2 ACE × Age			0.023 (0.017)	[-0.011, 0.057]	0.022 (0.023)	[-0.024, 0.067]
3 or more ACE × Age			0.062 (0.018) ***	[0.026, 0.098]	0.092 (0.025) ***	[0.042, 0.141]
1 ACE × Age²			-0.000 (0.002)	[-0.004, 0.003]	-0.001 (0.003)	[-0.006, 0.004]
2 ACE × Age²			0.003 (0.002)	[-0.001, 0.008]	0.003 (0.003)	[-0.002, 0.009]
3 or more ACE × Age²			-0.004 (0.002)	[-0.008, 0.001]	-0.009 (0.003) **	[-0.016, -0.003]
Three-way interactions						
Black × 1 ACE × Age			0.074 (0.029) *	[0.017, 0.131]	0.049 (0.042)	[-0.034, 0.132]
Black × 2 ACE × Age			0.053 (0.034)	[-0.013, 0.120]	0.095 (0.049) *	[0.001, 0.190]
Black × 3 or more ACE × Age			-0.036 (0.035)	[-0.104, 0.032]	-0.165 (0.050) **	[-0.263, -0.067]
Black × 1 ACE × Age²			-0.005 (0.003)	[-0.011, 0.002]	-0.007 (0.005)	[-0.017, 0.003]
Black × 2 ACE × Age²			-0.010 (0.004) *	[-0.018, -0.002]	-0.015 (0.006) *	[-0.027, -0.003]
Black × 3 or more ACE × Age²			0.001 (0.004)	[-0.001, 0.009]	0.006 (0.006)	[-0.007, 0.018]
Low birthweight (ref. = No)						
Yes					-0.562 (0.553)	[-1.64, 0.511]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-2.17 (0.917) *	[-3.95, -0.389]

Parental obesity (ref. = No)				
Yes			3.41 (0.342) ***	[2.75, 4.07]
Exclusive breastfeeding (ref. = Yes)				
No			0.407 (0.379)	[-0.328, 1.14]
Household income			-0.004 (0.003)	[-0.010, 0.001]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			0.009 (0.526)	[-1.01, 1.03]
Public assistance (ref. = No)				
Yes			0.134 (0.451)	[-0.741, 1.01]
Parental education (ref. = Some high school or less)				
Vocational training			-2.22 (2.26)	[-6.60, 2.17]
High school graduate			-1.18 (0.687)	[-2.51, 0.149]
Some college or technical school			-1.46 (0.680) *	[-2.78, -0.136]
College graduate			-2.02 (0.724) **	[-3.43, -0.618]
Postgraduate			-2.62 (0.761) ***	[-4.10, -1.15]
Parental marital status (ref. = Single/never married)				
Married			-1.60 (0.667) *	[-2.89, -0.301]
Widowed			0.253 (1.17)	[-2.01, 2.51]
Divorced			-2.03 (0.738) **	[-3.46, -0.59]
Separated			-1.71 (0.867) *	[-3.38, -0.022]
Place of residence (ref. = Rural)				
Suburban			-0.438 (0.370)	[-1.16, 0.279]
Urban			-0.554 (0.383)	[-1.30, 0.189]
Religious service attendance (ref. = Never attends)				
< once a month			-0.086 (0.558)	[-1.17, 0.998]
< once a week			-0.654 (0.555)	[-1.73, 0.424]
Once a week or more			0.052 (0.512)	[-0.942, 1.05]
Random effects (variances)				
Participants intercepts	30.15	30.04	24.36	
Residual error	12.54	12.35	12.02	
Model fit				
AIC	65,420.09	65,414.83	31,319.69	
BIC	65,485.82	65,604.73	31,628.79	
-2log-likelihood	65,402.09	65,362.83	31,225.69	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix H. Parameter Estimates of Multilevel Growth Curve Models of Race, ACEs, and BMI among Male Respondents using unimputed Exposure and confounding variables.

	Model 1		Model 2		Model 3	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.67 (0.157) ***	[26.36, 26.97]	26.68 (0.177) ***	[26.34, 27.03]	24.89 (1.11) ***	[22.75, 27.04]
Age	0.429 (0.005) ***	[0.419, 0.438]	0.427 (0.008) ***	[0.411, 0.444]	0.418 (0.012) ***	[0.396, 0.441]
Age²	-0.014 (0.001) ***	[-0.015, -0.013]	-0.016 (0.001) ***	[-0.018, -0.015]	-0.015 (0.001) ***	[-0.017, -0.012]
Race (ref. = White)						
Black	0.359 (0.207)	[-0.046, 0.763]	0.752 (0.384) *	[0.001, 1.50]	0.020 (0.599)	[-1.14, 1.18]
ACEs (ref. = 0 ACE)						
1 ACE	0.045 (0.226)	[-0.397, 0.488]	-0.021 (0.281)	[-0.570, 0.528]	-0.055 (0.407)	[-0.84, 0.734]
2 ACEs	0.083 (0.267)	[-0.440, 0.606]	0.474 (0.336)	[-0.184, 1.13]	0.786 (0.491)	[-0.167, 1.737]
3 or more ACEs	-0.122 (0.288)	[-0.685, 0.441]	-0.483 (0.370)	[-1.21, 0.241]	-0.733 (0.556)	[-1.81, 0.344]
Two-way interactions						
Black × Age			0.045 (0.019) *	[0.008, 0.082]	0.004 (0.028)	[-0.051, 0.058]
Black × Age²			0.004 (0.002) *	[0.0002, 0.009]	0.004 (0.003)	[-0.002, 0.011]
Black × 1 ACE			0.000 (0.553)	[-1.08, 1.08]	1.20 (0.837)	[-0.419, 2.83]
Black × 2 ACEs			-1.93 (0.635) **	[-3.17, -0.682]	-0.994 (0.974)	[-2.88, 0.895]
Black × 3 or more ACEs			-0.254 (0.660)	[-1.55, 1.04]	1.52 (0.929)	[-0.283, 3.32]
1 ACE × Age			-0.010 (0.014)	[-0.037, 0.016]	0.004 (0.019)	[-0.032, 0.041]
2 ACE × Age			0.026 (0.016)	[-0.005, 0.057]	0.042 (0.021) *	[0.001, 0.083]
3 or more ACE × Age			-0.015 (0.017)	[-0.049, 0.018]	-0.014 (0.023)	[-0.059, 0.030]
1 ACE × Age²			0.003 (0.002) *	[0.0001, 0.006]	0.002 (0.002)	[-0.003, 0.006]
2 ACE × Age²			0.002 (0.002)	[-0.001, 0.006]	0.002 (0.002)	[-0.003, 0.007]
3 or more ACE × Age²			0.007 (0.002) ***	[0.003, 0.011]	0.007 (0.003) **	[0.002, 0.012]
Three-way interactions						
Black × 1 ACE × Age			0.001 (0.028)	[-0.054, 0.056]	0.063 (0.042)	[-0.019, 0.144]
Black × 2 ACE × Age			-0.113 (0.031) ***	[-0.174, -0.052]	-0.047 (0.047)	[-0.138, 0.045]
Black × 3 or more ACE × Age			-0.065 (0.032) *	[-0.127, -0.002]	0.034 (0.043)	[-0.051, 0.118]
Black × 1 ACE × Age²			-0.011 (0.003) ***	[-0.017, -0.005]	-0.018 (0.005) ***	[-0.027, -0.009]
Black × 2 ACE × Age²			0.000 (0.004)	[-0.007, 0.007]	-0.001 (0.005)	[-0.012, 0.009]
Black × 3 or more ACE × Age²			-0.004 (0.004)	[-0.011, 0.003]	-0.010 (0.005) *	[-0.020, -0.0003]
Low birthweight (ref. = No)						
Yes					-0.129 (0.575)	[-1.24, 0.985]
Nativity status (ref. = U.S. born)						

