The Relationship between Parental Health, Family Functioning and Adolescent Body Mass Index

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Abstract

This study investigated the association between parental health and family functioning variables and adolescent body mass index (BMI). In this analysis of the 2003 National Survey of Children's Health (N=31,997), adolescent BMI was found to increase with age, male gender, poverty level, and being of White, Black, or Hispanic ethnicity. It was also positively associated with three family functioning variables (feeling that adolescent is much harder to care for; adolescent was doing things that really bothered the parent; frequency of eating meals together as a family for Whites and those of other races) and two parental health variables (positive perspective of the general health of the mother or father; and having a household member who smokes). On the other hand, adolescent BMI was found to decrease with a growing household size, being of American Indian or Native Alaskan ethnicity, and the frequency of physical activity among adolescents through aerobic exercise or engaging in biking, skateboarding, skating, or rollerblading. BMI was also lower with the ability of parent and child to share ideas or talk of things that really matter, a family functioning variable; and the frequent physical activity of the mother, a parental health variable. Although not found to be statistically significant, the following factors may have practical significance in addressing health issues in the home: degree of parental closeness with adolescent; availability of daily emotional help in parenting or caring for the adolescent; and parental feelings of anger at adolescent. The correlation of the aforementioned variables in the home with adolescent BMI in this national survey demonstrated that the family can impact the health of its members. Thus, it can be an appropriate setting for health promotion and disease prevention. Efforts by health professionals and policy makers to address parental health and family functioning may contribute to prevention of adolescent obesity.

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Key words: *Family Functioning; Parental Health; Adolescents; Body Mass Index; Obesity.*

Introduction

The prevalence of obesity among children, adolescents, and adults has risen to epidemic proportions within the last decade.[1] Obesity is associated with morbidity and mortality due to type II diabetes, hypertension, atherosclerosis, arthritis, cardiovascular disease, asthma, some cancers, and reproductive complications.[2-4] The National Health and Nutrition Examination Survey (NHANES) revealed that 16 percent of children age 6-19 are overweight.[5] Prevalence of overweight among children and adolescents increased 45 percent between the 1988-1994 and 1999-2002 study. More recently the Robert Wood Johnson Foundation reported that in 2009, 30 percent or more of the children living in 30 states in the U.S. are obese or overweight.[6]

Obesity results from a decline in the expenditure of daily energy compared to the amount of energy taken into the body system.[7] A common indicator of body fatness among children and adolescents is the body mass index (BMI) (i.e., weight divided by height squared). This measure is a number calculated by using a child's height and weight. Although BMI is considered a reliable measure of body fatness, body fatness is not measured directly and it does not take into account the weight contributed by muscles.[8] The calculation of BMI is the same for children and adults but a different set of criteria for interpretation is used among children and adolescents. The Centers for Disease Control and Prevention (CDC) uses the BMI-for-age-and-sex-specific percentiles for children until age 20 as the amount of body fat changes with age and gender. The categories for this classification include a BMI-for-age percentile below the 5th percentile; healthy weight, for those whose BMI-for-age falls between the 5th to less than the 85th percentile; overweight, for those between the 85th to less than the 95th percentile; and obese, for those at the 95th percentile or greater.

Rising obesity statistics and the important health implications have prompted national efforts including *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* to focus on identifying and reducing the underlying causes for obesity in all age groups.[9] In general, children and adolescents who are overweight are at risk of becoming obese as adults.[3, 4, 10] Since behavior and attitudes that contribute to excessive weight gain are established early in life, effectively addressing obesity calls for identifying and targeting risk factors for obesity that shape the family environment, such as family functioning and parental health. Therefore, the primary purpose of this study was to explore the association of parental health and family functioning per se with adolescent (age 12-17) BMI and also as a factor of race and ethnicity. The study is cross-sectional in nature and did not allow causal inferences.

