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Individual-Level and Socio-Contextual Influences on Body Mass Index and Achievement in
Adolescence to Young Adulthood

There has been much cause for concern regarding the high rates of obesity among children and adolescents living in the United States. According to reports from the Centers for Disease Control, approximately 33% of the nation's youth are considered overweight or obese (Fryar, Carroll, & Ogden, 2014). Prior to more current data suggesting that the rates of overweight and obesity among youth have been on a recent decline, (Ogden, Carroll, Kit, Flegal, 2014), among adolescents in particular, earlier research suggested that rates had more than tripled several decades leading up to 2008 (Ogden & Carroll, 2010). Recent studies addressing the health and social consequences associated with adolescents' overweight status suggests that its effects are both immediate and far-reaching (Bae, Wickrama, Walker O'Neal, 2014). Among its health consequences, overweight youth are at an increased risk for developing diabetes and cardiovascular diseases such as high cholesterol and high blood pressure (CDC, 2011; Freedman, Khan, Dietz, Srinivasan, Berenson, 2001; Li, Ford, Zhao, Mokdad, 2009). Equally as devastating are the social consequences that these youth face (Bae et al. 2014); they tend to have fewer friendships, experience lower self-esteem, and are at an increased risk for social stigmatization and isolation due to their weight (Strauss & Pollack, 2003). Furthermore, overweight youth face an increased chance of becoming overweight adults, thereby placing them at an even greater risk for decreased health and well-being in adulthood (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001).

In addition to health and social consequences, youth's overweight status is likely to impact other developmental outcomes in negative ways. For example, a review of literature addressing the linear relationship between overweight status among school-aged children and

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academic outcomes suggests that those who were overweight experienced lower academic achievement (Taras & Potts-Datema, 2005). However, though such linear associations have been tested, less is known about the impact that being overweight has on achievement from adolescence into young adulthood. Further, even fewer studies have explored the possible factors that moderate overweight status and academic achievement in adolescence. Therefore, based on theory and a review of the literature, the current study explores the association between medically-defined weight status (i.e., BMI) and academic performance from adolescence into young adulthood, and moderates effects of individual-level and socio-contextual factors.

Theoretical Perspective

The Social Cognitive Theory

Social Cognitive theory posits that “human functioning is rooted in social systems” (Bandura, 2011, p. 349). In this view, the human experience is a representation of a culmination of influences, primarily at the individual, interpersonal, and societal levels. Therefore, matters relating to one’s health and well-being involve a bidirectional interplay between individual characteristics, one’s observation and replication of the behaviors of others, as well as the influence of the environment in which they live. Adolescents’ overweight status for example, may be influenced by socio-demographic characteristics (i.e., gender, race/ethnicity, etc.), in addition to the dietary habits of those around them (i.e., observing the performances of others in their communities). These behaviors may be further linked to socio-contextual factors such as the condition of the communities in which they live (Singh, Siahpush, & Kogan, 2010; Wickrama, Wickrama, & Bryant, 2006).

Bandura’s (2004) Social Cognitive theory offers a core set of determinants from which to explore the potential risks and protective factors that may influence an individual’s propensity

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towards being overweight, given its focus on the bidirectional influence of the primary matters affecting adolescent and young adult obesity. Such an investigation is likely to have meaningful implications for individual's health, social well-being, and other important developmental markers, such as academic success.

Review of the Literature

Body Mass Index (BMI) and Academic Achievement

Adolescents are particularly susceptible to the increased risks associated with poor dietary habits (Ambrosini et al., 2009). Compared to adults, they are less likely to consume healthy meals and less likely to engage in physical activity for the sole purpose of improving their health (Harris, Gordon-Larsen, Chantala, & Udry, 2006). Unfortunately, such behaviors developed and maintained during adolescence are likely to lay the foundation for future issues surrounding overweight and obesity in adulthood (Kvaavik, Tell, & Klepp, 2003). Beyond the health and social consequences associated with being overweight however, limited research has explored its effects on other developmental outcomes. One such outcome that warrants further investigation is academic achievement—during adolescence and into young adulthood—given its significance to overall health and well-being (Hofferth & Sandberg, 2001).

Healthy weight proportions are often indicative of a healthy eating habit, a healthy lifestyle, and a generally positive disposition (Ambrosini et al., 2009). Therefore, it is not surprising that weight status is associated with other important developmental outcomes such as academic achievement, particularly among students at the secondary level (Sabia, 2007).

