



Published in final edited form as:

Health Psychol. 2012 July ; 31(4): 441–449. doi:10.1037/a0027927.

Parenting Styles and Body Mass Index Trajectories From Adolescence to Adulthood

Bernard F. Fuemmeler, Ph.D., M.P.H.¹, Chongming Yang, Ph.D.², Phil Costanzo, Ph.D.³, Rick H. Hoyle, Ph.D.³, Ilene C. Siegler, Ph.D., M.P.H.⁴, Redford B. Williams, M.D.⁴, and Truls Østbye, M.D., Ph.D.¹

¹Community and Family Medicine, Duke University Medical Center, Durham NC

²Social Science Research Institute, Duke University, Durham NC

³Psychology and Neuroscience, Duke University, Durham NC

⁴Psychiatry, Duke University Medical Center, Durham NC

Abstract

Objective—Parenting styles such as authoritarian, disengaged, or permissive are thought to be associated with greater adolescent obesity risk than an authoritative style. This study assessed the relationship between parenting styles and changes in body mass index (BMI) from adolescence to young adulthood.

Methods—The study included self-reported data from adolescents in the National Longitudinal Study of Adolescent Health. Factor mixture modeling, a data-driven approach, was used to classify participants into parenting style groups based on measures of acceptance and control. Latent growth modeling (LGM) identified patterns of developmental changes in BMI. After a number of potential cofounders were controlled for, parenting style variables were entered as predictors of BMI trajectories. Analyses were also conducted for males and females of three racial/ethnic groups (Hispanic, black, white) to assess whether parenting styles were differentially associated with BMI trajectories in these 6 groups.

Results—Parenting styles were classified into 4 groups: authoritarian, disengaged, permissive, and balanced. Compared with the balanced parenting style, authoritarian and disengaged parenting styles were associated with a less steep average BMI increase (linear slope) over time, but also less leveling off (quadratic) of BMI over time. Differences in BMI trajectories were observed for various genders and races, but the differences did not reach statistical significance.

Conclusions—Adolescents who reported having parents with authoritarian or disengaged parenting styles had greater increases in BMI as they transitioned to young adulthood despite having a lower BMI trajectory through adolescence.

Parents affect the general socialization of their children by acting as role models (Bandura, 1986), and through their cognitive beliefs, attitudes and parenting (Putallaz, Costanzo, Grimes, & Sherman, 1998). Parenting *styles* are recognized as being distinct from parenting *practices*. Ventura & Birch (2008) suggest parenting styles reflect a “typology of attitudes and behaviors that characterize how a parent will interact with a child across domains of parenting” (para. 11) and refer to general acceptance, warmth, or typical interaction with the

Corresponding Author: Bernard F. Fuemmeler, Ph.D., M.P.H., Assistant Professor, Community and Family Medicine, P.O. Box 104006 DUMC, Durham NC 27710; Telephone: (919) 681-7171; Fax: (919) 684-5108; Bernard.fuemmeler@duke.edu.

Financial disclosure: Redford Williams is founder of and a major stockholder in Williams LifeSkills, Inc., and holds a U.S. patent re use of 5HTTLPR L allele as marker of increased CVD risk.

child or children as examples of parenting style. Parenting practices are less trait-like and more dependent on the context. A parent could display similar styles among all his or her children but have different practices with each child.

Parental acceptance and demand for control are two dimensions of parental style that have been used to form 4 parental typologies: authoritative (high acceptance/high control), authoritarian (low acceptance/high control), indulgent/permissive (high acceptance/low control), and neglectful/disengaged (low acceptance/low control) (Maccoby & Martin, 1983). Compared with the authoritative parenting style, authoritarian or disengaged parenting styles generally lead to poorer psychological, social, and achievement outcomes in children and adolescents. Children and adolescents whose parents use permissive styles tend to have higher self-confidence but lack self-control (Rhee, Lumeng, Appugliese, Kaciroti, & Bradley, 2006).

Studies evaluating general parenting styles and child and adolescent diet (De Bourdeaudhuij et al., 2009; Kremers, Brug, de Vries, & Engels, 2003; Lytle et al., 2003; Young & Fors, 2001) or risk for obesity (Agras, Hammer, McNicholas, & Kraemer, 2004; Gable & Lutz, 2001; Rhee, et al., 2006; Zeller, Boles, & Reiter-Purtill, 2008) have produced mixed results. Authoritative parenting and behavioral control have been associated with greater fruit and vegetable intake in some studies (Kremers, et al., 2003; Lytle, et al., 2003), but not others (De Bourdeaudhuij, et al., 2009). Some studies have found no association between parenting style and BMI and weight outcomes (Agras, et al., 2004; Gable & Lutz, 2001), while others have reported an association with authoritarian, neglectful, or permissive parenting (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Rhee, et al., 2006) or with the behavioral control dimension of parenting (Zeller, et al., 2008). Insight into lasting effects of parenting style on weight-related outcomes have been limited in prior studies, which have employed cross-sectional designs (De Bourdeaudhuij, et al., 2009; Gable & Lutz, 2001; Kremers, et al., 2003; Lytle, et al., 2003; Zeller, et al., 2008) or short periods of assessment (Agras, et al., 2004; Berge, et al., 2010; Rhee, et al., 2006).

It has been reported that children not well cared for by their parents (as measured by a teacher's report of children's cleanliness) have an increased risk of obesity in young adulthood (Lissau and Sorensen (1994). In addition, middle-aged adults with a higher metabolic risk profile are more likely to have grown up in family environments where they felt unloved or ignored (Lehman, Taylor, Kiefe, & Seeman, 2005). Prospective data from the 1958 British birth cohort longitudinal study indicate that having disengaged and uninvolved parents is positively associated with a higher BMI at age 45 (Thomas, Hypponen, & Power, 2008). No studies to date have examined the association between parenting style, per se, experienced during childhood and adolescence and longer-term weight-related outcomes during adulthood.

Studies of parenting styles and weight-related outcomes have been of discrete community or clinical samples (Berge, et al., 2010) or have been insufficiently powered to examine potential group differences by race/ethnicity and gender (Rhee, et al., 2006). However, gender and race/ethnicity may be important factors in issues related to weight. For instance, one recent study found that a permissive parenting style was associated with greater physical activity among boys but not girls (Jago et al., 2011).