Risk Factors for Obesity

Researchers are beginning to profile several variables as important determinants for obesity in children and adolescents. For example, evidence suggests that certain genes and their sequence predispose individuals for obesity.[11] These findings help "to dispel the notion that obesity represents an individual defect in behavior with no biological basis."[12] However, developments in the field of genomics have demonstrated that obesity is caused by the interaction between multiple human genes, behavior, and the environment.[13] This multi-factorial interaction bears critically on how to effectively address the prevention and management of obesity.[12]

While rooted in individual behavior, several identified risk factors for obesity are highly influenced by practices and interactions within the home and its social environment. For example, there is strong evidence that skipping breakfast,[14, 15] excessive screen time (e.g., television and video games),[16-18] and lack of physical activity[17, 19, 20] negatively influence energy consumption and expenditure, thus increasing the likelihood of adolescent obesity. In addition, an unhealthy weight perception as influenced by the social environment, may lead to maladaptive compensatory behaviors for weight control such as vomiting, laxative abuse, and frequent dieting.[21, 22] Depressive symptoms [22-25] have also been shown to be a risk factor for adolescent obesity. The findings of Christakis and Fowler, as published in the New England Journal of Medicine, provided strong evidence to the social facet of obesity.[26] Their results showed that obesity is spread via social ties, with a higher likelihood of being obese when gaining weight is perceived as acceptable among siblings, friends, or spouses. These researchers looked at various social networks of about 12,000 people over 32 years who belonged to

the Framingham Heart Study. The likelihood of becoming obese increased by 57% in a given period if a friend is also obese, 40% if a sibling is, and 37% if a spouse is. The surprising phenomenon, according to researchers, is that this effect holds true even if the obese acquaintance is far away, with an editorialist suggesting, "friends have an even more important effect on a person's risk of obesity than genes do."

Even with such groundbreaking results, there remains a dearth in the literature of studies that look at and beyond those biologic and behavioral traits of obesity into how the family, as a social environment, may contribute to obesity in childhood and adolescence in general. As the very first social environment that children and adolescents grow into, it appears logical to start looking for factors in the home that strongly and sustainably shape lifestyle. Such studies identifying the roots of obesity in the home may have implications for clinical and public health interventions.

Theoretical Framework

The ecological perspective and principles of Social Cognitive Theory (SCT) recognize the influence of the environment on behavior and provide the theoretical framework and rationale for the study of parental health and family functioning. Ecological models in general acknowledge the importance of social, cultural, and physical environment variables on health behavior.[27] They also suggest that these "outside the individual" variables likely interact to influence health behavior. Social Cognitive Theory[28] is closely related to the ecological perspective and also acknowledges the influence of environmental factors on behavior. The physical environment is an important aspect of SCT because it provides opportunities for social learning as credible role models (e.g., parents) exemplify behavior.

Environmental factors in the home such as parenting style, family routines and activities, parental mood, parental behavior, and health promotion practices, including racial and ethnic differences in lifestyles and perspectives within and among families have been shown to influence behavior and impact health outcomes.[29, 30] Stress and conflict, created by parental health problems, contribute to higher levels of anxiety and depression among children who ultimately use overeating as a coping mechanism.[31] Parental expressions of anger and frustration is also linked to behavior and emotional problems in adolescents.[32] Additionally, parental obesity is well-documented as a risk factor for adolescent obesity [14, 22, 30, 33-35] while physical activity may be the primary mediating factor. Studies have shown a strong association between the physical activity levels of parents and children.[36] Parents who model physical activity increase the degree and amount of time children engage in vigorous physical activity.[30] Higher parental education attainment; a perception that parents care about them personally; and higher level of self-esteem among girls, serve to protect girls from obesity as young adults.[14] For boys however, a perception that parents are controlling their diet and greater closeness with parents puts them at greater risk for being overweight or obese six years later in life.[14]

Some studies suggest that weight-related behaviors among adolescents are a product of social learning from parental role models[36] within the socio-cultural context of the family.[14] These studies help to affirm principles of SLT and the ecological perspective with regard to adolescent weight; however, additional research is needed to further define the important link between parental role models and the socio-cultural context of the family. To explore this link, in this study, specific variables associated with parental health and family functioning were identified as possible risk factors for adolescent obesity, among children 12 to 17 years of age. Seven family functioning variables were used to explore social learning and the impact of the socio-cultural context of the family, such as: eating meals together as a family as a factor of ethnicity; closeness of parent with adolescent; ability of parent and adolescent to share ideas or talk of things that really matter; feeling of the parent that his or her adolescent is much harder to care for; parent feeling that his or her adolescent does things that really bothered him or her (as a factor of ethnicity); and finally, having daily emotional help in parenting or caring for the adolescent. Four parental health variables were used in the analyses such as the perceived general health of the mother and father; mother's level of physical activity and smoking in the household per se and as factor of ethnicity.