In a European adolescent sample, Kristjánsson and colleagues (2010) found that students who reported higher BMIs were also more likely to report lower academic achievement. Sabia (2007) also found an inverse association between female adolescent's BMI and academic

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achievement. Findings regarding such linear associations however, are not always consistent. In contrast to the aforementioned findings, Baxter and colleagues (2011) did not find a significant association between youth's BMI and academic-related outcomes.

Furthermore, overweight youth have a greater chance of becoming overweight adults (Bae et al., 2014). According to Freedman and colleagues (2001), they are far more susceptible to chronic weight-related illnesses, which may impact future development. However, to date, virtually no recent studies have examined the impact that being overweight may have on achievement among adolescents as they enter young adulthood. Therefore, in this study, the association between BMI and adolescents' academic achievement is investigated using a nationally representative U.S. sample. Additionally, this study also extends the current literature by exploring the association between overweight status in adolescence and achievement among them, as they enter young adulthood. Findings from this investigation may provide insight as to the far-reaching effects of being overweight.

The Influence of Individual-Level Factors

According to the literature, there are several factors that could potentially moderate the association between being overweight and adolescents' academic achievement, including race and ethnicity, gender, and family structure. For example, African-American and Hispanic adolescents often report the highest prevalence of being overweight, compared to their White peers (Harris et al., 2006; Wang & Beydoun, 2007). Over the last 30 years, such high rates are noticeable from age 6, and remain consistent into young adulthood (Freedman, Khan, Serdula, Ogden, & Dietz, 2006; Ogden et al., 2014).

Based on a sample of 8th to 12th grade youth, Delva and colleagues (2006) found that, in comparison to their White peers, African American and Hispanic youth were more likely to

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engage in unhealthy habits such as eating fewer breakfast meals, exercising less, and viewing extended hours of television. Research suggests that such habits contribute to being overweight and engaging in such practices may also hinder academic performance (Datar, Sturm, & Magnabosco, 2004; Delva, O'Malley, & Johnston, 2006). Datar and colleagues (2004) reported that, as early as elementary school, overweight children consistently reported lower math and reading scores. Given the linkage between BMI, race, and academic achievement, it may be worthwhile to investigate the influence of race and BMI on academic achievement, using a nationally representative adolescent sample.

Findings regarding gender and BMI appear somewhat inconsistent. Some studies have found that female adolescents report higher BMIs than their male peers (Neumark-Sztainer, Wall, Eisenberg, Story, & Hannan, 2006); while other studies have reported the inverse relationship (Haines, Neumark-Sztainer, Wall, & Story, 2007). A possible explanation for this inconsistency is the fluctuation in weight gain that tends to occur between the genders throughout the course of adolescence. Generally, trends seem to suggest that early adolescent females and males may have somewhat similar weights, with males being slightly heavier. Females however, tend to experience greater changes in weight as they get older (Neumark-Sztainer et al., 2006).

Relative to academic achievement, female adolescents typically report higher grade point averages than their male peers (Duckworth & Seligman, 2006; Gordon & Cui, 2012). However, when they exhibit concern over their weight, females tend to display lower academic performance. For example, Sabia (2007) found a significant negative association between BMI and grade point averages among a sample of adolescent females aged 14-17. Although this study did not specifically assess the moderating influence of gender and BMI on academic

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achievement, its finding suggests a possible variation between them, given a broader adolescent sample.

Regarding family structure, adolescents from single-parent households are considerably more likely to be overweight than those living with two biological parents (Huffman, Kanikireddy, & Patel, 2010). Ambrosini and colleagues (2009) reported that, compared to adolescents from two-biological parent families, those from single-parent families consumed fewer healthy meals options such as fruits and vegetables, and devoted a greater number of hours to sedentary activities such as television watching.

Further, adolescents raised by single parents are less likely to partake in behaviors that have been shown to affect their health, and subsequently, their academic performance (Datar et al., 2004; Delva et al., 2006). These behaviors include skipping breakfast, getting an appropriate number of hours of sleep, and participating in physical activity (Harris et al., 2006). Therefore, given the link between family structure, dietary patterns, and academic achievement, an investigation of family structure as a possible moderating variable between adolescent weight status and academic achievement, may extend the literature in a meaningful way.