Born outside of the U.S.			-1.09 (1.05)	[-3.12, 0.938]
Parental obesity (ref. = No)				
Yes			2.61 (0.314) ***	[2.00, 3.22]
Exclusive breastfeeding (ref. = Yes)				
No			0.171 (0.335)	[-0.477, 0.822]
Household income			-0.004 (0.002)	[-0.008, 0.001]
Health insurance coverage (ref. = had no health insurance plan)				
had at least one health insurance plan			1.05 (0.467) *	[0.143, 1.95]
Public assistance (ref. = No)				
Yes			-0.029 (0.421)	[-0.843, 0.786]
Parental education (ref. = Some high school or less)				
Vocational training			-3.84 (2.42)	[-8.52, 0.848]
High school graduate			0.201 (0.639)	[-1.04, 1.44]
Some college or technical school			-0.393 (0.637)	[-1.63, 0.839]
College graduate			-0.571 (0.679)	[-1.89, 0.743]
Postgraduate			-0.402 (0.706)	[-1.77, 0.965]
Parental marital status (ref. = Single/never married)				
Married			0.260 (0.680)	[-1.06, 1.58]
Widowed			1.79 (1.08)	[-0.301, 3.88]
Divorced			0.532 (0.724)	[-0.870, 1.93]
Separated			0.048 (0.858)	[-1.61, 1.71]
Place of residence (ref. = Rural)				
Suburban			-0.328 (0.334)	[-0.974, 0.319]
Urban			-0.005 (0.351)	[-0.685, 0.674]
Religious service attendance (ref. = Never attends)				
< once a month			-0.018 (0.465)	[-0.918, 0.884]
< once a week			0.231 (0.453)	[-0.646, 1.11]
Once a week or more			0.333 (0.427)	[-0.494, 1.16]
Random effects (variances)				
Participants intercepts	19.81	19.72	18.28	
Residual error	7.53	7.49	6.98	
Model fit				
AIC	51,911.97	51,996.47	24,470.57	
BIC	51,976.35	52,182.46	24,771.84	
-2log-likelihood	51,893.97	51,944.47	24,376.57	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix I. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Female Respondents using the unadjusted BMI data.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.57 (0.137) ***	[26.30, 26.84]	26.57 (0.143) ***	[26.29, 26.85]	28.58 (0.824) ***	[26.96, 30.20]
Age	0.441 (0.005)	[0.431, 0.452]	0.414 (0.008) ***	[0.398, 0.429]	0.414 (0.008) ***	[0.399, 0.429]
Age^2	-0.017 (0.001) ***	[-0.018, -0.016]	-0.017 (0.001) ***	[-0.019, -0.015]	-0.017 (0.001) ***	[-0.019, -0.015]
Race (ref. = White)						
Black	2.35 (0.241) ***	[1.87, 2.82]	2.65 (0.269) ***	[2.12, 3.17]	2.38 (0.292) ***	[1.80, 2.95]
Below NSF standard (ref. = No)						
Yes	0.190 (0.090) *	[0.013, 0.366]	-0.017 (0.181)	[-0.371, 0.338]	-0.023 (0.181)	[-0.377, 0.331]
Two-way interactions						
Black × Age			0.118 (0.015) ***	[0.087, 0.148]	0.117 (0.015) ***	[0.097, 0.148]
Black × Age^2			-0.005 (0.002) *	[-0.008, -0.001]	-0.005 (0.002) *	[-0.008, -0.001]
Black × Below NSF standard			-0.414 (0.307) *	[-1.02, 0.189]	-0.387 (0.307)	[-0.989, 0.215]
Below NSF standard × Age			-0.014 (0.014)	[-0.043, 0.014]	-0.017 (0.014)	[-0.046, 0.011]
Below NSF standard × Age^2			0.002 (0.002)	[-0.001, 0.006]	0.002 (0.002)	[-0.001, 0.006]
Three-way interactions						
Black × Below NSF standard × Age			-0.012 (0.026)	[-0.063, 0.040]	-0.010 (0.026)	[-0.061, 0.041]
Black × Below NSF standard × Age^2			0.006 (0.003)	[-0.001, 0.012]	0.006 (0.003)	[-0.001, 0.012]
Low birthweight (ref. = No)						
Yes					-0.222 (0.453)	[-1.11, 0.669]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.78 (0.726) *	[-3.21, -0.356]
Parental obesity (ref. = No)						
Yes					3.49 (0.263) ***	[2.97, 4.00]
Exclusive breastfeeding (ref. = Yes)						
No					0.374 (0.308)	[-0.231, 0.979]
Household income					-0.005 (0.002) *	[-0.009, -0.0003]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					-0.546 (0.278) *	[-1.09, -0.002]
Public assistance (ref. = No)						
Yes					-0.622 (0.341)	[-1.29, 0.046]
Parental education (ref. = Some high school or less)						
Vocational training					-2.02 (1.80)	[-5.55, 1.52]
High school graduate					-1.10 (0.510) *	[-2.10, -0.092]