Parenting style has traditionally been quantified by forming groups that are high (above the median) or low (below the median) on the 2 dimensions of acceptance and control. This means individuals who are slightly above the median are equated with those extremely above the median. Data driven methods, such as Latent Class Modeling or Mixture Modeling, offer an unbiased estimation of potential underlying subgroups in a population

based on observed variables (Collins & Lanza, 2009; B.Muthen & Asparouhov, 2006). Such methods have not previously been applied to research on identifying parenting style typologies but have been applied in other fields to help identify latent population subgroups (Lubke, Hudziak, Derks, van Bijsterveldt, & Boomsma, 2009; Lubke & Muthen, 2005; Ranby et al., in press).

In this cohort-sequential longitudinal study, associations between parenting style and changes in BMI from adolescence to young adulthood were evaluated in a large, nationally representative sample of adolescents in the US. Parenting style was classified by using a data-driven approach. Based on prior research, it was hypothesized that authoritarian, disengaged, and permissive parenting styles would be related to greater increases in BMI from adolescence to adulthood than other parenting styles. Also explored was the relationship between parenting styles and BMI trajectories among boys and girls of different races/ethnicities.

Methods

Data Source and Study Sample

The inception cohort included 20,745 adolescents in grades 7-12 (ages 11-21 years) from the National Longitudinal Study of Adolescent Health (Add Health). The cohort completed in-home surveys in three waves (April to December, 1995; April to August, 1996; August 2001 to August 2002). The response rate for all waves was at least 77.4%. The mean age of participants was 15.65 (SD = 1.75) years in Wave I, 16.22 (SD = 1.64) years in Wave II, and 22.96 (SD = 1.77) years in Wave III. The sample was stratified by region, urbanicity, school type, ethnic mix of the school, and school size. Details on design, recruitment, retention, and procedures are provided elsewhere (Harris et al., 2010).

Measures

Body mass index (kg/m²)—At Wave I, height and weight data were self-reported. In Waves II and III, weights (to the nearest 1/2 pound) and heights (to the nearest 1/8 inch) were measured during in-home interviews by trained Add Health field staff using a provided digital scale and measuring tape. During measurements, participants were clothed but not wearing shoes.

Parenting style—Wave I included six questions related to familial and parental acceptance (responses ranged from 1= not at all to 5= very much) and seven questions assessing parental control or monitoring (responses were *yes/no*) (Cox, 2006; Nowlin & Colder, 2007). Questions measuring acceptance included the following: 1) How much do you feel that your family understands you; 2) How much do you feel that you and your family have fun together; 3) How much do you feel your parents care about you; 4) How much do you feel your family pays attention to you; 5) How much do you feel you want to leave home (reverse coded); and 6) How close do you feel to your mother. Questions measuring control/monitoring were as follows: Do your parents let you make your own decisions about: 1) the people you hang around with; 2) the time you must be home on the weekend; 3) what you wear; 4) how much television you watch; 5) which television program you watch; 6) time you go to bed on the weeknights; 7) what you eat.

Family structure was indicated by whether the adolescent was living in a one- versus two-parent home during the initial in-home interview.

Potential Confounders—Primary caregivers (mostly mothers) also completed a survey that included questions about their own educational attainment. Gender and race were also self-reported by each participant.

Analysis Plan

All analyses were conducted using Mplus version 6.1 (L. K. Muthen & Muthen, 1998). Survey design effects were accounted for. Survey weights were incorporated to compensate for differences in selection probabilities of cases within sampling units, differential rates of non-response, or chance fluctuation of the sample from the population as a whole. Applying weights increases confidence that the Add Health sample represents the US population.

Factor Analysis and Factor Mixture Modeling of Parenting Styles—First, confirmatory factor analysis was performed for questions assessing parental acceptance and control. Because the responses for questions assessing control were categorical, the mean and variance-adjusted weighted least-squares estimation method (wlsmv) was used. Model fit statistics were evaluated by assessing the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). Values greater than .95 for the CFI and less than .05 for the RMSEA are indicators of good fit (Yu, 2002).

A factor mixture modeling approach (FMM) (Muthén, 2006; L. K. Muthen & Muthen, 1998) was used to overcome methodological concerns related to using median splits (Irwin, 2003; MacCallum, 2002) and for consistency with using combined measures of acceptance and control for assessing parenting styles (Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994). FMM is a hybrid of approaches such as Factor Analysis (FA) and Latent Class Analysis (LCA), which have some inherent assumptions. FA is employed for examining the latent variable structure of one or more associated constructs but is not useful for identifying latent classes (or subgroups) within a heterogeneous population. LCA can be useful for identifying such classes. However, LCA methods ignore within-class heterogeneity in the factor scores, which potentially results in an overestimation of classes. FMM combines the FA and LCA approaches by providing model-based classification of clusters or subgroups while retaining within-class heterogeneity of factor scores (Muthén, 2006; Ranby, et al., in press).

FMM assumes unobserved population heterogeneity that differs in severity represented by the underlying latent construct (Lubke & Muthen, 2005). This assumption is evaluated by Bayesian Information Criterion (BIC) (Schwarz, 1978), adjusted Bayesian Information Criterion (ABIC) (Sclove, 1987), and Akaike Information Criterion (AIC) (Akaike, 1973). In addition, the Lo-Mendell-Rubin (L-M-R) test statistic indicates whether a given model fit with a certain number of classes fits the data better than a nested model with one fewer classes. The most parsimonious model that represents the data is preferred. Substantive, or theoretical, interpretability is also indispensable for evaluating results. Lower values for the BIC, ABIC, and AIC are indications of improved fit. The BIC has been shown to perform better or equally well when compared with the AIC, the ABIC, and L-M-R test (Nylund, Asparouhov, & Muthen, 2007). A significant *p* value for the L-M-R test indicates that the model with fewer classes should be rejected in favor of the model with the greater number. Thus, for the purposes herein the BIC was given greater consideration, but the L-M-R test statistic and the classes produced were also examined to ensure that the model that best fit the data was interpretable.