The Influence of Socio-Contextual Factor: Economic Disadvantage

Additionally, socio-contextual factors may have a profound impact on adolescent BMI (Wickrama et al., 2006). For instance, the prevalence of overweight individuals tends to be significantly higher among adolescents residing in low-income communities, rather than in more affluent ones (Harris et al., 2006). Research suggests that this occurs largely through indirect effects of the physical environment of the community itself, and as such, may contribute to the greater prevalence of overweight individuals among its adolescent residents (Harris et al., 2006; Lee et al., 2009). For example, high crime rates along with a high frequency of delinquency

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within low-income communities may deter youth from participating in physical activity outside of their homes (Gordon-Larsen, McMurray, & Popkin, 2000). Also, such communities are less likely to provide adequate recreational facilities, such as parks and sports-related centers (Moore, Roux, Evenson, McGinn, & Brines, 2008). Additionally, Larson, Story, and Nelson (2009) reported that, compared to more affluent communities, low-income communities have fewer chain supermarkets and grocery stores, in addition to a greater availability of fast-food restaurants. Convenience stores and fast-food restaurants tend to offer high caloric foods items, further contributing to the higher rates of overweight individuals among its residents.

Relative to their peers, adolescents residing in low-income communities tend to experience lower academic achievement, which may also be a reflection of the indirect effects of the physical community (McBride Murry, Berkel, Gaylord-Harden, Copeland-Linder, & Nation, 2011). For example, schools in low-income communities are often understaffed and under-resourced, which, according to McBride and colleagues (2011), further impacts the quality of the education students receive. Therefore, based on previous literature, the present study explores the association between overweight status, economic disadvantage, and academic achievement.

The Present Study

In sum, the goal of the present study is to test whether individual-level and socio-contextual factors influence the association between body mass index and adolescents' academic achievement. Based on theoretical perspective and previous literature, the following hypotheses were formulated: 1) there is a significant negative association between BMI and adolescents' academic achievement, 2) there is a significant negative association between adolescent BMI and academic achievement over time, and 3) individual-level factors will moderate the association between BMI and adolescents' academic achievement, such that, adolescents who report being

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overweight and who also self-identify as African American or Hispanic, will experience significantly lower academic achievement than their White peers. Likewise, female adolescents who report being overweight will experience considerably lower academic achievement than their male peers. Additionally, adolescents raised by single parents, who report being overweight will experience significantly lower academic achievement than their peers who were raised by two biological parents. Lastly, it is hypothesized that economic disadvantage will also moderate the association between BMI and adolescents' academic achievement, such that, adolescents who report being overweight and residing in communities with the greatest economic disadvantage will experience lower academic achievement compared to their peers from more affluent communities.

The focus of this study will extend the current literature in several ways. First, this study investigates the interactive influences of BMI and other factors that have been empirically linked to adolescents' academic achievement outcomes. Such research broadens the scope of understanding of the interdependent nature of multiple factors, those at the individual-level, as well as the broader impact of socio-contextual factors. Furthermore, findings from this research could potentially foster a new wave of conversations surrounding how to better meet and serve the academic needs of adolescents, especially those who are most susceptible to being overweight. It may also provide insight into the far-reaching effects of being overweight in adolescence, as it investigates its relationship with achievement as adolescents mature into young adulthood. As the samples in most previous studies are limited in size, geographic locations, and racial and ethnic groups, in this study, data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) are utilized. Add Health includes a large, nationally representative sample reflective of the experiences of the average U.S. adolescent and adult of diverse

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geographic locations and racial/ethnic groups. Finally, because research suggests that both individual-level and socio-contextual factors are likely to act in conjunction with BMI to influence adolescents' academic achievement, important covariates, such as race and ethnicity, adolescent gender, family structure, and economic disadvantage are controlled for, in each model.

Method

Sample and Procedures

Given the study's interest in matters concerning adolescents and young adults, the National Longitudinal Study of Adolescent to Adult Health (Add Health) is an appropriate data set available to test the proposed hypotheses. The use of Add Health has spanned across a number of disciplines as it provides extensive data on matters relating to adolescents' attitudes, behaviors, family relationships, and developmental trajectories. Wave I data collection was initiated in the 1994/1995 school year, when adolescents were in the 7th through 12th grade. Students were randomly selected from an initial pool of 132 schools using a stratified, clustering sampling design. Subsequently, a total of 20,745 ethnically and economically diverse adolescents were included in Wave I. An additional three waves of data (1996, 2001/2002, and 2007/2008, respectively) has since been collected. Among other things, Add Health contains data relating to adolescent and young adults' dietary lifestyle, weight status, health care access, and academic achievement. Additional details and descriptions of the sample and procedures are provided by Harris and colleagues (2008), and can be found at the following website:

<http://www.cpc.unc.edu/projects/addhealth/design>.

