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Parenting Style as a Predictor of Adolescent Weight and Weight-Related Behaviors

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Abstract

Purpose: Current research indicates that specific parenting styles are associated with adolescent overweight, dietary intake and physical activity, but the majority of research has been cross-sectional making it difficult to determine the temporal order of these associations. The current study adds to the previous research by examining 5-year longitudinal associations between parenting style and adolescent weight and weight-related behaviors.

Methods: Data from Project EAT, a population-based study with adolescents from diverse ethnic and socioeconomic backgrounds were used. Adolescents (N = 2516) from 31 Minnesota schools completed in-class assessments in 1999 (Time 1) and mailed surveys in 2004 (Time 2). Multiple linear regression models were used to predict mean levels of adolescent outcomes at Time 2 from parenting style at Time 1.

Results: Time 1 maternal authoritative parenting style predicted lower BMI in adolescent sons and daughters at Time 2. Time 1 paternal permissive parenting style predicted more fruits and vegetables intake in daughters at Time 2. Significant associations were not found between parenting style and adolescent physical activity.

Conclusions: Findings suggest that authoritative parenting style may play a protective role related to adolescent overweight and that the dimension of warmth/caring in the parent/adolescent relationship may be important in relation to female adolescent healthy dietary intake. Further exploration of opposite sex parent/adolescent dyad patterns related to parenting style and adolescent weight and weight-related behaviors is warranted.

Keywords

Parenting Style; Adolescent; Overweight; Obesity

The prevalence of adolescent obesity has tripled over the last two decades.¹⁻³ In response, researchers have increased their efforts to identify causal factors of obesity in order to halt or

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slow the increase of obesity among youth.⁴⁻⁵ Numerous calls issued to the field by expert panels, national committees, and researchers have pointed to the potential influence of the family as a neglected area of research.^{3, 6-7}

Researchers who have responded to these calls have begun to establish a connection between parenting behaviors and adolescent overweight and obesity.⁸⁻¹³ Specifically, there is evidence suggesting that parenting style is associated with adolescent overweight, dietary intake and physical exercise.¹⁴⁻¹⁷ The four classic parenting styles are: authoritative, authoritarian, permissive, and neglectful.¹⁸⁻²⁰ Parenting style typologies are based on two dimensions: (a) the degree of responsiveness and (b) the degree of demandingness of the parent.

Responsiveness is the extent to which a parent fosters individuality, self-regulation, and self-assertion in their child by being attuned and supportive of their child's needs and demands.¹⁹⁻²⁰ Whereas, demandingness is the extent to which parents cultivate self-control and responsibility in their child through parental supervision, rules/structure and disciplinary efforts.¹⁹⁻²⁰ An authoritative parent balances high levels of responsiveness with high levels of demandingness. An authoritarian parent exhibits low levels of responsiveness and high levels of demandingness. A permissive parent expresses high levels of responsiveness and low levels of demandingness. A neglectful parent exhibits low levels of both responsiveness and demandingness. Thus, an authoritative parenting style provides the structure and support needed for children to internalize and maintain positive behaviors, whereas, authoritarian, permissive and neglectful parenting styles may interfere with children's ability to learn self-regulation, including regulation of eating.⁴

Several cross-sectional studies have found an association between authoritative parenting style (high responsiveness, high demandingness) and lower youth BMI, more frequent physical activity and healthy dietary intake²¹⁻²⁶ and one longitudinal study found that children of authoritarian parents (high demandingness, low responsiveness) had almost a fivefold increase in odds of being overweight.⁴ The research to date on parenting styles is promising, but the majority of the research has been cross-sectional and conducted with grade school children from primarily white, mid-high income families. Thus, in order to address the gaps in the extant research on parenting styles and overweight and obesity among adolescents, this study aims to use longitudinal data, which can show temporality of associations, to investigate the relationship between parenting style and adolescent weight and weight-related behaviors in an ethnically diverse and socio-economic diverse population. This paper will address the following research questions: (a) Does parenting style predict adolescent BMI longitudinally? (b) Which specific parenting styles serve as risk factors or protective factors in relation to adolescent obesity? (c) Does parenting style predict other weight-related outcomes for adolescents including, healthy dietary intake and physical activity?