Methods

Data Source

The 2003 National Survey of Children's Health (NSCH)[37] was designed by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention's (CDC) to collect state and local-level data on the health and well-being of children less than 18 years of age. The data is used together with other national data collection methods to address program and policy needs. The survey is administered through the State and Local Area Integrated Telephone Survey (SLAITS) program. When telephone interviews were conducted, respondents were asked if children under the age of 18 lived in the home. If the response was affirmative, one child under 18, living in the household, was selected by the respondent and each survey question was answered by the respondent with this child in mind.

The NSCH questionnaire is comprised of questions that are divided into 11 sections: demographics; health and functional health status; health insurance coverage; health care access and utilization; medical home; early childhood (0-5 years); middle childhood and adolescent (6-17 years); family functioning; parental health; neighborhood characteristics; and additional demographics. Questionnaire items came from previously validated instruments. An expert panel and members of the community of potential data users made specific recommendations on which questionnaire items to include. Additional information regarding survey question development and data collection can be obtain through the NCHS and NSCH.[37]

A total of 102,353 interviews were completed using the NSCH between January 29, 2003 and July 1, 2004. Respondents were adults in the home who were most knowledgeable about the selected/sampled child's health. Over 95% of respondents were the child's mother or father. The overall response rate was 55.3%. For this study, the criterion for inclusion was the survey data for adolescents aged 12 to17 years of age, of which there were 31,977 out of the total 102,353 interviews.

Study Variables

In this study, body mass index (BMI) was the dependent variable for analysis. This was obtained using the provided height and weight of the selected adolescent by the respondents. The independent variables in this study included two major sections of the NSCH that make up the environmental factors in the home: section 8 on family functioning and section 9 on parental health. Each variable of interest was measured by using only one survey item (see Table 1). Based on the 2003 NCHS, section 8 on family functioning was comprised of a total of 15 questions on the type of family interactions in the home such as: family outing; frequency of eating together as a family in the past week; frequency of attendance at a religious service; level of closeness of the relationship of the parent to the selected adolescent; ability of parent and child to share ideas or talk about things that really matter; level of coping with the daily demands of parenting or raising of children; frequency of feeling during that past month that the child is much harder to care for; frequency during the past month that parent felt the selected adolescent had been doing things that really bothered the parent; frequency during the past month that parent felt that he or she is giving up more of his or her life than expected to meet the selected adolescent's needs; frequency during the past month that parent had felt angry at the selected adolescent; presence of someone that the parent can turn for daily emotional help in parenting or caring for the selected adolescent; and finally, the ways in which the respondent's family deal with serious disagreements (keeping opinions to one's self; discussing disagreements calmly; arguing heatedly or shouting; or hitting or throwing things). Of these 15 possible variables that could assess family functioning, only seven could be used in the analyses due to low responses to most of the questions (see Table 1).

Section 9 of the 2003 NCHS is on parental health was comprised of 14 questions ranging from the respondent's relationship to the selected adolescent to more direct questions on the general physical and mental health status of the mother and father; frequency of regular exercise during the past month of the mother and father; availability of any form of health care coverage of the mother and father; and finally, presence of smoking in the home. Given the low responses on the majority of the questions, only four of the questions could be used in the analyses as independent variables for defining parental health in this particular survey population (see Table 1). Demographic measures and adolescent physical activity (i.e., days of physical activity such as riding a

bike, scooter, or rollerblades over the past 12 months; days of exercise or physical activity like basketball, soccer, or running for at least 20 minutes that led to sweating and breathing hard) were also included in the model (see Table 1).

Race and ethnicity was defined as American Indian/Alaskan Native, Asian, Black, Hispanic, Native Pacific Islander, Other, and White. The percentage of children sampled for each racial and ethnic group was similar to the 2000 Census data with the exception of Asians. Data on Asians were not collected in some states resulting in a lower number of Asians sampled.