Some college or technical school			-1.70 (0.506) **	[-2.69, -0.700]
College graduate			-2.006 (0.539) ***	[-3.06, -0.95]
Postgraduate			-2.704 (0.561) ***	[-3.81, -1.60]
Parental marital status (ref. = Single/never married)				
Married			0.613 (0.529)	[-1.65, 0.428]
Widowed			-0.318 (0.817)	[-1.92, 1.29]
Divorced			-0.887 (0.571)	[-2.01, 0.236]
Separated			-0.101 (0.643)	[-1.36, 1.16]
Place of residence (ref. = Rural)				
Suburban			-0.826 (0.269) **	[-1.35, -0.298]
Urban			0.063 (0.274)	[-0.474, 0.601]
Religious service attendance (ref. = Never attends)				
< once a month			0.016 (0.417)	[-0.802, 0.834]
< once a week			-0.245 (0.424)	[-1.08, 0.589]
Once a week or more			0.276 (0.378)	[-0.465, 1.02]
Random effects (variances)				
Participants intercepts	30.12	30.04	27.08	
Residual error	12.54	12.38	12.37	
Model fit				
AIC	65,416.26	65,359.26	65,133.55	
BIC	65,467.38	65,461.51	65,389.18	
-2log-likelihood	65,402.26	65,331.26	65,063.56	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix J. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Male Respondents using the unadjusted BMI data.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.62 (0.115) ***	[26.39, 26.84]	26.66 (0.121) ***	[26.42, 26.89]	25.53 (0.691) ***	[24.17, 26.88]
Age	0.438 (0.005) ***	[0.429, 0.448]	0.429 (0.007) ***	[0.416, 0.443]	0.430 (0.007) ***	[0.416, 0.443]
Age^2	-0.017 (0.001) ***	[-0.018, -0.016]	-0.017 (0.001) ***	[-0.019, -0.016]	-0.017 (0.001) ***	[-0.019, -0.016]
Race (ref. = White)						
Black	0.395 (0.205)	[-0.006, 0.796]	0.282 (0.236)	[-0.180, 0.744]	0.410 (0.254)	[-0.087, 0.907]
Below NSF standard (ref. = No)						
Yes	0.148 (0.073) *	[0.005, 0.292]	0.135 (0.131)	[-0.121, 0.391]	0.233 (0.434)	[0.136, 0.376]
Two-way interactions						
Black × Age			0.005 (0.015)	[-0.024, 0.034]	0.004 (0.015)	[-0.025, 0.033]
Black × Age^2			0.002 (0.002)	[-0.002, 0.005]	0.002 (0.002)	[-0.001, 0.005]
Black × Below NSF standard			0.001 (0.246)	[-0.480, 0.483]	0.018 (0.245)	[-0.463, 0.498]
Below NSF standard × Age			0.022 (0.013)	[-0.003, 0.047]	0.021 (0.013)	[-0.004, 0.046]
Below NSF standard × Age^2			0.000 (0.001)	[-0.003, 0.003]	0.000 (0.001)	[-0.003, 0.003]
Three-way interactions						
Black × Below NSF standard × Age			-0.002 (0.024)	[-0.049, 0.046]	0.001 (0.024)	[-0.047, 0.048]
Black × Below NSF standard × Age^2			0.000 (0.003)	[-0.005, 0.006]	0.000 (0.003)	[-0.005, 0.005]
Low birthweight (ref. = No)						
Yes					0.233 (0.434)	[-0.620, 1.086]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-0.780 (0.681)	[2.12, 0.556]
Parental obesity (ref. = No)						
Yes					2.76 (0.227) ***	[2.31, 3.20]
Exclusive breastfeeding (ref. = Yes)						
No					0.090 (0.246)	[-0.392, 0.572]
Household income					-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					0.324 (0.239)	[-0.144, 0.792]
Public assistance (ref. = No)						
Yes					-0.646 (0.294) *	[-1.22, -0.069]
Parental education (ref. = Some high school or less)						
Vocational training					0.172 (1.636)	[3.04, 3.39]
High school graduate					0.123 (0.397)	[-0.656, 0.902]

Some college or technical school					-0.206 (0.406)	[-1.00, 0.590]
College graduate					-0.411 (0.454)	[-1.30, 0.479]
Postgraduate					-0.580 (0.475)	[-1.51, 0.35]
Parental marital status (ref. = Single/never married)						
Married					0.295 (0.470)	[-0.626, 1.22]
Widowed					0.771 (0.672)	[-0.547, 2.09]
Divorced					0.285 (0.492)	[-0.679, 1.25]
Separated					0.096 (0.601)	[-1.08, 1.28]
Place of residence (ref. = Rural)						
Suburban					-0.438 (0.226)	[-0.881, 0.005]
Urban					-0.214 (0.238)	[-0.681, 0.253]
Religious service attendance (ref. = Never attends)						
< once a month					0.346 (0.353)	[-0.348, 1.04]
< once a week					0.560 (0.342)	[-0.111, 1.23]
Once a week or more					0.566 (0.318)	[-0.059, 1.19]
Random effects (variances)						
Participants intercepts	19.67		19.65		18.37	
Residual error	7.50		7.49		7.49	
Model fit						
AIC	51,860.31		51,918.33		51,802.54	
BIC	51,910.38		52,018.47		52,052.90	
-2log-likelihood	51,846.32		51,890.32		51,732.54	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix K. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Female Respondents using unimputed Exposure and confounding variables.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.58 (0.143) ***	[26.30, 26.86]	26.58 (0.149) ***	[26.29, 26.87]	28.71 (1.17) ***	[26.43, 30.99]
Age	0.432 (0.006) ***	[0.420, 0.444]	0.400 (0.009) ***	[0.383, 0.417]	0.407 (0.012) ***	[0.384, 0.429]
Age^2	-0.014 (0.001) ***	[-0.015, -0.012]	-0.013 (0.001) ***	[-0.015, -0.011]	-0.014 (0.001) ***	[-0.016, -0.011]
Race (ref. = White)						
Black	2.45 (0.251) ***	[1.95, 2.94]	2.68 (0.281) ***	[2.13, 3.23]	2.19 (0.429) ***	[1.36, 3.03]
Below NSF standard (ref. = No)						
Yes	0.205 (0.100) *	[0.008, 0.401]	0.118 (0.199)	[-0.272, 0.507]	0.223 (0.284)	[-0.331, 0.781]
Two-way interactions						
Black × Age			0.123 (0.017) ***	[-0.090, 0.156]	0.107 (0.024) ***	[0.059, 0.155]
Black × Age^2			-0.005 (0.002) *	[-0.009, -0.001]	-0.001 (0.003)	[-0.007, 0.005]
Black × Below NSF standard			-0.551 (0.334)	[-1.21, 0.104]	-1.00 (0.495) *	[-1.97, -0.034]
Below NSF standard × Age			-0.004 (0.017)	[-0.037, 0.028]	-0.006 (0.023)	[-0.052, 0.040]
Below NSF standard × Age^2			0.001 (0.002)	[-0.003, 0.005]	-0.001 (0.003)	[-0.007, 0.004]
Three-way interactions						
Black × Below NSF standard × Age			-0.019 (0.030)	[-0.078, 0.039]	-0.023 (0.043)	[-0.108, 0.061]
Black × Below NSF standard × Age^2			0.007 (0.004)	[-0.00008, 0.014]	0.009 (0.005)	[-0.002, 0.019]
Low birthweight (ref. = No)						
Yes					-0.595 (0.574)	[-1.71, 0.521]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.90 (0.959)*	[-3.77, -0.039]
Parental obesity (ref. = No)						
Yes					3.43 (0.355) ***	[2.74, 4.12]
Exclusive breastfeeding (ref. = Yes)						
No					0.559 (0.394)	[-1.04, 1.09]
Household income					-0.005 (0.003)	[-0.010, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					0.023 (0.547)	[-1.04, 1.09]
Public assistance (ref. = No)						
Yes					0.244 (0.464)	[-0.658, 1.15]
Parental education (ref. = Some high school or less)						
Vocational training					-2.49 (2.35)	[-7.04, 2.07]
High school graduate					-1.07 (0.714)	[-2.45, 0.32]