Latent growth model (LGM) of changes in BMI—LGM was used to model patterns of developmental change in BMI among youth ages 15 through 26. LGM allows for estimating the average level of a parameter at a point in time (i.e., intercept), rate of

increase/decrease over time (i.e., linear slope), and the rate of change in the increase/decrease (e.g., quadratic, cubic) (Bollen & Curran, 2006; Duncan & Duncan, 2004). These growth functions can be regressed on covariates to determine the association that a particular covariate has with each growth indicator. A cohort-sequential design methodology was employed, in which age, rather than Wave of assessment, was the unit of time (Bollen & Curran, 2006; S. C. Duncan, Duncan, & Strycker, 2006; S. C. Duncan, Duncan, Strycker, & Chaumeton, 2007; Nesselroade & Blates, 1979). In Add Health, individual respondents contribute three repeated observations of weight and height, but because of age overlap, there is information on a possible total of 14 discrete ages. Thus, it is possible to model the developmental BMI trajectory over the entire age span (i.e., age 12-26 even though no children were followed more than 14 years) (Bollen & Curran, 2006). By design this approach creates substantial missing data; however, the direct maximum likelihood (ML) approach employed in Mplus overcomes potential biases in samples with substantial missing data (Bollen & Curran, 2006). The outcome variable was absolute BMI rather than BMI z score, as absolute BMI is more appropriate for modeling changes over time (Berkey & Colditz, 2007; Cole, Faith, Pietrobelli, & Heo, 2005). Although useful for modeling change, weight classifications cannot be interpreted based on absolute BMI values.

First, a series of unconditional models (i.e., models without covariates or predictor variables) (S. C. Duncan, et al., 2006; S. C. Duncan, et al., 2007) were evaluated to determine whether the BMI trajectories were best represented by a linear or quadratic growth function. After the viability and growth function of the unconditional models were assessed, conditional models that included covariates such as parental education, family structure, gender, race/ethnicity, and FMM parenting style groups were constructed (Figure 1).

Multi-group model of moderating effects of gender and race/ethnicity—In LGM analyses, a multi-group (or multiple-sample) framework was used to compare six groups: male white, male black, male Hispanic, female white, female black, and female Hispanic. The method is useful for evaluating the moderating effects of group membership (Bollen & Curran, 2006; Duncan & Duncan, 2004). In this study, initial analyses were done to test significant group differences in the intercept, slope, and quadratic function of the unconditional LGM of BMI. Next done were tests for significant group differences in parenting style variables predicting BMI latent curve components. The statistical significance of the potential moderating effect of gender and race/ethnicity was evaluated by testing for equality of parameters (intercept, slope, or quadratic function for the first analysis and parenting style variable for the second analysis) across the different groups using a series of nested models. The Satorra-Bentler chi-square difference test was used to determine significance (Satorra & Bentler, 2001).

Results

The analysis sample included participants with available weight and height data in at least two of the three waves and was limited to African American (17.1%), Caucasian (70.2%), and Hispanic (12.7%) respondents ($n = 12,550$). Other racial/ethnic groups were not of sufficient size for meaningful subgroup analyses. Among participants, 49% were female ($n=6175$) and 71% were in a two-parent household. Education level for primary caregivers was 11.4% with less than high school, 26.9% with high school or equivalent, 30.5% with some college, and 31.2% with college or greater.

Factor Analysis and Factor Mixture Modeling of Parenting

The confirmatory factor analysis indicated that questions assessing acceptance and control fit adequately within a two-factor solution [$\chi^2=2220.586$, $df=64$, $p < .0001$, $CFI=.95$, $RMSEA=.04$]. Factor loadings for the two factors exceeded .44, and cross loadings did not exceed .17 (data not shown). Reliability coefficients were .80 for acceptance and .81 for control. Thus, psychometric results showed that the indicators measured acceptance and control factors well.

FMM of the acceptance and control factors was applied to determine the number of potential unobserved subgroups (or classes) with similar scores on these factors. One to five classes were identified from the estimation. Based on fit statistics and substantive theory (Nylund, et al., 2007), a four class solution was chosen. Specifically, the L-M-R p value for three versus four classes was lower ($p=.09$), whereas the p -value for four classes versus five was greater ($p=.18$), suggesting a better fit for a four class solution. Additionally, the Bayesian Information Criterion (BIC) values favored a solution of four classes (BIC values: $BIC_{1class}=265,900$, $BIC_{2class}=259,453$, $BIC_{3class}=258,846$, $BIC_{4class}=258,152$, $BIC_{5class}=257,780$), as the decrease in BIC values between four and five classes was less than the decrease in values up to four classes. The AIC and ABIC also show similar patterns (data not shown). The four-class solution was also preferred because it approximated the intent of achieving four parenting style dimensions. The latent class probabilities for the most likely latent class membership all exceeded 78% (entropy = .67), indicating efficient assignment to class membership. Class membership was used as the primary index of parenting style. Based on factor scores of acceptance and control, which are model-fitted centered mean scores, the mixture classes were labeled as follows: permissive, authoritarian, disengaged, and balanced (Figure 2). The balanced class was chosen as the referent class in the main analyses.

Latent Growth Model of changes in BMI

To evaluate the viability of the cohort-sequential modeling approach, an initial linear unconditional model on ages 12 through 26 was constructed. Data from the 12, 13, and 14 year-olds from the first two assessments was relatively sparse compared with the other ages, and including these age cohorts in the model resulted in negative error variance estimates and model non-convergence. A linear model excluding these ages resulted in convergence and an adequate fit, $\chi^2(84)=751.08$, $CFI=.94$, $RMSEA=.03$. This did not substantially reduce the available sample size ($n=12,592$ for unconditional model). The intercept for all models was set at age 15. A comparison of the linear (slope) and nonlinear (quadratic) unconditional models using the chi-square difference test (Satorra-Bentler) was significant, $\Delta\chi^2(5)=55.0$, $p < .001$, indicating the nonlinear model with a quadratic factor was a better fit. Error variances for LGM are typically assumed to be constant (invariant), but this assumption can be relaxed. Constraining the error variances to be invariant significantly reduces the number of estimated parameters and can help the model converge. Attempts to relax this assumption resulted in a non-identified model. To ensure convergence, the final model was a non-linear model with a quadratic function with error variance constrained to be equal, $\chi^2(80)=337.59$, $CFI=.98$, $RMSEA=.02$. The average BMI at the intercept (age 15) was $M_i=22.04$ (s.e.=.11, $p < .0001$), the slope was $M_s=.78$ (s.e.=.03, $p < .0001$), and the quadratic latent curve factor was $M_q=-.02$ (s.e.=.003). The positive linear slope indicates that for every one year increase in age, there was an increase in BMI of .78. The negative quadratic latent curve factor indicates that, on average, the BMI slope levels off at a rate of .02 as age increases yearly. Significant individual variability in the intercept ($D_i=21.89$, s.e.=2.1, $p < .01$), slope ($D_s=.88$, s.e.=.22, $p < .01$) and quadratic curve ($D_q=.01$, s.e.=.002, $p < .01$) indicated significant individual differences across adolescents in these latent curve components.