Statistical Analysis

Step-wise regression was conducted on the demographic variables (i.e., age, age position of child, gender, poverty level, total adults in the household, total children in the household) in order to fit the best model for BMI. Other demographic variables were considered but could not eventually be used in the analyses given the low number of responses in relation to the other variables (highest educational level of a household member; household member employment status; and health insurance coverage). Race/ethnicity was not included in this model in order that it might be explored after adjusting for other demographic variables. Analysis of Covariance was used to determine which family functioning and parental health variables had the strongest relationship with BMI among adolescents. Backward elimination was employed to find the best fitting model. Age, gender, poverty level, household size, and adolescent physical activity were used as control variables.

Results

A total of 31,997 adolescents age 12-17 were included in the analysis, of which almost 36 percent of the sample were 16 to 17 years of age. The demographics for this sample are shown in Table 2. As expected, a significantly positive relationship existed between age and BMI (p=<.0001) and gender and BMI (p=<.0001). Increasing age was associated with an increasing BMI and male gender was associated with higher BMI. A positive association was also found for poverty level (p = <.0001). As percentage of poverty level (i.e., household income compared to poverty threshold) increased so did BMI. In other words, adolescents were more likely to have a higher BMI if they resided in a household with a lower total family income. A negative association was found between household size and BMI (p=<.0001). As the number of people living in the household increased, BMI decreased. A significantly positive relationship was observed between BMI levels and ethnicity. For instance, BMI levels increased with being Black (p = .0007), White (p = <.0001) or Hispanic (p = .0384).

Several of the family functioning and parental health variables were directly associated with BMI (see Table 3). In this analysis of the 2003 National Survey of Children's Health (N=31,997), adolescent BMI was found to increase with three family functioning variables (feeling that adolescent is much harder to care for ; adolescent was doing things that really bothered the parent; frequency of eating meals together as a family for Whites and those of other races) and two parental health variables (positive perspective of the general health of the mother or father; and having a household member who smokes). For these items, adolescent BMI increased with increasing frequency of a parent's difficulty and frustration in caring for his or her adolescent and a positive perspective of the mother's health and a positive perspective of the father's health.

On the other hand, adolescent BMI was found to be lower with the increasing ability of parent and child to share ideas or talk of things that really matter, a family functioning variable; and the frequent physical activity of the mother, a parental health variable. Although not found to be statistically significant, the following factors may have practical significance in addressing health issues in the home: degree of parental closeness with adolescent; availability of daily emotional help in parenting or caring for the adolescent; and parental feelings of anger at adolescent. Adolescent BMI decreased with increasing closeness of parent with child and increasing availability of emotional resources and support for parenting.

Several parental health and family functioning variables were retained in the regression model when there was an interaction with racial/ethnic group. For instance, a significant effect was observed for the number of days during the week that family members ate together. This was significant only for Whites (b = .047, t = 3.34, p = .0009) and for adolescents whose ethnicity was classified under the "other" category (b = -.184, t = -1.96, p = .0501). For Whites, the results

showed that BMI increased as family members ate together more often. On the other hand, the statistically significant value of -1.84 suggests that BMI decreases with group eating among those in the ethnic category designated as "other." No significant difference was found for eating together as a family and BMI for Native Americans, Asians, Blacks, Hispanics, Multiracials, Native Pacific Islanders however this relationship was positive, similar to the finding among Whites.

The level of frustration of a caregiver respondent or feeling that his or her adolescent is much harder to care for was also associated with BMI by racial/ethnic group. A statistically significant positive effect was observed for Whites (b = .175, t = 2.88, p = .0040). In this case, BMI increased as parent's frustration in caring for the child increased. However, the reverse was observed for Asians (b = -2.00, t = -2.70, p = .0070) and Hispanics (b = -.345, t = -1.97, p = .049) and even among Blacks and Multiracials in which adolescent BMI decreased with the parent's increasing level of frustration with the child. While not statistically significant, a positive effect was observed for all racial/ethnic groups except Native Pacific Islanders and among those in the "other" category on BMI and parental frustration with child.