METHODS

Study Design and Population

Project EAT-II (Eating Among Teens) is a longitudinal, follow-up study of Project EAT-I, a study of eating patterns and weight-related behaviors in adolescents.²⁷ The study population includes 2516 adolescents (1386 girls and 1130 boys) who participated in Project EAT-I and Project EAT-II. Schools serving ethnically and socioeconomically diverse populations were invited to participate in the study. In Project EAT-I, middle and high school students from 31 Minnesota schools completed in-class surveys and anthropometric measures during the 1998-1999 academic year. Project EAT-II aimed to survey all of the original participants by mail 5 years later (2003-2004). The University of Minnesota's Institutional Review Board Human Subjects Committee approved all study protocols.

Of the original Project EAT-I study population ($N = 4746$), 1074 (22.6%) were lost to follow-up. Of the remaining 3672 participants contacted by mail, 2516 completed surveys, representing 53.0% of the original cohort and 68.5% of participants who could be contacted for Project EAT-II. Approximately one-third (32%) of the participants were in middle school during Project EAT-I; at Time 1 their mean age was 12.8 years ($SD=0.8$) and at Time 2 their mean age was 17.2 years ($SD=0.6$). Two-thirds of the participants were in high school in Project EAT-I; at Time 1 their mean age was 15.8 years ($SD=0.8$) and at Time 2 their mean age was 20.4 years ($SD=0.8$) (see Table 1 for other demographic information).

For Project EAT-II, participants were mailed a Project EAT survey and the Youth and Adolescent Food Frequency Questionnaire (FFQ). The development of the Project EAT survey was guided by focus groups with adolescents,²⁸ social cognitive theory,²⁹ a review of existing instruments, reviews by experts in the area, and several pilot tests of the survey.²⁷ All participants were mailed a letter along with their survey explaining that completion of the survey implied written consent.

MEASURES

Time 1 Predictor Variables

Parenting Style Variables—Four parenting styles (authoritative, authoritarian, permissive and neglectful), were created using adolescents' reports of parenting characteristics in EAT-I data and based on Baumrind¹⁹ and Maccoby and Martin's²⁰ conceptualization of parenting styles. Parent responsiveness was measured by two items assessing “caring” and “communication”.³⁰ The caring item asked, separately for mothers and fathers, “How much do you feel your mother/father cares about you?” The communication item asked, separately for mothers and fathers, “How much do you feel you can talk to your mother/father about your problems?” Both questions had response options ranging from “not at all” to “very much” on a 5-point Likert scale. Students' responses to these two questions were averaged and then dichotomized such that an average response of 4 or higher was considered “high responsiveness” and less than 4 considered “low responsiveness.” Test-retest values for these items ranged from Spearman $r = .69$ (for both items for fathers) to Spearman $r = .82$ (for both items for mothers).

Parent demandingness was measured by the following question, asked separately for mothers and fathers.³¹ “Compared to other mothers/fathers, how strict would you say your mother/father is?” Response options were: “much less strict,” “somewhat less strict,” “about the same,” “somewhat more strict,” or “much more strict.” The pivot value of 3 was anchored at “about the same” on this 5-point Likert scale. Student's responses of 3 or higher were coded as “high demandingness” and less than 3 were “low demandingness”. The test-retest value for this item was Spearman $r = .71$ for fathers and Spearman $r = .74$ for mothers. Parental style variables were defined by the data as follows: authoritative (high responsiveness/high demandingness), authoritarian (low responsiveness/high demandingness), permissive (high responsiveness/low demandingness) and neglectful (low responsiveness/low demandingness).¹¹

Outcome Variables

Adolescent BMI—BMI at time 1 and time 2 was based on self-reported height and weight measures and calculated with the formula, weight (kg)/height (in meters squared). Although at Time 2 only self-reported heights and weights were collected, at Time 1 both measured and self-reported heights and weights were assessed. The correlations between reported BMI at Time 2 and measured BMI at Time 1 were $r = 0.85$ for adolescent girls and $r = 0.89$ for adolescent boys.³² Past research has indicated that self-reported and objectively measured weight and height are highly correlated.³³

Dietary Intake—Dietary intake was assessed with the 149-item Youth and Adolescent Food Frequency Questionnaire (YAQ).³⁴ For the current analysis, youths' self-reported servings of fruits and vegetables eaten per day were summed together. These two food items were selected given the importance of fruit and vegetables in weight-related behaviors and overall health.