Some college or technical school			-1.42 (0.708) *	[-2.79, -0.041]
College graduate			-2.01 (0.752) **	[-3.47, -0.550]
Postgraduate			-2.62 (0.788) ***	[-4.16, -1.09]
Parental marital status (ref. = Single/never married)				
Married			-1.46 (0.694) *	[-2.80, -0.107]
Widowed			-0.020 (1.22)	[-2.39, 2.35]
Divorced			-1.61 (0.753) *	[-3.08, -0.148]
Separated			-1.08 (0.897)	[-2.82, 0.666]
Place of residence (ref. = Rural)				
Suburban			-0.390 (0.386)	[-1.14, 0.360]
Urban			-0.546 (0.399)	[-1.32, 0.230]
Religious service attendance (ref. = Never attends)				
< once a month			-0.026 (0.583)	[-1.16, 1.11]
< once a week			-0.587 (0.580)	[-1.72, 0.541]
Once a week or more			0.061 (0.535)	[-0.979, 1.10]
Random effects (variances)				
Participants intercepts	31.94	31.89	25.93	
Residual error	12.87	12.70	12.37	
Model fit				
AIC	58,190.55	58,147.26	27,747.77	
BIC	58,240.76	58,247.69	27,973.33	
-2log-likelihood	58,176.54	58,119.26	27,677.77	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix L. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on NSF standard), and BMI among Male Respondents using unimputed Exposure and confounding variables.

	Model 4		Model 5		Model 6	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.62 (0.120) ***	[26.38, 26.85]	26.64 (0.126) ***	[26.40, 26.89]	24.55 (1.12) ***	[22.38, 26.72]
Age	0.429 (0.005) ***	[0.418, 0.439]	0.417 (0.008) ***	[0.403, 0.432]	0.415 (0.010) ***	
Age^2	-0.014 (0.001) ***	[-0.015, -0.013]	-0.014 (0.001) ***	[-0.016, -0.012]	-0.013 (0.001) ***	
Race (ref. = White)						
Black	0.337 (0.213)	[-0.080, 0.754]	0.301 (0.246)	[-0.181, 0.784]	0.507 (0.394)	[-0.259, 1.27]
Below NSF standard						
(ref. = No)			0.160 (0.141)			
Yes	0.154 (0.082)	[-0.007, 0.315]		[-0.117, 0.437]	0.129 (0.199)	[-0.259, 0.519]
Two-way interactions						
Black × Age			0.008 (0.017)	[-0.025, 0.040]	0.010 (0.023)	[-0.035, 0.056]
Black × Age^2			0.000 (0.002)	[-0.003, 0.004]	-0.005 (0.003)	[-0.010, -0.0003]
Black × Below NSF standard			-0.117 (0.267)	[-0.639, 0.405]	-0.328 (0.390)	[-1.09, 0.436]
Below NSF standard × Age			0.039 (0.015) ***	[0.010, 0.068]	0.044 (0.021)	[0.004, 0.084]
Below NSF standard × Age^2			-0.001 (0.002)	[-0.004, 0.002]	-0.001 (0.002)	[-0.006, 0.003]
Three-way interactions						
Black × Below NSF standard × Age			-0.035 (0.028)	[-0.090, 0.020]	-0.011 (0.041)	[-0.091, 0.0699]
Black × Below NSF standard × Age^2			0.003 (0.003)	[-0.003, 0.009]	0.008 (0.004)	[-0.001, 0.017]
Low birthweight (ref. = No)						
Yes					-0.065 (0.596)	[-1.22, 1.09]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-0.809 (1.12)	[-2.98, 1.36]
Parental obesity (ref. = No)						
Yes					2.67 (0.323) ***	[2.04, 3.29]
Exclusive breastfeeding (ref. = Yes)						
No					0.256 (0.345)	[-0.414, 0.927]
Household income					-0.004 (0.002)	[-0.008, 0.0005]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					1.21 (0.478) *	[0.287, 2.14]
Public assistance (ref. = No)						
Yes					0.022 (0.431)	-0.814, 0.859]
Parental education (ref. = Some high school or less)						
Vocational training					-3.17 (2.46)	[-7.95, 1.62]
High school graduate					0.165 (0.657)	[-1.11, 1.44]