Discussion

BMI and Demographic Factors

The results of this study indicate that adolescent BMI is associated with age; male gender; race; and family income levels. The higher risk for obesity among adolescent Blacks and Whites is consistent with several studies on BMI and race.[38] For instance, Saha and colleagues[38] found that between these two ethnic groups, the risk for overweight and/or being overweight occurs at a much earlier age among Blacks than Whites, mostly as early as age seven. In addition, being a Black female adolescent carries the most risk, whereas, racial differences in overweight risk remain relatively constant with age among males. Demographic factors such as this may help direct the attention of public health and medical professionals to at-risk segments of the population and offer weight programs tailored to the more modifiable aspects of their socio-cultural environments such as the home. Additional studies may help quantify the extent to which these demographic correlates contribute to adolescent weight challenges.

BMI, Family Functioning, and Parental Health Influences

Among family functioning variables, adolescent BMI tended to increase with parental frustration marked by the feeling that the adolescent does things that really bothered the parent and by the parent feeling that his or her adolescent is much harder to care for. Parental health variables that increase adolescent BMI were the positive perception of the general health status of the mother and father, and the presence of smoking in the household. On the other hand, adolescent BMI tended to be lower with the increasing ability/frequency of parent-child communication on vital issues, a family functioning variable; and frequent maternal physical activity in the last 30 days. These findings indicate that although parental health, physical activity and family eating habits may be intuitive determinants of weight matters, there are also important underlying emotional and psychological factors in the home that are correlated with adolescent BMI. These include openness in parent-adolescent communication; level of closeness between parent and adolescent; parental frustration in caring for adolescent; and the availability and accessibility of daily emotional parenting support. As the findings indicated, these family functioning and parental health variables may lead to not only an obesity-promoting environment, but may also serve as impediments to establishing healthy eating attitudes and lifestyles.[39] For example, impaired family dynamics, characterized by mealtime challenges and a breakdown in family unity and structure, aggravates stress levels among mothers of obese youth.[39]

Our findings suggest that increased eating may be used as a coping mechanism for stress or perceived conflict in the home. For instance, youth may overeat to cope with higher levels of anxiety and depression in the home resulting from health problems in parents.[40] In addition, parental expressions of anger and frustration alter the emotional climate in the home and place strain on the parent-child relationship potentially leading to emotional and behavioral problems in the adolescent.[41] As such, what may start off as an innocuous response to stress, overeating may eventually evolve into an established behavior among adolescents that carries serious health

consequences later in life. Likewise, there is a relationship between how well the parent-child communicates and BMI. Our results showed that BMI was negatively correlated with the ability of parents to discuss important matters with their child. That is, BMI increased with the decreasing ability of parents to communicate with the child. Whereas, having parents and adolescents share ideas and discuss things that really matter appear to be protective of an elevated BMI. The association in open parent-child communication has also been observed in other adolescent health issues such as sex and condom use.[42]

A risk behavior, such as smoking, was seen in our study to be strongly associated with adolescent BMI. Smoking in the home may be a reflection of the psychological impact on the teenager of the general health attitude of parents. The child, especially if modeled by the parent, may perceive such behavior as a lesser valuation placed by the family on healthy lifestyles, let alone, a healthy attitude towards food. Thus, smoking in the home may convey a general health attitude in the home that has a psychological impact on the child. Perhaps this may also explain the higher response rate seen in weight reduction interventions using behavior modification strategies directed at both parents and child, versus the child alone.[31, 32, 39] The parental health of either the father or the mother is a strong positive correlate of adolescent obesity. Our analysis showed that adolescent BMI increased with a higher perceived positive health of either parent. It is possible that the physical health of parents provides adolescents with a positive outlook.[41] Though this may contribute to a less stressful home environment, it may unintentionally give adolescents the liberty to overeat thinking that they are not vulnerable to diseases given their parent's excellent health. On the other hand, given adolescents' positive perception of their parent's health, they may be more likely to follow their parents' examples. For instance, better weight loss outcomes are seen among children whose parents exhibit healthy eating habits.[39] Additionally, obese children are more likely to have obese parents. Zeller and colleagues found that both the rate and severity of parental obesity are remarkably high among obese versus non-obese youth.[39] Treatment outcomes tend to be unsatisfactory in clinical settings in which both adolescents and parents struggle with obesity.[39]

Maternal physical activity within the last 30 days is associated with reduced adolescent BMI. Although this was not statistically significant in the population surveyed, it is possible that additional research may prove this variable to be of practical significance in relation to the important role that mothers play in modeling active lifestyles,[35] a concrete display of the intrinsic value placed by the mother on physical activity.