Given the study's interest in adolescence and young adulthood, Wave I and Wave II data are appropriate for the current study. Of the 20,745 participants in Wave I, 18,924 had cases

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relevant to this investigation, after the appropriate weighting variable was applied. The full information maximum likelihood procedure which obtains the maximum likelihood estimation of nonlinear equations was used in order to handle missing data. Consequently, although all 18,924 cases were used in the calculation of the standard errors, due to the subpopulation option used to weight the data (i.e., ensure a representative sample), a total of $N= 17,175$ cases defined by the subpopulation is used in the calculation of the estimates. At Wave II, after the appropriate weighting variable was applied, $N= 9,279$ participants were included in the Wave II analysis. Participants' average ages was 15 at Wave I, and 17 at Wave II. Additionally, attrition analyses suggested that males, African Americans, and those in lower grade levels in earlier waves were more likely to have dropped out from the survey.

Measures

Academic Achievement (Wave I & II). Academic achievement was assessed by averaging adolescents' school grades across four subject areas: mathematics, science, history or social studies, and language arts. Grades ranged between 1 (*D or lower*) and 4 (*A*) after being reverse coded. Scores reflected student's GPA and higher values indicated better overall academic achievement (Gordon & Cui, 2012).

Body Mass Index (BMI) (Wave I & II). BMI was calculated using the ratio of weight to height squared ($[\text{lbs} \times 703] / \text{inches}^2$) (see Bae et al., 2014). Adolescents were defined as overweight based on the Center for Disease Control's body mass index-for-age percentiles scale.

The scale can be found at:

http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html#percentile

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Individual-level Factors. Race and ethnicity were assessed by three dummy variables, including White (reference category), African American, and Hispanic. Adolescent *gender* was coded as 0 = *male* and 1 = *female*. Family structure was assessed by three dummy variables: two biological parents (reference category), single-mother, and single-father families.

Socio-contextual Factor. Economic adversity variable was retrieved from Add Health's contextual data set which includes data from the 1990 U.S. Census and houses numerous tract-level data. Each census block consists of approximately 40 blocks representing a greater number of respondents than each individual block, which further allows the exploration between contextual factors and individual level outcomes (Merten, 2010). In this study, there were 2,244 census tract areas represented with an average of 8 families in each tract. To create this variable, participants provided responses to the following five items: proportion of female headed households with children 18 years of age or younger, proportion of households with public assistance income, proportion of individuals with service-level or clerical jobs, proportion of persons or households with income below poverty, and proportion of individual's unemployed. Scores ranged from 0 (least advantage) to 5 (highest advantage) (see Merten, 2010; Wickrama & Bryant, 2003).

Analytic Strategy

Because the aim of the current study was to test several associations, including the association between BMI and adolescents' academic achievement, the association between adolescents' BMI and achievement over time, as well as the individual-level and socio-contextual factors that moderated this association, structural equation modeling (SEM) path analyses is an appropriate statistical tool. Path Analysis is a multivariate technique, which allows for the specification of relationships between observed (measured) variables. Using the statistical

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software STATA, path analysis tested models and relationships among multiple independent, mediating, and dependent variables. Accordingly, a direct path (Figure 1, path a) was tested between BMI and adolescents' academic achievement, and all other factors (race and ethnicity, gender, family structure, and economic disadvantage) included as covariates. Also, a direct path was tested between BMI and achievement among adolescents as they entered young adulthood, (Figure 1, path b), controlling for achievement during adolescence and including all other factors as covariates. Next, SEM path analyses, which simultaneously examines direct and indirect effects, tested each individual-level and BMI variable interaction term (e.g., gender X BMI, Figure 1, path c¹), and the socio-contextual and BMI variable interaction term (e.g., economic disadvantage X BMI, (Figure 1, path c²)). For the interaction plots, GPA was included as a proxy for academic achievement.

Results**Descriptive Statistics**

Descriptive statistics were provided in Table 1. The average GPA for Wave I participants was 2.75 (*SD*= 0.77) and 2.79 (*SD*= 0.76) for Wave II participants. Adolescents' average BMI was 22.55. According to the Centers for Disease Control, this falls within the healthy weight range for an adolescent who is 15 years old, which was the average age of respondents in this sample (Mei et al., 2002). Regarding race and ethnicity, 71.6% of respondents were White, 13.7% were Black, and 10.9% reported they were Hispanic. Approximately half the sample (50.2%) were females. The economic disadvantage variable was standardized. Therefore, the mean was -0.02 with a standard deviation of .44 (see Merten, 2010; Wickrama & Bryant, 2003).