Some college or technical school			-0.443 (0.656)	[-1.72, 0.829]
College graduate			-0.686 (0.698)	[-2.04, 0.670]
Postgraduate			-0.473 (0.727)	[-1.88, 0.938]
Parental marital status (ref. = Single/never married)				
Married			0.478 (0.703)	[-0.889, 1.84]
Widowed			2.31 (1.11) *	0.149, 4.47]
Divorced			0.854 (0.733)	[-0.570, 2.28]
Separated			0.082 (0.865)	[-1.60, 1.76]
Place of residence (ref. = Rural)				
Suburban			-0.331 (0.343)	[-0.998, 0.335]
Urban			-0.044 (0.361)	[-0.745, 0.658]
Religious service attendance (ref. = Never attends)				
< once a month			-0.083 (0.482)	[-1.02, 0.852]
< once a week			0.197 (0.465)	[-0.707, 1.10]
Once a week or more			0.287 (0.440)	[-0.567, 1.14]
Random effects (variances)				
Participants intercepts	20.64	20.63	18.95	
Residual error	7.66	7.65	7.18	
Model fit				
AIC	45,697.56	45,754.62	21,637.30	
BIC	45,746.65	45,852.80	21,856.93	
-2log-likelihood	45,683.56	45,726.62	21,567.30	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix M. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Female Respondents using the unadjusted BMI data.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.59 (0.138) ***	[26.32, 26.86]	26.55 (0.143) ***	[26.27, 26.83]	28.55 (0.823) ***	[26.93, 30.16]
Age	0.439 (0.005) ***	[0.428, 0.449]	0.406 (0.007) ***	[0.393, 0.419]	0.406 (0.007) ***	[0.392, 0.419]
Age^2	-0.017 (0.001) ***	[-0.018, -0.016]	-0.016 (0.001) ***	[-0.017, -0.015]	-0.016 (0.001) ***	[-0.018, -0.015]
Race (ref. = White)						
Black	2.35 (0.241) ***	[1.88, 2.82]	2.62 (0.268) ***	[2.09, 3.14]	2.35 (0.291) ***	[1.78, 2.92]
Below seven-hour standard (ref. = No)						
Yes	0.088 (0.101)	[-0.109, 0.285]	0.076 (0.189)	[-0.293, 0.446]	-0.219 (0.453)	[-0.307, 0.431]
Two-way interactions						
Black × Age			0.111 (0.014) ***	[0.084, 0.138]	0.111 (0.014) ***	[0.083, 0.138]
Black × Age^2			-0.004 (0.002) *	[-0.007, -0.0004]	-0.004 (0.002) *	[-0.007, -0.0004]
Black × Below seven-hour standard			-0.379 (0.316)	[-0.998, 0.239]	-0.347 (0.315)	[-0.964, 0.271]
Below seven-hour standard × Age			0.006 (0.020)	[-0.032, 0.044]	0.004 (0.019)	[-0.034, 0.043]
Below seven-hour standard × Age^2			-0.000 (0.002)	[-0.058, 0.070]	-0.000 (0.002) *	[-0.004, 0.004]
Three-way interactions						
Black × Below seven-hour standard × Age			0.006 (0.032)	[-0.058, 0.070]	0.007 (0.032)	[-0.057, 0.070]
Black × Below seven-hour standard × Age^2			0.004 (0.004)	[-0.003, 0.112]	0.004 (0.004)	[-0.003, 0.011]
Low birthweight (ref. = No)						
Yes					-0.219 (0.453)	[-1.11, 0.671]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.77 (0.725) *	[-3.19, -0.345]
Parental obesity (ref. = No)						
Yes					3.49 (0.263) ***	[2.97, 4.01]
Exclusive breastfeeding (ref. = Yes)						
No					0.374 (0.308)	[-0.230, 0.979]
Household income					-0.005 (0.002) *	[-0.009, -0.0003]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					-0.543 (0.277)	[-1.087, 0.0005]
Public assistance (ref. = No)						
Yes						[-1.29, 0.046]
Parental education (ref. = Some high school or less)						
Vocational training					-1.99 (1.80)	[-5.52, 1.54]
High school graduate					-1.10 (0.510) *	[-2.10, -0.093]

Some college or technical school			-1.69 (0.506) **	[-2.68, -0.695]
College graduate			-2.00 (0.539) ***	[-3.06, -0.943]
Postgraduate			-2.68 (0.561) ***	[-3.79, -1.59]
Parental marital status (ref. = Single/never married)				
Married			-0.611 (0.529)	[-1.65, 0.430]
Widowed			-0.307 (0.817)	[-1.91, 1.30]
Divorced			-0.884 (0.571)	[-2.01, 0.24]
Separated			-0.090 (0.643)	[-1.35, 1.17]
Place of residence (ref. = Rural)				
Suburban			-0.818 (0.269) ***	[-1.35, -0.291]
Urban			0.064 (0.274)	[-0.473, 0.602]
Religious service attendance (ref. = Never attends)				
< once a month			0.020 (0.417)	[-0.798, 0.837]
< once a week			-0.242 (0.423)	[-1.07, 0.589]
Once a week or more			0.277 (0.378)	[-0.463, 1.02]
Random effects (variances)				
Participants intercepts	30.11	30.01	27.06	
Residual error	12.55	12.39	12.39	
Model fit				
AIC	65,419.73	65,365.34	65,140.36	
BIC	65,470.85	65,467.59	65,395.98	
-2log-likelihood	65,405.72	65,337.34	65,070.36	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix N. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Male Respondents using the unadjusted BMI data.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.61 (0.115) ***	[26.38, 26.83]	26.64 (0.121) ***	[26.41, 26.88]	25.53 (0.691) ***	[24.17, 26.88]
Age	0.435 (0.005) ***	[0.425, 0.445]	0.427 (0.006) ***	[0.415, 0.440]	0.428 (0.006) ***	[0.415, 0.440]
Age²	-0.017 (0.001) ***	[-0.018, -0.016]	-0.017 (0.001) ***	[-0.019, -0.016]	-0.017 (0.001) ***	[-0.019, -0.016]
Race (ref. = White)						
Black	0.391 (0.205)	[-0.010, 0.792]	0.274 (0.235)	[-0.186, 0.734]	0.401 (0.253)	[-0.095, 0.897]
Below seven-hour standard (ref. = No)						
Yes	0.206 (0.082) *	[0.045, 0.368]	0.177 (0.134)	[-0.085, 0.439]	0.160 (0.134)	[-0.101, 0.422]
Two-way interactions						
Black × Age			0.010 (0.013)	[-0.017, 0.036]	0.009 (0.013)	[-0.017, 0.036]
Black × Age²			0.001 (0.002)	[-0.002, 0.005]	0.001 (0.002)	[-0.002, 0.005]
Black × Below seven-hour standard			0.030 (0.251)	[-0.461, 0.522]	0.049 (0.250)	[-0.442, 0.539]
Below seven-hour standard × Age			0.043 (0.018) *	[0.008, 0.077]	0.042 (0.018) *	[0.007, 0.076]
Below seven-hour standard × Age²			-0.002 (0.002)	[-0.005, 0.002]	-0.002 (0.002)	[-0.005, 0.002]
Three-way interactions						
Black × Below seven-hour standard × Age			-0.040 (0.030)	[-0.100, 0.019]	-0.038 (0.030)	[-0.097, 0.021]
Black × Below seven-hour standard × Age²			0.003 (0.003)	[-0.003, 0.009]	0.003 (0.003)	[-0.003, 0.009]
Low birthweight (ref. = No)						
Yes					0.232 (0.434	[-0.620, 1.085]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-0.777 (0.681)	[-2.11, 0.559]
Parental obesity (ref. = No)						
Yes					2.75 (0.227) ***	[2.31, 3.20]
Exclusive breastfeeding (ref. = Yes)						
No					0.088 (0.246)	[-0.394, 0.570]
Household income					-0.002 (0.002)	[-0.006, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					0.321 (0.239)	[-0.147, 0.789]
Public assistance (ref. = No)						
Yes					-0.647 (0.294) *	[-1.22, -0.071]
Parental education (ref. = Some high school or less)						
Vocational training					0.177 (1.64)	[-3.04, 3.39]
High school graduate					0.121 (0.397)	[-0.658, 0.900]