Family dinners can serve as a forum for parent-child communication. While family dinners have been an important protective factor against adolescent social morbidities,[43] our findings suggest that for Whites, increased frequency of family dinners is associated with a higher adolescent BMI, which was not observed among other racial categories. These ethnic differences in adolescent BMI may be due to cultural differences in practices such as the type and portion of food eaten as a family, level of family interaction, parental supervision, and even television viewing during meal times.[44] For example, recent research suggests that the educational level and physical presence of parents during family meal time is associated with the likelihood that adolescents consume healthy foods.[45]

Limitations

While this study focused on previously collected data from a large sample of adolescents across the United States, several limitations exist. For instance, the study was an analysis of publicly available existing data that did not directly assess the perceptions of adolescents on either family functioning or parental health. Adult caregivers living in the home, either the biological parent or guardian that was most familiar with the selected adolescent, served as the respondents. As such, the responses provided were from their own points-of view. This limitation extended to responses on the height and weight as based on the adult respondent's "best guess" without necessarily attempting to obtain more accurate measurements, thus impacting the quality of the BMI data. Similarly, the caregiver's report of the level of the adolescent's physical activity was also an estimate as it was not realistic to be around the adolescent throughout an entire day. The same constraint was experienced for survey questions in which the respondent, typically the mother, was asked to report on the physical activity of the father.

Future research should seek to directly obtain responses from adolescents to gauge their perceptions

of parental health and family functioning in the home. A more accurate system for determining weight and height measures should be factored in the survey. As this study was cross-sectional in nature with the intent of looking at associations rather than causal relationships, future research might employ a longitudinal research design, with random assignment into experimental and control groups, to more accurately determine, if any, a casual relationship between parental health, family functioning, and adolescent BMI.

Conclusion and Implications

While the cross-sectional nature of this study did not allow for making causal inferences, important relationships were identified that reaffirmed the risk contributed by parental health and family functioning on adolescent obesity. Rather than being a product of a singular determinant, this study demonstrated that increases in BMI were correlated with a confluence of factors in an ecological setting such as the home environment. These findings are consistent with previous research on the determinants of overweight among children and adolescents.[44] Although culture and ethnicity may play a role in the types of food and meal size eaten, nonetheless, obesity is a family matter. As such, effective overweight/obesity prevention efforts must also be directed at the entire social and emotional environment adolescents experience in the home. The disruption in this dimension of interaction increases the likelihood for obesity. Clinical as well as behavioral weight management programs will need to look into the simultaneous targeting of adolescent - and parent - level factors through identification and change of specific obesity-promoting risk behaviors in the home.[39] Parental modeling of regular exercise and healthy eating is important for reinforcing healthy behavior patterns among adolescents. Mothers and fathers are also crucial partners in the early and sustained monitoring of home psychosocial factors. They need access to resources that will help them cope with the challenges of parenting including the ability to communicate effectively with their teenagers. Health professionals and policy makers should work on instituting a program that will assist clients with parenting skills for managing conflicts and stresses for healthier home environment. In turn, a healthy and supportive home atmosphere enables adolescents to regulate their own behavior consistent with their parent's values and expectations.[44]

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Table 1. Study Variables and Corresponding 2003 NCHS/SLAITS Survey Questions

Variables	Variable Code	2003 NCHS/SLAITS Survey Question
Demographic Variables (9)		
Age of Adolescent	AGEYR_CHILD	Would you please tell me the age/ages of the child/children less than 18 years old in this household? NOTE: Focal child is selected for the rest of the interview from all children rostered. In this study, responses that pertain to the focal child of 12-17 years old were used in the analyses.
Gender	S1Q01	Is [selected adolescent] male or female?
Height	S2Q02 & S2Q02A	How tall is [selected adolescent] ----- feet? ----- inches?
Weight	S2Q03	How much does [selected adolescent] weigh now ----- pounds?
Poverty Level	POVERTY_LEVELR	Poverty level of this household based on DHHS Poverty Level Guidelines? Level 1 = <0.0001 (50% Federal Poverty Level) Level 2 = <0.0001 (100% Federal Poverty Level) Level 3 = <0.0001 (133% Federal Poverty Level) Level 4 = 0.0003 (150% Federal Poverty Level) Level 5 = <0.0001 (185% Federal Poverty Level) Level 6 = <0.0001 (200% Federal Poverty Level) Level 7 = 0.0003 (300% Federal Poverty Level) Level 8 = --------- (400% Federal Poverty Level)
Household Size	TOTKIDS4	How many people less than 18 years old live in this household?