Table 1 about here

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Prior to testing the primary hypotheses related to this study, preliminary analyses were conducted. Results suggested that female adolescents had significantly higher BMIs than their male peers. Hispanic and Black adolescents reported higher BMIs than White adolescents, and adolescents from single-parent households reported higher BMIs than those from two biological parent households. Additionally, adolescents who experienced greater economic disadvantage also reported higher BMI levels than those from more affluent communities. Such findings are generally reflective of the current literature (i.e., Harris et al., 2006; Huffman et al., 2010; Neumark-Sztainer et al., 2006; Wang & Beydoun, 2007).

Figure 1 about here

Hypotheses Testing

Regarding the association between BMI and adolescents' academic achievement, findings suggested a significant negative association ($b=-0.07, p<.05$). Similarly, after controlling for being overweight during adolescence, there was a significant negative association between being overweight and achievement as adolescents matured into young adulthood ($b=-0.01, p<.05$). Of particular interest were the individual-level and socio-contextual factors that moderated the association between BMI and adolescent's academic achievement. Overall, results suggested that being overweight placed certain adolescents at an even greater risk for lower academic achievement. At the individual-level, such factors included identifying as Black ($b=0.05, p<.05$), and residing in a single-mother household ($b=0.05, p<.05$). However, there were no significant BMI X female interaction ($b=0.01, p=.58$), identifying as Hispanic ($b=0.02, p=.05$), or residing in a single-father household ($b=0.09, p=.84$) interaction effects. Regarding the socio-contextual factor, adolescents reporting higher BMIs and experiencing greater

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economic disadvantage were significantly less likely to perform well academically ($b=0.06$, $p<.05$). Results were presented in Table 2.

Table 2 about here

Discussion

Empirical support suggesting the negative health and social consequences of being overweight during adolescence have been well established in the literature (e.g., Dietz, 2004). Less empirical attention however, has focused on the effects of overweight status on other important developmental outcomes such as their academic achievement, whether during adolescence or as they entered into young adulthood. Furthermore, even fewer research studies have explored the varying conditions under which individual-level and socio-contextual factors influence overweight status and adolescents' academic achievement. The current study aimed to fill this gap in the literature by investigating the link between medically-defined weight status (i.e., BMI) and adolescents' academic achievement and achievement among them as they entered into young adulthood. Additionally, the moderating effects of individual-level and socio-contextual factors on BMI and adolescents' academic achievement are tested as factors that could potentially improve or otherwise exacerbate adolescents' academic efforts. This study extended current literature as it addressed the far-reaching and possibly detrimental consequences of adolescents' overweight status on their academic performance, above and beyond health and social consequences.

Based on Social Cognitive theory and previous literature, findings suggested that, in addition to the health and social consequences of being overweight, adolescents who are overweight also tended towards lower academic achievement in comparison to their normal weight peers. This finding is supported by those of Florin and colleagues (2011), who reported

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that adolescents who were overweight were also more likely to experience lower academic achievement. A possible rationale for this finding is that overweight adolescents may not feel particularly supported within the school environment, and may experience weight discrimination from the school staff (Neumark-Sztainer, Story, & Harris, 1999). Neumark-Sztainer and colleagues (1999) reported that school staff is more likely to perceive overweight individuals as more emotional, less tidy, and less likely to succeed at work, than persons who are not overweight. Such negative perceptions may affect how the school staff interacts with overweight adolescents, which may further impact how well the adolescent performs in school.

Second, it was found that adolescents who were overweight continued to experience lower academic achievement even as they matured into young adulthood. This finding alludes to the far-reaching effect of one's overweight status during adolescence. This finding is in line with previous literature that has reported overweight adolescents are at an increased risk of becoming overweight adults (Freedman et al., 2001). Therefore, it is possible that the issues contributing to being overweight during adolescence may not have been sufficiently dealt with, and as such, continue to have a lasting, negative impact on other developmental outcomes such as academic performance.