The conditional model examining effects of parenting style on BMI trajectories for all participants, which was adjusted for parental education, family structure, gender, and race, resulted in good fit, $\chi^2(152) = 387.73$, CFI = .98, RMSEA = .01 (Table 1). Higher parental education was associated with a significantly lower BMI at age 15 ($\beta = -.37$, $s.e. = .08$, $p < .05$), but there were no associations between parental education and the linear slope or the quadratic curve factor (data not shown). Living in a two-parent home did not have a statistically significant association with any of the latent curve components (data not shown). With balanced parenting style as the referent, there was no association between the other three parenting styles and the BMI at age 15. However, authoritarian parenting and disengaged parenting styles were significantly related to the BMI linear slope and quadratic curve ($p < .05$). Specifically, the parameter estimates for the BMI slope for the authoritarian ($\beta = -.23$, $s.e. = .07$, $p < .05$) and disengaged ($\beta = -.33$, $s.e. = .14$, $p < .05$) parenting styles were negative, which indicated BMI did not increase as rapidly over the developmental period relative to those with a balanced parenting style. Parameter estimates for quadratic curvature for authoritarian ($\beta = .02$, $s.e. = .01$, $p < .05$) and disengaged ($\beta = .04$, $s.e. = .01$, $p < .05$) parenting styles were positive, which indicated the rate of change in BMI did not level-off as it did with a balanced parenting style.

Multi-group model of moderating effects of gender and race/ethnicity

A series of nested models indicated that all of the latent curve components (intercept, linear, and quadratic) for black males were significantly different than curve components for white males (Figure 3). Compared with white males, black males had a lower average BMI at age 15 (intercept), more gradual linear increase (slope) in BMI, and less leveling off of BMI over time (quadratic) [$\Delta\chi^2(1)$ for intercept = 7.77, $p < .01$, $\Delta\chi^2(1)$ for slope = 5.45, $p < .05$, $\Delta\chi^2(1)$ for quadratic = 5.11, $p < .05$]. The average BMI at age 15 for black and Hispanic females was statistically greater than for white females [$\Delta\chi^2(1)$ for intercept was 75.23 ($p < .0001$) for black females and 35.67 ($p < .0001$) for Hispanic females]. The linear slope for black and Hispanic females was slightly steeper than for whites, but the difference was not statistically significant. The quadratic component was not different between groups.

In the conditional model of parenting style on BMI trajectories for each of the 6 gender and race/ethnicity groups adjusted for parental education and family structure, disengaged parenting style among white males was associated with a less steep linear increase in BMI compared with the balanced style ($\beta = -.65$, $s.e. = .25$, $p < .05$), but less leveling off over time ($\beta = .06$, $s.e. = .03$, $p < .05$) (Table 1, Figure 4a-f). Among black males, disengaged parenting style was associated with a lower BMI at age 15 relative to the balanced style ($\beta = -2.69$, $s.e. = 1.05$, $p < .05$), but parenting style had no significant association with BMI linear slope or quadratic curve components. For Hispanic males, authoritarian parenting style was associated with a lower BMI at age 15 ($\beta = -2.04$, $s.e. = .69$, $p < .05$), but parenting style had no significant association with BMI linear slope or quadratic curve.

Compared with balanced parenting, authoritarian parenting was associated with a less steep linear increase in BMI for black females ($\beta = -.49$, $s.e. = .20$, $p < .05$) and white females ($\beta = -.27$, $s.e. = .10$, $p < .05$). However, over time there was less leveling off of BMI for black ($\beta = .04$, $s.e. = .02$, $p < .05$) and white ($\beta = .03$, $s.e. = .01$, $p < .05$) females with authoritarian parents relative to those whose parents had a balanced parenting style.

Although parenting style predicted BMI growth components within gender and racial/ethnic groups, there was little evidence that the parenting style variables differed significantly between groups. Models that held the effect of the parenting style variables on the latent curve components equivalent between gender and race/ethnicity groups did not significantly differ from the test model, where the effect of the parenting style variables were not equivalent. However, there was one exception: among Hispanic males, authoritarian

parenting had a significantly lower average BMI intercept than among white males ($\Delta\chi^2 [1]=3.99, p<.05$).

Conclusions

This study suggests that parenting style, as characterized by dimensions of perceived parental acceptance and behavioral control, is associated with changes in BMI from adolescence to young adulthood (ages 15–26). Authoritarian and disengaged parenting styles were consistently associated with altered BMI trajectories relative to the balanced parenting style (i.e., neither high nor low on acceptance and control). Contrary to expectations, authoritarian and disengaged parenting styles were associated with a less steep increase in BMI than with balanced parenting. However, authoritarian and disengaged parenting styles were associated with less leveling off of BMI trajectories over time, which may reflect the complexity by which parenting styles affect weight regulation during the transition from adolescence to adulthood.

Data from several studies have indicated a childhood climate characterized by disengaged or authoritarian parenting may be associated with greater weight and poorer health in adulthood. Thomas et al. (2008) reported a positive association between higher BMI at age 45 and indicators of low acceptance and disengaged parenting. Lissau and Sorrenson (1994) reported that children 9-10 years old who were rated by their teachers as “unkempt” (potentially indicating low parental involvement) had higher BMI 10 years later. Some of their data indicated that children with strict parents were also heavier as adults. This present study is unique in that it examines associations between parenting styles and the development of BMI over an 11 year period.

A higher adiposity among adolescent black and Hispanic females versus white females has also been reported in previous studies (Johnson et al., 2009; Ogden, Carroll, & Flegal, 2008). The data in this study indicate that while black and Hispanic females tend to be heavier at age 15 compared with white females, their BMI trajectories do not increase at a greater rate. Black adolescent males, while heavier during adolescence than whites, had a more gradual increase in BMI that did not level off as quickly. These findings point to differences in adiposity development between black females and black males relative to their white counterparts. The reasons for the differences justify further study.

The findings in this study were consistent with findings of others that suggest parenting styles may take on a different meaning for members of different racial/ethnic backgrounds (Anderson, Hughes, Fisher, & Nicklas, 2005; Baumrind, 1972; Hughes et al., 2006; Lansford et al., 2005; Pachter & Harwood, 1996). However, in this study the differences between groups were not statistically significant. Because a parenting style that is normative in one culture may be less so in another (Lansford, et al., 2005), it may be fruitful to investigate the meaning that persons from different cultures attribute to various parenting styles.