Physical Activity—EAT-I and EAT-II physical activity questions were adapted from the Godin Leisure-Time Exercise Questionnaire.³⁵ Youth were asked, “In a usual week, how many hours do you spend doing the following activities:” (1) strenuous exercise (e.g. biking fast, aerobic dancing, running, jogging, swimming laps, cross-country skiing) (2) moderate exercise (e.g. walking quickly, gymnastics, baseball, skiing, skateboarding, easy bicycling). Response options ranged from “none” to “6+ hours a week”. Youths' self-reported hours of moderate to vigorous physical activity were summed to create this variable.

Control Variables

Sex, Age/Cohort and Ethnicity/Race—Students self-reported their ethnicity/race, age and sex. Ethnicity/race was assessed with the question, “Do you think of yourself as: (a) White, (b) Black/African-American, (c) Hispanic or Latino, (d) Asian-American, (e) Hawaiian/Pacific Islander, (f) American Indian or Native American? A few participants identified their background as “Hawaiian or Pacific Islander” these youth were included in the category “mixed/other.” Age was grouped into two cohorts, young adolescents (16-18 yrs.) and older adolescents (19-21 yrs.).

Socioeconomic status (SES)—Classification tree methodology³⁶ was used to generate five categories of SES (Low SES, Low-Mid SES, Middle SES, Mid-High SES, High SES)²⁷. The prime determinant of SES was the higher education level of either parent. Subsidiary variables were family eligibility for free/reduced lunch, family receipt of public assistance, and parent employment status.

Statistical Analysis

Descriptive statistics representing the proportions of adolescents' reporting paternal and maternal parenting style by sex are presented in Table 1. Four multiple linear regression models, stratified by adolescent sex, were run for outcomes of interest (BMI, dietary intake of fruit and vegetables, physical activity). All analyses were adjusted for ethnicity/race, SES and age/cohort in order to control for potential confounders. In particular, the adjustment for age/cohort allowed for correction of differences in BMI by age. Model 1 regressed outcomes on mother and father parenting style separately adjusted for demographic variables. This model predicts the independent relationships between mother and father parenting style on adolescent BMI, dietary intake and physical activity (see Table 2). The second model additionally adjusts for outcome variables at Time 1. This model allows for an examination of how Time 1 paternal and maternal parenting style independently predict Time 2 adolescent BMI, dietary intake and physical activity above and beyond any cross-sectional associations between these variables at Time 1, and thus allows for predicting the change in BMI, dietary intake and physical activity during the 5-year study period.

In order to account for the reciprocal effects each parent may have on the other's parenting style, a multiple regression model (Model 3) was created that included maternal and paternal parenting style simultaneously to allow them to control for one another. This model is particularly important because it allows for the detection of an association between parenting styles and adolescent/young adult BMI, dietary intake and physical activity above and beyond the effect of the opposite parent's influence (see Table 3). Model 4 additionally adjusts for outcome variables at Time 1. Thus, Model 4 allows for the examination of how paternal and maternal parenting style at Time 1 predicts Time 2 adolescent BMI, dietary intake and physical

activity, above and beyond any cross-sectional associations between these variables at Time 1, in order to assess predictors of change in BMI, dietary intake and physical activity during the 5-year study period, while taking into account each parent's potential influence on the other's parenting style.

In the case where a significant overall parenting style effect was found to be significant at the .05 level, post hoc analyses were also conducted to determine which specific parenting styles were significantly different from each other. To identify specific mean differences by style, post-hoc mean difference tests used the more conservative .01 significance level in light of multiple comparisons.

All analyses were conducted using SAS statistical software package³⁷ and weighted to adjust for differential response rates to Project EAT-I and Project EAT-II using the response propensity method.³⁸ Attrition in the study population was not equal across sociodemographic characteristics; Time 2 participants were more likely to be female, white and of higher SES than Time 1 participants. The response propensity method applies a weight equal to the inverse of the estimated probability that an individual responded in 2003-2004 and results in the estimates representative of the demographic makeup of the original Project EAT-I sample. The weighted ethnic/racial and SES proportions are shown in Table 1.