Some college or technical school			-0.207 (0.406)	[-0.00, 0.590]
College graduate			-0.413 (0.454)	[-1.30, 0.477]
Postgraduate			-0.585 (0.474)	[-1.52, 0.346]
Parental marital status (ref. = Single/never married)				
Married			0.289 (0.470)	[-0.632, 1.21]
Widowed			0.765 (0.672)	[-0.553, 2.08]
Divorced			0.280 (0.492)	[-0.684, 1.24]
Separated			0.092 (0.601)	[-1.09, 1.27]
Place of residence (ref. = Rural)				
Suburban			-0.440 (0.226)	[-0.883, 0.002]
Urban			-0.214 (0.238)	[-0.681, 0.253]
Religious service attendance (ref. = Never attends)				
< once a month			0.346 (0.353)	[-0.348, 1.04]
< once a week			0.558 (0.342)	[-0.113, 1.23]
Once a week or more			0.564 (0.318)	[-0.060, 1.19]
Random effects				
Participants intercepts	19.66	19.64	18.36	
Residual error	7.50	7.49	7.49	
Model fit				
AIC	51,857.85	51,913.34	51,797.69	
BIC	51,907.92	52,013.49	52,048.05	
-2log-likelihood	51,843.86	51,885.34	51,727.70	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix O. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Female Respondents using unimputed Exposure and confounding variables.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.59 (0.138) ***	[26.32, 26.86]	26.56 (0.143) ***	[26.28, 26.84]	28.99 (1.13) ***	[26.80, 31.18]
Age	0.430 (0.005) ***	[0.419, 0.440]	0.397 (0.007) ***	[0.383, 0.410]	0.404 (0.009) ***	[0.386, 0.422]
Age²	-0.013 (0.001) ***	[-0.014, -0.012]	-0.013 (0.001) ***	]-0.014, -0.011]	-0.013 (0.001) ***	[-0.015, -0.010]
Race (ref. = White)						
Black	2.37 (0.242) ***	[1.89, 2.84]	2.62 (0.269) ***	[2.09, 3.14]	2.13 (0.410) ***	[1.33, 2.93]
Below seven-hour standard (ref. = No)						
Yes	0.121 (0.101)	[-0.076, 0.318]	0.130 (0.189)	[-0.240, 0.499]	0.196 (0.272)	[-0.334, 0.731]
Two-way interactions						
Black × Age			0.111 (0.014) ***	[0.084, 0.138]	0.100 (0.020) ***	[-1.44, 0.391]
Black × Age²			-0.004 (0.002) *	[-0.029, -0.0002]	-0.000 (0.003)	[0.061, 0.140]
Black × Below seven-hour standard			-0.388 (0.315)	[-1.01, 0.230]	-0.526 (0.469)	[-0.051, 0.061]
Below seven-hour standard × Age			0.010 (0.020)	[-0.029, 0.048]	0.005 (0.028)	[-0.005, 0.005]
Below seven-hour standard × Age²			-0.000 (0.002)	[-0.005, 0.004]	-0.002 (0.003)	[-0.008, 0.004]
Three-way interactions						
Black × Below seven-hour standard × Age			0.000 (0.032)	[-0.063, 0.064]	0.005 (0.048)	[-0.089, 0.099]
Black × Below seven-hour standard × Age²			0.004 (0.004)	[-0.003, 0.012]	0.004 (0.005)	[-0.006, 0.015]
Low birthweight (ref. = No)						
Yes					-0.600 (0.552)	[-1.67, 0.473]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.97 (0.915) *	[-3.75, -0.188]
Parental obesity (ref. = No)						
Yes					3.42 (0.342) ***	[2.76, 4.09]
Exclusive breastfeeding (ref. = Yes)						
No					0.439 (0.379)	[-0.298, 1.18]
Household income					-0.005 (0.003)	[-0.010, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					-0.010 (0.526)	[-1.03, 1.01]
Public assistance (ref. = No)						
Yes					0.130 (0.446)	[-0.737, 0.998]
Parental education (ref. = Some high school or less)						
Vocational training					-2.00 (2.26)	[-6.40, 2.39]
High school graduate					-1.07 (0.687)	[-2.41, 0.262]

Some college or technical school			-1.34 (0.681) *	[-2.66, -0.014]
College graduate			-1.94 (0.723) **	[-3.35, -0.537]
Postgraduate			-2.53 (0.758) ***	[-4.00, -1.05]
Parental marital status (ref. = Single/never married)				
Married			-1.67 (0.666) *	[-2.96, -0.371]
Widowed			0.096 (1.17)	[-2.169, 2.361]
Divorced			-1.71 (0.724) *	[-3.11, -0.298]
Separated			-1.36 (0.858)	[-3.02, 0.315]
Place of residence (ref. = Rural)				
Suburban			-0.442 (0.370)	[-1.16, 0.277]
Urban			-0.539 (0.383)	[-1.28, 0.205]
Religious service attendance (ref. = Never attends)				
< once a month			-0.070 (0.558)	[-1.15, 1.02]
< once a week			-0.665 (0.558)	[-1.74, 0.414]
Once a week or more			0.021 (0.511)	[-0.972, 1.02]
Random effects (variances)				
Participants intercepts	30.24	30.14	24.41	
Residual error	12.54	12.39	12.12	
Model fit				
AIC	65,165.87	65,112.30	31,201.34	
BIC	65,216.96	65,214.49	31,431.42	
-2log-likelihood	65,151.86	65,084.30	31,131.34	

N = 2,813 respondents with a total of 10, 978 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

Appendix P. Parameter Estimates of Multilevel Growth Curve Models of Race, Short Sleep Duration (assessed based on seven-hour standard), and BMI among Male Respondents using unimputed Exposure and confounding variables.