Although this study is unique in examining associations between parenting styles and BMI over 11 years, certain limitations are acknowledged. First, the association between parenting styles and BMI trajectories does not equate with causation. To show causation, studies would have to change parenting styles and demonstrate subsequent changes in adolescent diet and weight greater than that observed in a control group. Further, this study did not address mechanisms or factors causing associations between parenting style and BMI. It may be that authoritarian parenting undermines the development of self-regulatory control, thereby leading to poorer weight management or that disengaged parenting in an obesogenic home environment may set the course for deleterious weight management

practices among adolescents and young adults. Future research is needed to elucidate potential mediators or moderators relevant to the relationship between parenting style and BMI. Heights and weights were self-reported in the first wave and measured thereafter. Future studies with more precise measurement of height and weight and other indicators of adiposity should be pursued. This study may also be subject to residual confounding of both measured and unmeasured variables. Finally, because parenting style prior to adolescence was not considered, it is unknown whether early versus late parenting has a greater influence on BMI or whether parenting style changed over development.

Strengths of this study were use of a growth modeling approach and inclusion of a large sample representative of the US population. Growth modeling approaches can be more powerful for assessing associations between risk factors and dynamic changes in an outcome than ordinary least square (OLS) methods. In this study, parenting styles were empirically derived using mixture modeling. This data-driven approach may more closely approximate how parenting styles vary in the population than the traditional method of classifying parenting style groups based on use of median splits. Replication of the latent classes in other samples would add confidence that the typologies identified are meaningful. Notably, some of the available items for measuring acceptance referenced both the family as well as parents and thus this may have reduced measurement precision of this construct. However, items referencing the parent or the family did load on the same factor in the factor analysis. Further, ratings were only from the adolescent themselves. This is not uncommon, and some argue that the method is consistent with the socialization process from the perspective of the adolescent (Barber, Stolz, & Olsen, 2005).

In sum, the findings in this study support the notion that a disengaged or authoritarian parenting climate may have long-lasting effects on risk for obesity. The results contribute to a growing literature regarding a life-course epidemiologic approach to health (Ben-Shlomo, 2007). The findings of this study, as well as those of others, suggest that a potentially fruitful method for preventing obesity may be to incorporate strategies that address not only parenting practices around food and eating but also general parenting styles. Given that cultural beliefs and attitudes may shape normative beliefs about what constitutes a specific parenting style, careful attention should be paid to ensure that interventions are culturally tailored and appropriate.

Acknowledgments

Funding support: Authors received support for conducting analysis and preparing manuscript from the following grants: National Cancer Institute (NCI) K07CA124905 (BFF), National Heart Lung and Blood Institute (NHLBI) P01-HL36587 (RBW; ICS), National Institute on Drug Abuse (NIDA) P30 DA023026 (PC, RHH, CY).

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (<http://www.cpc.unc.edu/addhealth>). No direct support was received from grant P01-HD31921 for this analysis.

References

- Agras WS, Hammer LD, McNicholas F, Kraemer HC. Risk factors for childhood overweight: a prospective study from birth to 9.5 years. *Journal of Pediatrics*. 2004; 145(1):20–25.10.1016/j.jpeds.2004.03.023 [PubMed: 15238901]
- Akaike H. Information theory and an extension of the maximum likelihood principle. Paper presented at the Second international symposium on information theory. 1973

- Anderson CB, Hughes SO, Fisher JO, Nicklas TA. Cross-cultural equivalence of feeding beliefs and practices: the psychometric properties of the child feeding questionnaire among Blacks and Hispanics. *Preventive Medicine*. 2005; 41(2):521–531.10.1016/j.yjmed.2005.01.003 [PubMed: 15917048]
- Bandura, A. *Social foundation of thought and action: A social cognitive theory*. Englewood Cliffs, N.J.: Prentice Hall; 1986.
- Barber BK, Stolz HE, Olsen JA. Parental support, psychological control, and behavioral control: assessing relevance across time, culture, and method. *Monographs of the Society for Research in Child Development*. 2005; 70(4):1–137.10.1111/j.1540-5834.2005.00365.x [PubMed: 16359423]
- Baumrind A. An exploratory study of socialization effects on black children: some black-white comparisons. *Child Development*. 1972; 43:261–267. [PubMed: 5027666]
- Ben-Shlomo Y. Rising to the challenges and opportunities of life course epidemiology. *International Journal of Epidemiology*. 2007; 36(3):481–483.10.1093/ije/dym116 [PubMed: 17675305]
- Berge JM, Wall M, Loth K, Neumark-Sztainer D. Parenting Style as a Predictor of Adolescent Weight and Weight-Related Behaviors. *Journal of Adolescent Health*. 2010; 46(4):331–338.10.1016/j.jadohealth.2009.08.004 [PubMed: 20307821]
- Berkey CS, Colditz GA. Adiposity in adolescents: change in actual BMI works better than change in BMI z score for longitudinal studies. *Ann Epidemiol*. 2007; 17:44–50.10.1016/j.annepidem.2006.07.014 [PubMed: 17140812]
- Bollen, KA.; Curran, PJ. *Latent Curve Models: A Structural Equation Perspective*. Hoboken, New Jersey: John Wiley & Sons, Inc; 2006.
- Cole TJ, Faith MS, Pietrobelli A, Heo M. What is the best measure of adiposity change in growing children: BMI, BMI %, BMI z-score or BMI centile? *European Journal of Clinical Nutrition*. 2005; 59:419–425.10.1038/sj.ejcn.1602090 [PubMed: 15674315]
- Collins, LM.; Lanza, ST. *Latent Class and Latent Transition Analysis: With Applications in the Social Behavioral and Health Sciences*. Wiley; 2009.
- Cox MF. Racial differences in parenting dimensions and adolescent condom use at sexual debut. *Public Health Nursing*. 2006; 23(1):2–10.10.1111/j.0737-1209.2006.230102.x [PubMed: 16460415]
- De Bourdeaudhuij I, Te Velde SJ, Maes L, Perez-Rodrigo C, de Almeida MD, Brug J. General parenting styles are not strongly associated with fruit and vegetable intake and social-environmental correlates among 11-year-old children in four countries in Europe. *Public Health Nutr*. 2009; 12(2):259–266.10.1017/S1368980008002930 [PubMed: 18616848]
- Duncan SC, Duncan TE. An introduction to latent growth curve modeling. *Behavior Therapy*. 35(2): 333.10.1016/S0005-7894(04)80042-X
- Duncan SC, Duncan TE, Strycker LA. Alcohol use from ages 9 to 16: A cohort-sequential latent growth model. *Drug and Alcohol Dependence*. 2006; 81(1):71–81.10.1016/j.drugalcdep.2005.06.001 [PubMed: 16006054]
- Duncan SC, Duncan TE, Strycker LA, Chaumeton NR. A cohort-sequential latent growth model of physical activity from ages 12 to 17 years. *Annals of Behavioral Medicine*. 2007; 33(1):80–89.10.1207/s15324796abm3301_9 [PubMed: 17291173]
- Gable S, Lutz S. Nutrition socialization experiences of children in the Head Start program. *Journal of the American Dietetic Association*. 2001; 101(5):572–577.10.1016/S0002-8223(01)00143-2 [PubMed: 11374352]
- Harris, KM.; Florey, F.; Tabor, J.; Bearman, PS.; Jones, J.; Udry, JR. *The National Longitudinal Study of Adolescent Health: Research Design*. 2010. Retrieved June 8, 2010, 2010, from <http://www.cpc.unc.edu/projects/addhealth/design>
- Hughes SO, Anderson CB, Power TG, Micheli N, Jaramillo S, Nicklas TA. Measuring feeding in low-income African-American and Hispanic parents. *Appetite*. 2006; 46(2):215–223.10.1016/j.appet.2006.01.002 [PubMed: 16504340]
- Irwin JR. Negative consequences of dichotomizing continuous predictor variables. *JMR, Journal of Marketing Research*. 2003; 40(3):366.