Ethnicity	racefine	Please choose one or more of the following categories to describe [selected child's] race. Is [selected adolescent] American Indian/Alaskan Native, Asian, Black or African-American, Hispanic, Multiracial, Native Pacific Islander, Other, White?***
Physical Activity of Adolescent: Aerobic Exercise	S7Q21	During the past week, how many days did adolescent exercise or participate in physical activity for at least 20 minutes that made him/her sweat and breathe hard, such as basketball, soccer, running, swimming laps, fast bicycling, fast dancing, or similar aerobic exercise?
Physical Activity of Adolescent: Biking, Skateboarding, Skating, Rollerblading	S7Q22	During the past 12 months, has [selected adolescent] ridden a bike, scooter, skateboard, roller skates, or roller blades?
Family Functioning Variables (7)*		
Eating Meals Together as a Family	S8Q03	During the past week, on how many days did all the family members who live in the household eat a meal together?
Closeness of Relationship with Adolescent	S8Q04	Is your relationship with [selected adolescent] very close, somewhat close, not very close, or not close at all?
Sharing Ideas & Talking with Adolescent of Things That Really Matter	S8Q05	How well can you and [selected adolescent] share ideas or talk about things that really matter?
Parent Feeling Adolescent is Much Harder to Care For	S8Q07	During the past month, how often have you felt [selected adolescent] is much harder to care for than most children [his/her] age?
Adolescent Doing Things That Really Bothered Parent	S8Q08	During the past month, how often have you felt [selected adolescent] does things that really bother you a lot? Would you say never, sometimes, usually, or always?
Parent Feeling Angry at Adolescent	S8Q10	During the past month, how often have you felt you are angry with [him/her]?
Having Daily Emotional Help in Parenting/Caring for Adolescent	S8Q11	Is there someone that you can turn to for day-to-day emotional help with parenthood/raising children?
Parental Health Variables (4)**		
Mother's General Health	S9Q08	Would you say that in general [adolescent's mother type/your] health is excellent, very

		good, good, fair, or poor?
Father's General Health	S9Q09	Would you say that in general [adolescent's father type/your] health is excellent, very good, good, fair, or poor?
Mother's Physical Activity	S9Q15D	During the past month, did [adolescent's mother type/you] regularly exercise or play sports hard enough to make [you/her] breathe hard, make [you/her] sweat for 20 minutes or more?
Smoking in the Household	S9Q11B	Does anyone in the household use cigarettes, cigars, or pipe tobacco?

*Family functioning is Section 8 of the 2003 NCHS/SLAITS Survey Questionnaire

**Parental health is Section 9 of the 2003 NCHS/SLAITS Survey Questionnaire

*** Reference: Blumberg SJ, Olson L, Frankel MR, Osborn L, Srinath KP, Giambo P. Series 1 Program and Collection Procedures, *Design & Operation of the National Survey of Children's Health*, 2003; 30-31

Table 2. Demographic Characteristics

Variable	N (%)
Age	
12	5937 (15.66)
13	6093 (16.07)
14	6144 (16.21)
15	6195 (16.34)
16	6782 (17.89)
17	6783 (17.84)
Gender	
Male	19620 (51.80)
Female	18257 (48.20)
Adults in family	
1	5396 (14.27)
2	21241 (56.17)
3	11180 (29.56)
Total children in the family	
1	17897 (47.20)
2	12964 (34.19)
3	5019 (13.24)
4	2034 (5.36)
Racial Ethnic Group	
American Indian/Alaskan Native	236 (.63)
Asian	233 (.62)
Black	3603 (9.65)
Hispanic	3800 (10.17)
Multiracial	1289 (3.45)
Native Pacific Islander	194 (.52)
Other	622 (1.67)
White	27371 (73.29)