	Model 7		Model 8		Model 9	
Fixed Effects	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]	Beta (SE)	[95% CI]
Intercept	26.62 (0.116) ***	[26.39, 26.84]	26.64 (0.121) ***	[26.40, 26.88]	24.79 (1.08) ***	[22.70, 26.89]
Age	0.425 (0.005) ***	[0.416, 0.435]	0.417 (0.006) ***	[0.405, 0.429]	0.417 (0.008) ***	[0.400, 0.433]
Age^2	-0.014 (0.001) ***	[-0.015, -0.013]	-0.014 (0.001) ***	[-0.016, -0.013]	-0.013 (0.001) ***	[-0.015, -0.011]
Race (ref. = White)						
Black	0.329 (0.205)	[-0.072, 0.731]	0.253 (0.235)	[-0.207, 0.714]	0.536 (0.380)	[-0.203, 1.27]
Below seven-hour standard (ref. = No)						
Yes	0.212 (0.082) *	[0.051, 0.373]	0.184 (0.134)	[-0.079, 0.4462]	0.136 (0.189)	[-0.234, 0.508]
Two-way interactions						
Black × Age			0.009 (0.013)	[-0.017, 0.036]	0.011 (0.019)	[-0.027, 0.049]
Black × Age^2			0.001 (0.002)	[-0.002, 0.004]	-0.006 (0.002) *	[-0.010, -0.001]
Black × Below seven-hour standard			0.039 (0.249)	[-0.449, 0.528]	-0.171 (0.367)	[-0.888, 0.549]
Below seven-hour standard × Age			0.045 (0.018) *	[0.010, 0.079]	0.035 (0.025)	[-0.015, 0.084]
Below seven-hour standard × Age^2			-0.002 (0.002)	[-0.005, 0.001]	-0.001 (0.002)	[-0.006, 0.004]
Three-way interactions						
Black × Below seven-hour standard × Age			-0.039 (0.030)	[-0.098, 0.021]	-0.023 (0.044)	[-0.108, 0.064]
Black × Below seven-hour standard × Age^2			0.003 (0.003)	[-0.003, 0.009]	0.009 (0.004) *	[0.0003, 0.018]
Low birthweight (ref. = No)						
Yes					-0.134 (0.573)	[-1.25, 0.979]
Nativity status (ref. = U.S. born)						
Born outside of the U.S.					-1.18 (1.05)	[-3.21, 0.853]
Parental obesity (ref. = No)						
Yes					2.58 (0.314) ***	[1.97, 3.19]
Exclusive breastfeeding (ref. = Yes)						
No					0.178 (0.335)	[-0.473, 0.830]
Household income					-0.004 (0.002)	[-0.008, 0.001]
Health insurance coverage (ref. = had no health insurance plan)						
had at least one health insurance plan					1.10 (0.465) *	[0.193, 2.00]
Public assistance (ref. = No)						
Yes					-0.009 (0.418)	[-0.822, 0.804]
Parental education (ref. = Some high school or less)						
Vocational training					-3.17 (2.40)	[-7.83, 1.51]
High school graduate					0.237 (0.637)	[-1.00, 1.47]

Some college or technical school			-0.323 (0.636)	[-1.56, 0.910]
College graduate			-0.569 (0.678)	[-1.89, 0.746]
Postgraduate			-0.398 (0.705)	[-1.77, 0.971]
Parental marital status (ref. = Single/never married)				
Married			0.233 (0.679)	[-1.09, 1.55]
Widowed			1.84 (1.08)	[-0.253, 3.93]
Divorced			0.56 (0.707)	[-0.815, 1.93]
Separated			-0.012 (0.837)	[-1.64, 1.61]
Place of residence (ref. = Rural)				
Suburban			-0.302 (0.333)	[-0.948, 0.344]
Urban			-0.001 (0.351)	[-0.682, 0.680]
Religious service attendance (ref. = Never attends)				
< once a month			-0.007 (0.465)	[-0.909, 0.895]
< once a week			0.220 (0.450)	[-0.655, 1.09]
Once a week or more			0.328 (0.425)	[-0.498, 1.15]
Random effects (variances)				
Participants intercepts	19.68	19.66	18.3	
Residual error	7.50	7.50	7.00	
Model fit				
AIC	51,645.65	51,702.93	24,339.12	
BIC	51,695.69	51,803.01	24,563.35	
-2log-likelihood	51,631.65	51,674.93	24,269.12	

N = 2,618 respondents with a total of 9,444 observations. P-values: * < .05, ** < .01, *** < .001. CI: confidence interval. Age was grand mean centered at 23.9 years among females and 23.54 years among males. Household income was grand mean centered at 48.36 per $1000.

CURRICULUM VITAE

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Education

Ph.D. in Sociology (Demography) August 2023
Utah State University, Logan, Utah, United States
Committee: Eric Reither (co-chair), Hyojun Park (co-chair), Sarah Schwartz, Guadalupe Marquez-Velarde, Sojung Lim

M.Phil. in Demography and Social Statistics May 2018
Obafemi Awolowo University, Ile Ife, Nigeria

B.Sc. in Demography and Social Statistics (with Highest Distinction) March 2013
Obafemi Awolowo University, Ile Ife, Nigeria

Professional Appointments

Graduate Teaching and Research Assistant August 2019 – July 2023
Department of Sociology and Anthropology, Utah State University, United States

Lecturer March 2016 – August 2019
Department of Demography and Social Statistics, Federal University, Birnin Kebbi, Nigeria

Demographic Specialist October 2018 – November 2018
Adams Smith International West Africa Ltd (ASIWA), Abuja, Nigeria

Graduate Intern January 2015 – June 2015
KPMG Consulting Firm Victoria Island, Lagos, Nigeria

Publications

Journal Articles

2023 Abbani, Y.A., Sawangdee, Y., **Omisakin, O.A.**, and Maretalinia, M. Socio-Demographic Determinants of Non-Utilisation of Antenatal Care Services by Women in the Northern Region of Nigeria. *Journal of Health Research*, 37(4).