- Jago R, Davison KK, Brockman R, Page AS, Thompson JL, Fox KR. Parenting styles, parenting practices, and physical activity in 10- to 11-year olds. *Preventive Medicine*. 2011; 52(1):44–47.10.1016/j.ypmed.2010.11.001 [PubMed: 21070805]
- Johnson WD, Kroon JJ, Greenway FL, Bouchard C, Ryan D, Katzmarzyk PT. Prevalence of risk factors for metabolic syndrome in adolescents: National Health and Nutrition Examination Survey (NHANES), 2001-2006. *Arch Pediatr Adolesc Med*. 2009; 163(4):371–377.10.1001/archpediatrics.2009.3 [PubMed: 19349567]
- Kremers SP, Brug J, de Vries H, Engels RC. Parenting style and adolescent fruit consumption. *Appetite*. 2003; 41(1):43–50.10.1016/S0195-6663(03)00038-2 [PubMed: 12880620]
- Lansford JE, Chang L, Dodge KA, Malone PS, Oburu P, Palmerus K, Quinn N. Physical discipline and children's adjustment: cultural normativeness as a moderator. *Child Dev*. 2005; 76(6):1234–1246.10.1111/j.1467-8624.2005.00847.x [PubMed: 16274437]
- Lehman BJ, Taylor SE, Kiefe CI, Seeman TE. Relation of childhood socioeconomic status and family environment to adult metabolic functioning in the CARDIA study. *Psychosomatic Medicine*. 2005; 67(6):846–854.10.1097/01.psy.0000188443.48405.eb [PubMed: 16314588]
- Lissau I, Sorensen TI. Parental neglect during childhood and increased risk of obesity in young adulthood. *Lancet*. 1994; 343(8893):324–327.10.1016/S0140-6736(94)91163-0 [PubMed: 7905145]
- Lubke GH, Hudziak JJ, Derks EM, van Bijsterveldt TC, Boomsma DI. Maternal ratings of attention problems in ADHD: evidence for the existence of a continuum. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2009; 48(11):1085–1093.10.1097/CHI.0b013e3181ba3dbb [PubMed: 19797980]
- Lubke GH, Muthen B. Investigating population heterogeneity with factor mixture models. *Psychol Methods*. 2005; 10(1):21–39.10.1037/1082-989X.10.1.21 [PubMed: 15810867]
- Lytle LA, Varnell S, Murray DM, Story M, Perry C, Birnbaum AS, Kubik MY. Predicting adolescents' intake of fruits and vegetables. *J Nutr Educ Behav*. 2003; 35(4):170–175.10.1016/S1499-4046(06)60331-X [PubMed: 12859881]
- MacCallum RC. On the practice of dichotomization of quantitative variables. *Psychological methods*. 2002; 7(1):19.10.1037/1082-989X.7.1.19 [PubMed: 11928888]
- Maccoby, EE.; Martin, JA. Socialization in the context of the family: Parent-child interaction. In: Mussen, PH.; Hetherington, EM., editors. *Handbook of child psychology: Vol 4 Socialization personality and social development*. New York: Wiley; 1983. p. 1-101.
- Muthén B. Should substance use disorders be considered as categorical or dimensional? *Addiction*. 2006; 101:6–16.10.1111/j.1360-0443.2006.01583.x [PubMed: 16930156]
- Muthen B, Asparouhov T. Item response mixture modeling: application to tobacco dependence criteria. *Addict Behav*. 2006; 31(6):1050–1066.10.1016/j.addbeh.2006.03.026 [PubMed: 16675147]
- Muthen, LK.; Muthen, BO. *Mplus User's Guide*. Los Angeles: Muthen & Muthen; 1998.
- Nesselroade, JR.; Blates, PB. *Longitudinal Research in the Study of Behavior and Development*. New York: Academic; 1979.
- Nowlin PR, Colder CR. The role of ethnicity and neighborhood poverty on the relationship between parenting and adolescent cigarette use. *Nicotine Tob Res*. 2007; 9(5):545–556.10.1080/14622200701239613 [PubMed: 17454711]
- Nylund KL, Asparouhov T, Muthen B. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*. 2007; 14:535–569.10.1080/10705510701575396
- Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003-2006. *JAMA*. 2008; 299(20):2401–2405.10.1001/jama.299.20.2401 [PubMed: 18505949]
- Pachter LM, Harwood RL. Culture and child behavior and psychosocial development. *Journal of Developmental and Behavioral Pediatrics*. 1996; 17(3):191–198.10.1097/00004703-199606000-00010 [PubMed: 8783068]