RESULTS

Descriptive Analysis of Parenting Style by Adolescent Demographics

Probabilities of Parenting Style by Adolescent Demographics—At Time 1, the prevalence of maternal parenting styles did not differ ($p = .560$) between sons and daughters; authoritative parenting style was the most common (see Table 1). In contrast, significant differences ($p < .001$) were found for paternal parenting style across adolescent sex. For fathers of girls, the most prevalent parenting style was authoritarian (35.6%), while for fathers of boys, the most prevalent parenting style was authoritative (34.5%), based on adolescent reports.

Relationship Between Parenting Style and Adolescent Outcomes

In all findings, results in the text are compared to the authoritative parenting style referent group, while the table presents comparisons between all four parenting styles. This was done because past research and theory indicate that authoritative parenting style is associated with positive adolescent health behavior outcomes.^{4, 21-26} In model 1 (see Table 2), Time 1 maternal authoritarian parenting style (low responsiveness/high demandingness) predicted significantly higher BMI in sons at Time 2, compared to sons of authoritative (high responsiveness/high demandingness) mothers ($M = 25.2$ vs. 24.1 , $p < .01$). Also, Time 1 paternal neglectful (low responsiveness/low demandingness) parenting style predicted less frequent physical activity at Time 2 in sons compared to sons of authoritative fathers ($M = 5.88$ hours of PA/week vs. 7.34 , $p < .01$). Further, there was no difference in daughters' Time 2 fruit and vegetable intake between Time 1 permissive paternal parenting style and authoritative paternal parenting style ($M = 3.90$ vs. 3.76 servings/day, $p = .485$), but there was a significant difference between daughters of paternal permissive parenting style and paternal authoritarian parenting style ($M = 3.90$ vs. 3.32 servings/day, $p < .01$).

After adjusting for Time 1 outcomes (Model 2), the only association that remained statistically significant was between fathers' parenting style and dietary intake in daughters. There was no difference in Time 2 fruit and vegetable intake between daughters of permissive and authoritative fathers ($M = 3.84$ vs. 3.43 servings/day, $p = .029$), but there was a significant difference between daughters of permissive fathers and authoritarian fathers ($M = 3.84$ vs. 3.21 servings/day, $p < .01$).

In model 3 (see Table 3), controlling for reciprocal effects of parenting style, Time 1 maternal authoritarian parenting style predicted significantly higher BMI for sons at Time 2, compared to sons with authoritative mothers ($M = 25.4$ vs. 23.9 , $p < .01$). Also, Time 1 maternal neglectful parenting style predicted significantly higher BMI for daughters at Time 2, compared to daughters with authoritative mothers ($M = 25.1$ vs. 23.5 , $p < .01$). Further, as in Model 1 and 2, there was no difference in daughters' Time 2 fruit and vegetable intake between permissive and authoritative fathers ($M = 3.94$ vs. 3.62 servings/day, $p = .140$), but there was a significant difference between daughters of permissive and authoritarian fathers ($M = 3.94$ vs. 3.26 servings/day, $p < .01$). No other associations were statistically significant.

After adjusting for Time 1 outcomes (Model 4), the only association that remained statistically significant was between fathers' parenting style and daughters' dietary intake (See Table 3). There was no difference in daughters' fruit and vegetable intake at Time 2 between permissive and authoritative fathers ($M = 3.89$ vs. 3.39 servings/day, $p = .013$), but daughters of permissive fathers at Time 1 had higher intake of fruits and vegetables at Time 2 compared to authoritarian fathers ($M = 3.89$ vs. 3.18 servings/day, $p < .01$).

DISCUSSION

The present study explored the 5-year longitudinal associations between parenting style and adolescent BMI, dietary intake and physical activity. The findings suggest that maternal authoritative parenting style may play a protective role related to BMI in sons and daughters and maternal authoritarian parenting style is a risk factor related to BMI in sons and maternal neglectful parenting style is a risk factor related to BMI in daughters. Among sons, maternal authoritative parenting style predicted lower BMI and maternal authoritarian parenting style predicted higher BMI at 5-year follow-up, even after adjusting for potential confounding variables and the opposite parent's influence on the other's parenting style. Thus, findings suggest that mothers who had high expectations/structure and high caring/emotional responsiveness in the home created environments that promoted lower BMIs for sons. In contrast, findings do not suggest a protective role of paternal parenting style for BMI in sons.