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2020 Omoleke, S.A., Ajibola, O., **Omisakin, O.A.**, and Umeh, G.C. Vaccine hesitancy among medical practitioners. *Sahel Medical Journal*, *23*(2), 126.

2019 Adedini, S. A., **Omisakin, O. A.**, and Somefun, O. D. Trends, patterns, and determinants of long-acting reversible methods of contraception among women in sub-Saharan Africa. *PLoS ONE*, *14*(6).

2018 Gulumbe, U., Alabi, O., **Omisakin, O. A.**, and Omoleke, S. Maternal mortality ratio in selected rural communities in Kebbi State, Northwest Nigeria. *BMC Pregnancy and Childbirth*, *18*(1), 503.

2018 Alabi, O., **Omisakin, O.A.**, and Alabi, A. Under-age marital childbirth in north-west Nigeria: Implications for child health. *African Population Studies*, *32*(3).

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2017 Adedini, S.A., **Omisakin, O.A.**, Oyinlola, F.F., Abe, J.O., and Adetutu, O.M. "Poor Maternal and Child Health Care Utilization in Nigeria: Does Partners' Age Difference Matter?" *Ife Social Sciences Review* 25:1–12.

2016 Titilayo, A., Palamuleni, M. E., and **Omisakin, O.A.** Sociodemographic factors influencing adherence to antenatal iron supplementation recommendations among pregnant women in Malawi: Analysis of data from the 2010 Malawi Demographic and Health Survey. *Malawi Medical Journal*, *28*(1), 1–5.

2015 Titilayo, A., Palamuleni, M. E., and **Omisakin, O.A.** Knowledge of Causes of Maternal Deaths and Maternal Health Seeking Behaviour in Nigeria. *African Population Studies*, *29*(2)

2014 Titilayo, A., **Omisakin, O. A.**, and Ogunfowokan, A. A. Early Childbirth and its Implications for Household Living Condition Among Women in Nigeria. *Social Work Review*, 133–145.

2014 Titilayo, A., **Omisakin, O. A.**, and Ehindero, S. A. Influence of Women's Attitude on the Perpetration of Gender-Based Domestic Violence in Nigeria. *Gender and Behavior, 12(2)*. Ife Center for Psychological Studies/ Services.

Book Chapter

2020 Alabi, O., Shamaki, M. A., **Omisakin, O. A.**, Giro, M., & Odusina, E. K. Family and Household Issues in Northern Nigeria: Change and Continuity. In C. O. Odimegwu (Ed.), *Family Demography and Post-2015 Development Agenda in Africa* (pp. 287–300). Springer International Publishing.

Grants and Awards

Utah State University Diversity Award in the student category. The Division of Diversity, Equity, & Inclusion. 2022.

Clifford C. Clogg Scholarship to attend the Inter-university Consortium for Political and Social Research (ICPSR) summer program. 2022. $2600.

CHaSS Summer Graduate Student-Faculty Funding. Utah State University. 2022. $5,000.

Graduate Enhancement Award. Utah State University Student Association. 2021-22. $5,000.

International Student Council Scholarship, An award for leadership in the International Student Council, Utah State University. 2021-22. $500.

Utah State University Travel Award, for conference paper presentation at the Population Association of America annual meeting. 2022. $1,300.

Best Poster Presenter, Population Association of America annual meeting. 2021.

Professor Aderanti Adepoju Prize, An award to a student with the overall best performance in the Department of Demography and Social Statistics, Obafemi Awolowo University, Nigeria. 2014.

Presentations

2022 **Omisakin, O.A.** Mother's educational attainment and diarrhea prevalence among Black children. Population Association of America Conference, Atlanta, Georgia.

2021 **Omisakin, O.A.**, Park, H., Roberts, M.T., Reither, E.N. Contributors to reduced life expectancy among Native Americans in the Four Corner States. Demography Seminar, Yun Kim Population Research Lab, Utah State University.

2021 **Omisakin, O.A.**, Reither, E.N., Park, H., Roberts, M.T. Contributors to reduced life expectancy among Native Americans in the Four Corner States. Population Association of America Virtual Conference.

Research in Progress

Olusola A. Omisakin, Jessica D. Ulrich-Schad, Aaron Hunt, Jennifer Givens, and Mitchell Beacham. Belief in Vaccine Myths and Vaccine Uptake in Utah During the COVID-19 Pandemic. *Preventive Medicine Reports* (Submitted 03/10/2023).

Oluwaseun Emoruwa, Gabe Miller, Gbenga Elufisan, Guadalupe Marquez-Velarde, David Ademule, **Olusola A. Omisakin**, Guizhen Ma, Stephanie Hernandez, and Verna Keith. "Physical Health among Black Immigrants by Region of Birth: A Test of the Racial Context Hypothesis." *Ethnicity and Health* (Submitted 02/02/2023)

Courses Taught

Utah State University, United States
SOC 3120: Social Statistics I (F 2021, S 2023)

Federal University Birnin Kebbi, Nigeria
DSS 105/106: Mathematics for Social Scientists
DSS 302: Introduction to Demographic Analysis
DSS 305/405: Social Statistics
DSS 408: Reproductive Health

Professional Development

ICPSR summer course on structural equation models with latent variables at the University of Michigan. July 18 – August 12, 2022.

Development research in practice workshop, The World Bank Group's Development Impact Evaluation (DIME) department, September 2021.

Max Planck Institute for Demographic Research online course on data visualization – the art/skill cocktail (IDEM 181), June 2021.

Seventh annual Berkeley workshop in Formal Demography, Berkeley Population Center, University of California, May 2021.

Collaborative Institutional Training Initiative (CITI) on social and behavioral research, Utah State University, October 2020.

International teaching assistant workshop, Intensive English Language Institute, Utah State University, August 2020.

Grant proposal writing workshop, Utah State University, September 2019.

Software Proficiencies

R / R-Markdown, Stata, SPSS and Qualtrics

Community Service

Vice President (Student life and advocate), International Student Council, Utah State University, 2021-2022.

College of Humanities and Social Sciences (CHaSS) Representative on Graduate Student Council, 2021-2022.

Member of Utah State University Student Association (USUSA) Hearing Board, 2021-2022.

Poster Discussant for the Population Association of America, 2022.

Reviewer for: Epidemiology, PLOS ONE, Sleep Health.

Professional Memberships

American Sociological Association (ASA)
Population Association of America (PAA)
International Union for the Scientific Study of Population (IUSSP)
International Sociology Honor Society (Alpha Kappa Delta)