- Putallaz M, Costanzo PR, Grimes CL, Sherman DM. Intergenerational continuities and their influences on children's social development. *Social Development*. 1998; 7(3):389–427.10.1111/1467-9507.00074
- Ranby KW, Boynton MH, Kollins S, McClernon FJ, Yang C, Fuemmeler B. Understanding the Phenotypic Structure of Adult Retrospective ADHD symptoms during Childhood in the United States. *Journal of Clinical Child and Adolescent Psychology*. in press.
- Rhee KE, Lumeng JC, Appugliese DP, Kaciroti N, Bradley RH. Parenting styles and overweight status in first grade. *Pediatrics*. 2006; 117(6):2047–2054.10.1542/peds.2005-2259 [PubMed: 16740847]
- Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*. 2001; 66(4):507–514.10.1007/BF02296192
- Schwarz G. Estimating the Dimension of a Model. *The Annals of Statistics*. 1978; 6(2):461–464.10.1214/aos/1176344136
- Sclove S. Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika*. 1987; 52(3):333–343.10.1007/bf02294360
- Steinberg L, Lamborn SD, Darling N, Mounts NS, Dornbusch SM. Overtime changes in adjustment and competence among adolescents from authoritative, authoritarian, indulgent, and neglectful families. *Child Dev*. 1994; 65(3):754–770.10.1111/j.1467-8624.1994.tb00781.x [PubMed: 8045165]
- Thomas C, Hypponen E, Power C. Obesity and type 2 diabetes risk in midadult life: the role of childhood adversity. *Pediatrics*. 2008; 121(5):e1240–1249.10.1542/peds.2007-2403 [PubMed: 18450866]
- Ventura AK, Birch LL. Does parenting affect children's eating and weight status? *Int J Behav Nutr Phys Act*. 2008; 5:15.10.1186/1479-5868-5-15 [PubMed: 18346282]
- Young EM, Fors SW. Factors related to the eating habits of students in grades 9-12. *Journal of School Health*. 2001; 71(10):483–488.10.1111/j.1746-1561.2001.tb07285.x [PubMed: 11816396]
- Yu, CY. Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes. 2002. Available from <http://worldcat.org/zwcorg/database>
- Zeller MH, Boles RE, Reiter-Purtill J. The additive and interactive effects of parenting style and temperament in obese youth seeking treatment. *Int J Obes (Lond)*. 2008; 32(10):1474–1480.10.1038/ijo.2008.125 [PubMed: 18698318]

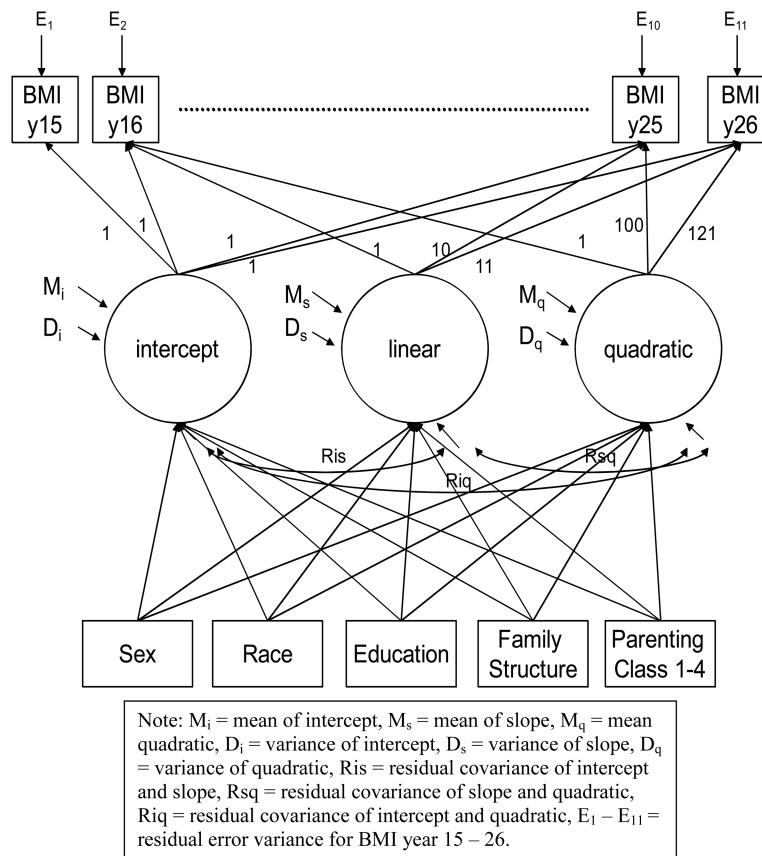


Figure 1. Representation of the conditional cohort-sequential mode

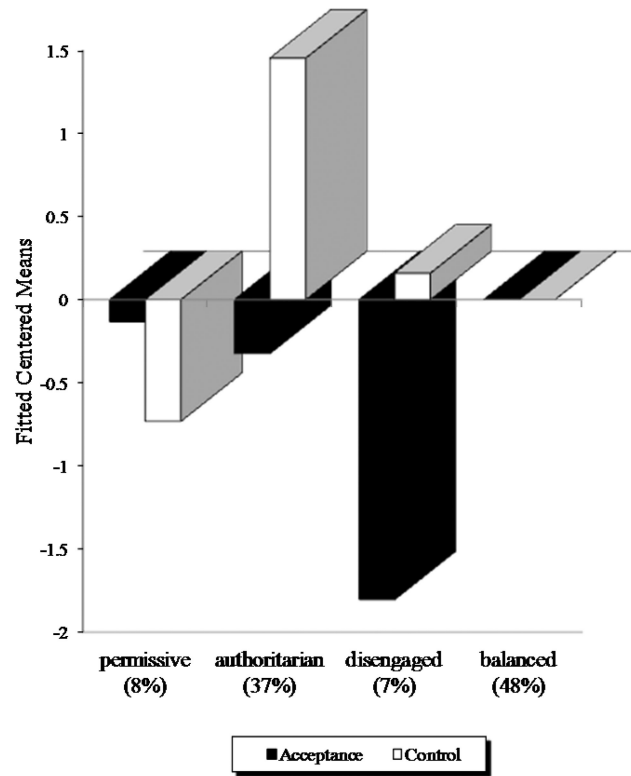


Figure 2. Fitted centered means for acceptance and control for each class labeled permissive (low control), authoritarian (high control), disengaged (low acceptance), and balanced (mean levels of acceptance and control).