Table 3. Predictability of Adolescent Body Mass Index as to Demographic Variables, Physical Activity Levels, Family Functioning, and Parental Health

Source	Variable Code	DF	Type III SS	Mean Square	F Value	Pr > F $p < 0.05$
Demographic Variables (7)						
Age of Adolescent	AGEYR_CHILD	1	9874.29	9874.29	604.19	<0.0001
Gender	S1Q01	1	6648.59	6648.59	406.82	<0.0001
Poverty Level	POVERTY_LEVELR	7	1548.28	221.18	13.53	<0.0001
Household Size	TOTKIDS4	1	644.17	644.17	39.42	<0.0001
Ethnicity	racefine	7	360.68	51.53	3.15	0.0025
Physical Activity of Adolescent: Aerobic Exercise	S7Q21	1	2157.71	2157.71	132.03	<0.0001
Physical Activity of Adolescent: Biking, Skateboarding, Skating, Rollerblading	S7Q22	1	967.11	967.11	59.18	<0.0001
Family Functioning Variables (7)						
Eating Meals Together as a Family (By ethnicity)	S8Q03*racefine	8	328.28	41.04	2.51	0.0100
Closeness of Relationship with Adolescent	S8Q04	1	31.65	31.65	1.94	0.1640
Sharing Ideas & Talking with Adolescent of Things That Really Matter	S8Q05	1	265.50	265.50	16.25	<.0001
Parent Feeling Adolescent is Much Harder to Care For	S8Q07	1	254.79	254.79	15.59	<.0001
Adolescent Doing Things That Really Bothered Parent (By ethnicity)	S8Q08	8	419.91	52.49	3.21	0.0012

Feeling Angry at Adolescent (By ethnicity)	S8Q10*racefine	8	245.85	30.73	1.88	0.0584
Having Daily Emotional Help in Parenting/Caring for Adolescent	S8Q11	1	35.36	35.36	2.16	0.1413
Parental Health Variables (4)						
Mother's General Health	S9Q08	1	1261.61	1261.61	77.20	<0.0001
Father's General Health	S9Q09	1	1074.87	1074.87	65.77	<0.0001
Mother's Physical Activity	S9Q15D	1	222.65	222.65	13.62	0.0002
Smoking in Household	S9Q11B	1	268.09	268.09	16.40	<0.0001
Smoking in Household (By ethnicity)	S9Q11B*racefine	7	182.32	26.05	1.59	0.1320

Table 4. Association of Adolescent BMI with Study Variables

Adolescent BMI INCREASES with:	Adolescent BMI DECREASES with:
Demographic Variables 1. Increasing age of adolescent 2. Male gender 3. Increasing poverty level 4. Ethnicity – being White (p = 0.000); Black (p = 0.0007); or Hispanic (p = 0.0259)	**Demographic Variables** 1. Increasing household size 2. Ethnicity – being American Indian or Native Alaskan (p = 0.0324)
Family Functioning Variables 1. Eating meals together as a family – increases BMI for Whites but not for Asians, Multiracial or "Other" category 2. Parent feeling his or her adolescent is much harder to care for 3. Parent feeling that his or her adolescent is doing things that really bothered him or her as a parent – increases BMI for American Indians/Alaskan Natives; Native Pacific Islanders; Whites; and "Other." 4. Parent feeling angry at adolescent by ethnicity* - increases BMI except for Native Pacific Islanders and "Other" category	**Family Functioning Variables** 1. Increasing ability of parent & adolescent to share ideas or talk of things that really matter 2. Parent feeling that his or her adolescent is doing things that really bothered him or her as a parent – lowers BMI for Asians; Blacks; Multiracial; and Hispanics 3. Closeness of parent's relationship with adolescent** 4. Having daily emotional help in parenting or caring for adolescent***
Parental Health Variables 1. Positive perspective of mother's general health 2. Positive perspective of father's general health 3. Smoking in the household	**Parental Health Variables** 1. Frequent physical activity of mother
	Physical Activity of Adolescent 1. Frequent physical activity of adolescent through aerobic exercise 2. Frequent physical activity of adolescent through biking, skateboarding, skating, or rollerblading

*Not statistically significant at p = 0.0584
**Not statistically significant at p = 0.1640
***Not statistically significant at p= 0.1413