Among daughters, maternal authoritative parenting style predicted lower BMI and maternal neglectful parenting style predicted higher BMI at 5-year follow-up, after adjusting for the potential confounding variable of the opposite parent's influence on the other's parenting style. These findings suggest that mothers who had high expectations/structure and high caring/emotional responsiveness in the home created home environments conducive to lower BMI in daughters. In contrast, findings do not suggest a protective role of paternal parenting style for BMI in daughters.

After Time 1 adjustments were made, the association between maternal authoritative parenting style and sons' and daughters' lower BMI was attenuated. The reduction in the strength of this association may be largely due to the tracking effects of parenting style established during late childhood and early adolescence. Thus, the positive effect of having an authoritative mother on sons' and daughters' BMI established in late childhood and early adolescents may track into young adult lives.

Findings also suggest that paternal permissive parenting style plays a protective role related to higher fruits and vegetables intake in daughters, but not in comparison to authoritative paternal parenting style. Among daughters, paternal permissive parenting style predicted higher intake of fruits and vegetables at 5-year follow-up compared to authoritarian fathers, even after adjusting for potential confounding variables, the opposite parent's influence on the other's parenting style, and fruits and vegetable intake at Time 1. Thus, findings from the current study suggest that fathers who had high emotional responsiveness/caring and less structure in the

home created environments where daughters ate more fruits and vegetables. Because there was no difference between paternal permissive and authoritative parenting styles, this may indicate that the key variable for daughters' fruit and vegetable intake is related to the warmth and caring she feels from her father (i.e. responsiveness is the variable that authoritative and permissive parenting styles overlap on, but authoritarian parenting style doesn't), versus the importance of having a structured home. This is a new finding in the literature; it is somewhat surprising and warrants replication prior to drawing firm conclusions.

Findings from the current study add to the extant research suggesting specific parenting styles may contribute to the health and well-being of adolescents.^{4-5, 8-14} The present study builds on and extends current cross-sectional and limited longitudinal studies that suggest authoritative parenting style is associated with lower BMI in sons and daughters.^{4-5, 8-13} The findings also suggest the importance of warmth and caring in father/daughter relationships in connection to higher intakes of fruits and vegetables. The current study found several significant associations between parenting style and adolescent outcomes that were specific to opposite sex parent/adolescent dyads. These results add support to findings from child and adolescent weight loss intervention studies that show greater weight loss in opposite sex parent/child dyads.³⁹ Taken together, these results suggest that the opposite sex parent plays a unique role in influencing adolescent health behaviors.

Although further research is needed, our results, in conjunction with previous studies,⁸⁻¹⁴ suggest that it is important for health care professionals to promote authoritative parenting styles in relation to adolescent weight. Findings from the current study suggest that maternal authoritative parenting style may have particular relevance for influencing adolescents' BMI. Health care professionals have an important role to play in reinforcing the benefits of authoritative parenting style, helping parents set realistic goals for parenting, exploring ways to enhance parenting skills, discussing strategies to help parents be more authoritative, and making referrals for parents who are in need of further parenting skills training. Also, it may be important to promote the importance of warmth/caring in the home, particularly with fathers, in relation to adolescent daughters' healthy dietary intake.

This study had several strengths, including: the use of a large, diverse, population-based sample, the inclusion of both mother and father data, and the use of longitudinal data. There were some limitations, including the measure of parenting style and the use of a single item to measure parent demandingness. Because of the comprehensive nature of Project EAT, many of the items included in the survey are brief and a standardized measure of parenting style was not included. Thus, results should be viewed cautiously and future research should examine the relationship between parenting style and adolescent weight-related outcomes with more comprehensive measures. The use of adolescent report of parenting behaviors may also be viewed as a study limitation, although adolescent perceptions of parental weight-related behaviors have been found to be a stronger predictor of adolescent weight-related outcomes than parent reports of their own behaviors.⁴⁰ Future research should include both youths' and parents' own perception of parenting style. A further limitation was attrition from the original population. To help address this limitation, analyses were weighted such that the analytic sample reflects the baseline study population.

CONCLUSION

This study found that maternal authoritative parenting style predicted lower BMI in sons and daughters and paternal permissive parenting style predicted healthier dietary intake in daughters. Future research should continue to look at the effect of parenting style on adolescent BMI to provide new insight into the complex dynamics of the home environment on adolescents' weight and weight-related behaviors. In particular, it would be important to

examine further the relationship between opposite sex parent/adolescent dyads and weight status and weight-related behaviors.