Figure 2 about here

Third, findings were consistent with previous studies, as well as the Social Cognitive theory, suggesting that there are overlapping spheres of influence that contribute to adolescents' academic success (Haines et al., 2007). Results suggested that Black adolescents who were overweight were at a significantly greater risk for lower academic achievement. This finding is in line with those of previous studies, suggesting that Black adolescents were more likely to engage in behaviors that impacted their weight and subsequently, their academic achievement.

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For example, Harris et al. (2006), reported that, compared to their White peers, Black adolescents tended towards a more sedentary lifestyle. and were more likely to skip important meals such as breakfast. Such unhealthy practices have been shown to impact on how well adolescents perform in school (Datar et al., 2004).

Fourth, findings also suggested that those adolescents from single-mother households who were overweight had significantly lower academic achievement than those adolescents residing in two-biological parent households. Single-mothers are more likely than two-biological parents and single-dads, to experience economic hardships (Ambrosini et al., 2009; Bae et al., 2014). They are also less likely to have the capacity to monitor their adolescents eating habits. Limited resources and infrequent monitoring have been shown to contribute to poor eating habits as well as lower academic outcomes among adolescents (e.g., Lee et al., 2009).

Lastly, results suggested that the association between BMI and adolescents' academic achievement varied as a result of adolescents' economic disadvantage—such that, adolescents who were overweight and experiencing the most adverse economic circumstances also reported lower academic achievement. This finding is in line with those provided by Wickrama and colleagues (2006). Adolescents living in low income communities are less likely to have access to healthy and affordable meal options. More often than not, they have easy access to over-priced convenient stores or fast-food restaurants, neither of which is likely to offer healthy meal options at a reasonable cost (e.g., Lee et al., 2009). Furthermore, low-income communities may not be encouraging of physical activity, as such communities often have high concentrations of crime, and gang related activities (Gordon-Larsen et al., 2000). Such circumstances often pose a challenge to one's ability to be physically engaged, which may ultimately affect academic performance (Eamon & Altshuler, 2004).

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Taken together, this study fills an important gap in the literature, as it explores the influence of BMI on other developmental outcomes pertinent to adolescents' well-being. It also adds a new element of inquiry beyond the health and social consequences often associated with adolescents' overweight status. This exploration incorporates a more extensive observation of BMI and its relationship with other individual-level and socio-contextual factors, as such factors could potentially work in conjunction to impede or otherwise delay adolescents' academic success. Given that adolescents inherently experience a host of changes simply as a result of being in this developmental stage, those who are encountering a range of additional stressful responsibilities and pressures are even more susceptible to negative outcomes. Study findings reiterate the earnestness of combating issues such as being overweight, as it is likely to impact future development into young adulthood. It is hopeful that findings from this study will prompt conversations surrounding new and innovative techniques relating to intervention and prevention that consider both the individual-level and socio-contextual factors affecting adolescents who are overweight. An understanding of these complex processes are likely to raise some practical questions about current and future programs aimed at reducing adolescent obesity and improving adolescents' academic success. Policies aimed at improving the well-being of youth therefore, should incorporate an interdisciplinary approach by including parents, community leaders, teachers, and school administrators as each entity affects youth in various ways.

Further, this study utilized the Add Health data, which is a large, nationally representative sample of the average U.S. adolescents of diverse geographic locations and racial/ethnic groups, therefore reflecting the experiences of the typical U.S. adolescent. Lastly, this study included important covariates, such as race and ethnicity, adolescent gender, family structure, and

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adolescents' economic adversity, as the current literature suggests that these individual-level and socio-contextual factors are likely to influence adolescents' academic achievement.

Although the findings from this study broaden our understanding of factors relating to BMI and adolescents' academic achievement, findings must be considered in light of several limitations. First, although this study extended the literature by examining the association between being overweight in adolescence and achievement among them as they matured into young adulthood, future studies should consider extending findings even further to examine the interaction effects of BMI and individual-level and socio-contextual factors most pertinent to young adults. For example, given the extent of the "thin ideal" in young adulthood, it is possible that young adult females who are overweight may perceive themselves negatively as a result, which may inadvertently influence their well-being.

Second, even though the data consist of a national representation of adolescents in the United States, it is based on self-reports by adolescents. Self-report measures, according to Schwartz (1999) may not be ideal, as they can lead to inaccuracies. However, previous studies using similar measures have demonstrated good reliability (Gordon & Cui, 2012). Nonetheless, future studies may want to consider incorporating adolescents' reports as well as the perspectives of other individuals (i.e., parents), in an effort to capture a broader range of perspectives. Lastly, even though this study controlled for economic disadvantage in all models, it is quite possible that other socio-contextual factors may in fact influence adolescents' academic achievement. Future studies should attempt to include other important covariates, especially socio-contextual variables, so as to ensure that findings are not merely an artifact.