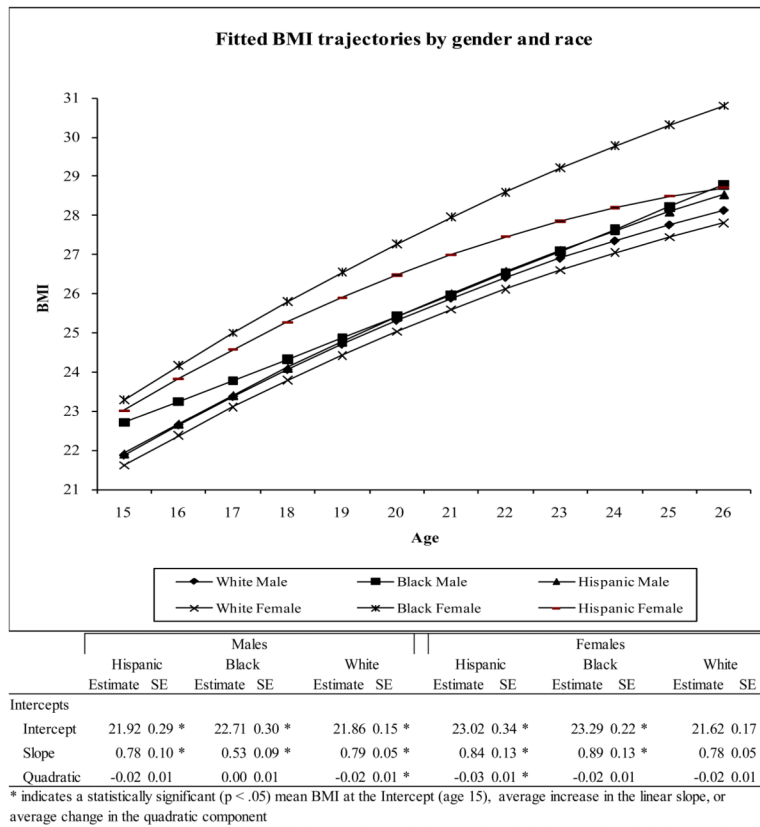


Figure 3. Fitted BMI curves by gender and race with parameter estimates for the intercept, linear, and quadratic.

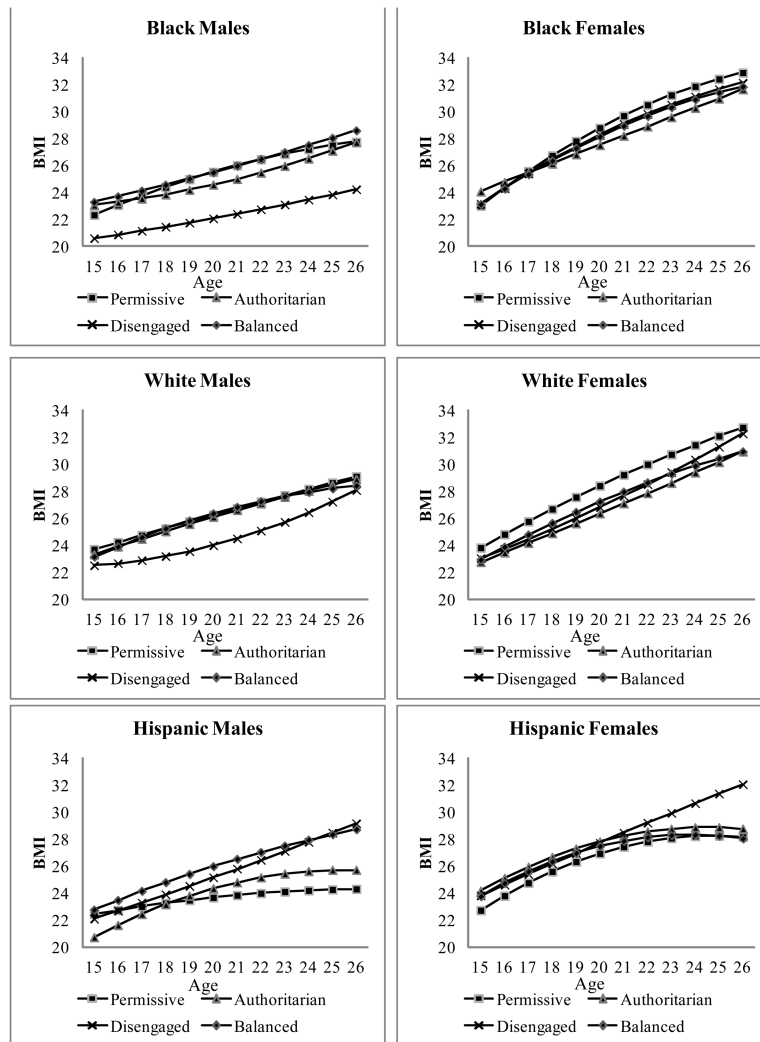


Figure 4. a-f. BMI trajectories for males and females by race/ethnicity in each of the 4 parenting style subgroups.

Table 1
Parameter estimates for the associations between parenting styles and BMI intercept, linear and quadratic for all participants and males and females of the racial/ethnic groups

	All participants [‡] (n=10,894)			Males [‡]			Females [‡]			
	Estimate	SE		Hispanic (n = 914)	Black (n = 1091)	White (n = 3130)	Hispanic (n = 940)	Black (n = 1385)	White (n = 3434)	
Intercept on Balanced (referent)										
Permissive	0.23	0.33		-0.33	1.74	0.55	0.68	-1.04	1.11	0.89
Authoritarian	0.01	0.18		-2.04 *	0.69 *	0.17	0.29	0.41	0.82	-0.18
Disengaged	-0.28	0.38		-0.67	4.17	-0.65	0.74	0.05	1.31	0.10
Linear on Balanced (referent)										
Permissive	-0.06	0.11		-0.42	0.60	-0.25	0.15	0.10	0.36	0.04
Authoritarian	-0.23	0.07 *		0.22	0.26	-0.18	0.12	-0.05	0.29	-0.27
Disengaged	-0.33	0.14 *		-0.14	1.46	-0.65	0.25 *	-0.23	0.48	-0.29
Quadratic on Balanced (referent)										
Permissive	0.01	0.01		0.00	0.05	0.02	0.02	0.00	0.03	0.00
Authoritarian	0.02	0.01 *		-0.03	0.02	0.02	0.01	0.01	0.03	0.03
Disengaged	0.04	0.01 *		0.02	0.12	0.06	0.03 *	0.05	0.05	0.04
Intercepts										
Intercept	22.85	0.37 *		22.75	0.64 *	23.15	0.46 *	23.75	0.79 *	22.92
Linear	0.75	0.14 *		0.73	0.26 *	0.78	0.16 *	1.04	0.26 *	0.97
Quadratic	-0.02	0.01		-0.02	0.02	-0.03	0.02	-0.06	0.03 *	-0.02

[‡]Models for all participants adjusted for race, gender, parental education, and 1 vs. 2 parent homes

[†]Models males and females from racial/ethnic groups adjusted for education and 1 vs. 2 parent homes

* p < .05