Despite the study limitations, the present study addressed an important gap, and as such, extends the current body of literature regarding the impact of BMI on an outcome pertinent to

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adolescent and young adult development. Consequently, parents, practitioners and researchers alike may be better able to distinguish the factors that are most important to adolescents' academic success relative to their overweight status. Given the study's findings, there are several important implications available for those invested in exploring the various avenues for improving adolescents' academic performance. This study draws attention to the importance of exploring multiple determinants of adolescents' academic success, while paying close attention to BMI, given the present overweight and obesity epidemic among our nation's youth. When efforts are directed towards improving achievement, personal characteristics along with the important role of other individual-level and socio-contextual factors should also be considered. It is imperative that all adolescents, especially those most vulnerable to the high rates of overweight and obesity, are provided ample opportunities for better health. Parents can facilitate this by ensuring that their adolescent participates in physical activities, consumes healthy meals, and acquires a sufficient amount sleep. School can also assist by providing healthy school lunches and opportunities to engage in physical activities during their school day, as such efforts have been positively linked to successful school performance.

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Table 1- Summary of Descriptive Variables

Variable	Mean/%	SD	Min	Max
Dependent Variable				
Adolescent Educational Attainment	2.75	0.77	1	4
Achievement in Young Adulthood	2.79	0.76	1	4
Variables				
Adolescent's body mass index (BMI)	22.55	4.46	11.21	63.49
Race/Ethnicity				
White (reference)	71.6%			
Black	13.7%			
Hispanic	10.4%			
Gender: Female (reference)	50.2%			
Family Structure				
Two-biological parents (reference)	57.5%			
Single mother	20.5%			
Single father	2.4%			
Economic disadvantage *	-0.02	0.44	-0.61	2.10

Note. White is the reference category for race/ethnicity. Female is reference category for gender. *A composite of Community level variables was used to create 'Community Poverty' (Merten, 2010; Wickrama & Bryant, 2003).

Table 2. Unstandardized path coefficients of direct and moderation analyses

Path	<i>b</i>	<i>SE</i>
Linear Analyses		
BMI→ Academic Achievement	-0.07*	0.01
BMI→ Achievement in Young Adulthood	-0.01*	0.00
Moderation analyses		
Gender X BMI→ Academic Achievement	0.01	0.02
Race/Ethnicity		
Hispanic X BMI→ Academic Achievement	0.02	0.02
Black X BMI→ Academic Achievement	0.05*	0.02
Family Structure		
Single-mother X BMI→ Academic Achievement	0.05*	0.02
Single-father X BMI→ Academic Achievement	0.02	.09
Economic disadvantage X BMI→ Academic Achievement	0.06*	0.02

Note. White is the reference category for race/ethnicity. Female is reference category for gender. Community. **p<.01.

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Figure 1. Individual-level and Socio-contextual Influences on BMI

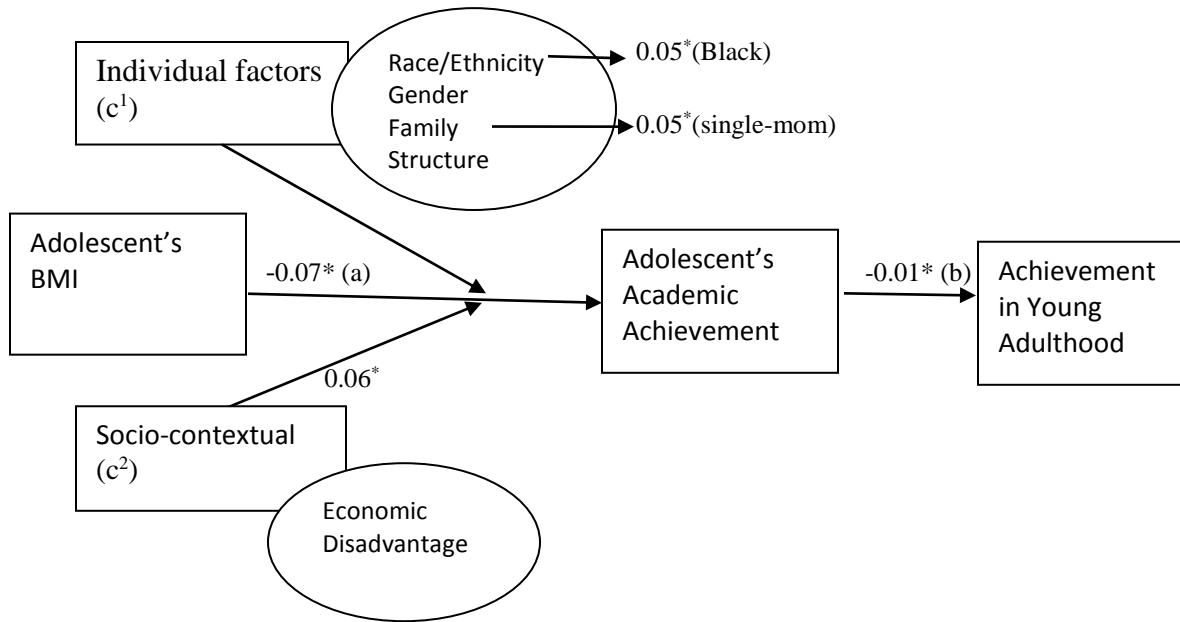
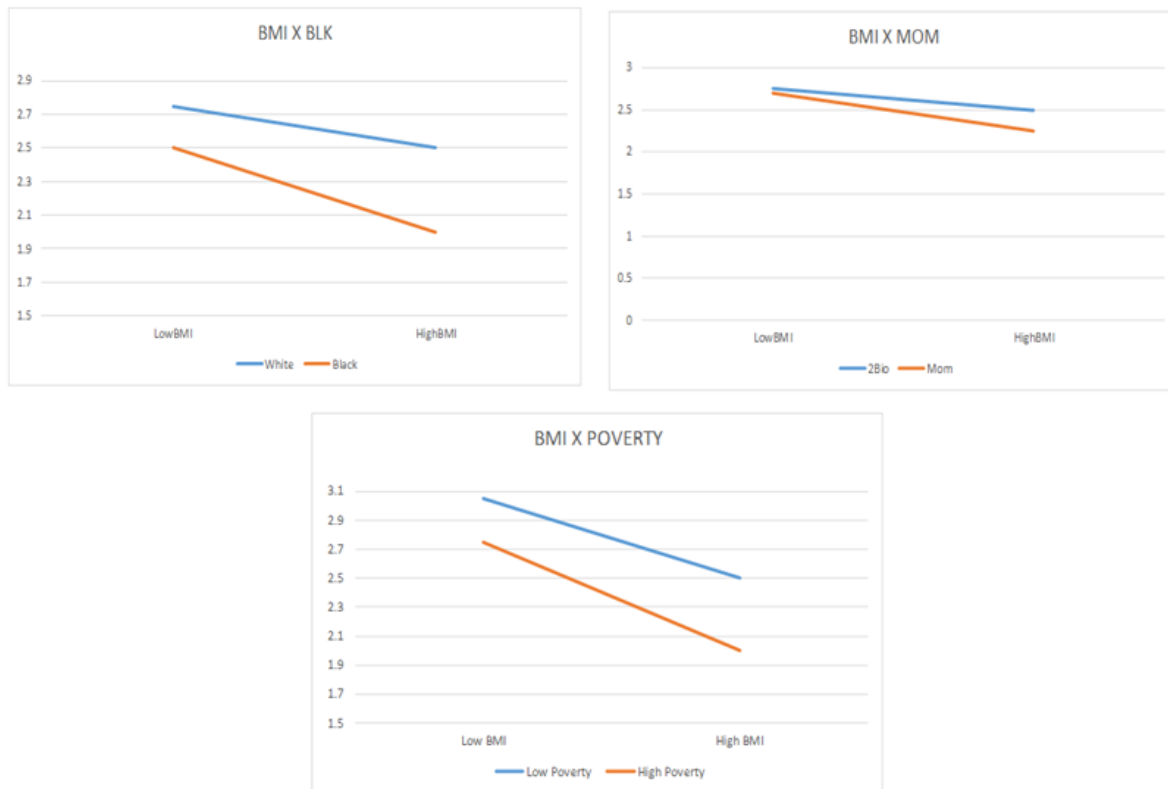


Figure 2. Interaction Plots based on BMI



Note. Significant Interaction plots- BMI X BLK= bmi X Black adolescent, BMI X mom= single mom, BMI X Poverty= community poverty