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References

1. Ogden C, Flegal K, Carroll M, Johnson C. Prevalence and trends in overweight among U.S. children and adolescents, 1999-2002. *JAMA* 2003;288:1728-1732. [PubMed: 12365956]
2. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006;295(13):1549-1555. [PubMed: 16595758]
3. The US Department of Health and Human Services. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity. US Department of Health and Human Services, Public Health Service, Office of the Surgeon General; Rockville, MD: 2001.
4. Rhee KE, Lumeng JC, Appugliese DP, Kaciroti N, Bradley RH. Parenting styles and overweight status in first grade. *Pediatrics* 2006;117:2047-2054. [PubMed: 16740847]
5. Zeller MH, Reiter-Purtill J, Modi AC, Gutzwiller J, Vannatta K, Davies WH. Controlled study of critical parent and family factors on the obesigenic environment. *Obesity* 2007;15:126-136. [PubMed: 17228040]
6. Expert Committee Recommendations on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity. http://www.amaassn.org/ama1/pub/upload/mm/433/ped_obesity_recs.pdf. Accessed July 27, 2008
7. Institute of Medicine. Preventing Childhood Obesity: Health in the Balance. National Academies Press; Washington, DC: 2005. Committee on Prevention of Obesity in Children and Youth, Food and Nutrition Board, Board on Health Promotion and Disease Prevention.
8. Rhee K. Childhood overweight and the relationship between parent behaviors, parenting style, and family functioning. *The ANNALS of the American Academy of Political and Social Science* 2008;615:11-37.
9. Lindsay AC, Sussner KM, Kim J, Gortmaker S. The role of parents in preventing childhood obesity. *Future Child* 2006;16(1):169-186. [PubMed: 16532663]
10. Kitzman KM, Dalton WT, Buscemi J. Beyond parenting practices: Family context and the treatment of pediatric obesity. *Family Relations* 2008;57:13-23.
11. Patrick H, Nicklas TA, Hughes S, Morales M. The benefits of authoritative feeding style: caregiver feeding styles and children's food consumption patterns. *Appetite* 2005;44:243-249. [PubMed: 15808898]
12. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: Long-term results. *Obes Res* 2004;12:357-361. [PubMed: 14981230]
13. Golan M, Weizman A. Familial approach to the treatment of childhood obesity: Conceptual model. *J Nutr Educ* 2001;33(2):102-107. [PubMed: 12031190]
14. Kremers S, Brug J, de Vries H, Engels R. Parenting style and adolescent fruit consumption. *Appetite* 2003;41:43-50. [PubMed: 12880620]
15. Schmitz KH, Lytle LA, Phillips GA, Murray DM, Birnham AS, Kubik MY. Psychosocial correlates of physical activity and sedentary leisure habits in young adolescents: The Teens Eating for Energy and Nutrition at School study. *Preventive Medicine: An International Journal Devoted to Practice and Theory* 2002;34:266-278.

16. Tinsley, BJ.; Markley, CN.; Ericksen, AJ.; Oritz, RV.; Kwasman, A. Health promotion for parents. In: Bornstein, MH., editor. Handbook of parenting: Vol 5. Practical issues in parenting. 2nd ed.. Lawrence Erlbaum Associates; Mahwah, NJ: 2002. p. 311-328.
17. van der Horst K, Oenema A, Ferreira I, Wendel-Vos W, Giskes K, van Lenthe F, Brug J. A Systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Educ Res* July 21;2006 :24. doi:10.1093/her/cyl1069.
18. Darling N, Steinberg L. Parenting style as context: An integrative model. *Psychological Bulletin* 1993;113:487–496.
19. Baumrind, D. Rearing competent children. In: Damon, editor. Child development today and tomorrow. Josey-Bass; San Francisco: 1989. p. 349-378.
20. Maccoby EE. Parenting and its effects on children: On reading and misreading behavior genetics. *Annual Reviews of Psychology* 2000;51:1–27.
21. Arredondo EM, Elder JP, Ayala GX, Campbell N, Baquero B, Duerksen S. Is parenting style related to children's healthy eating and physical activity in Latino families? *Health Education Research* 2006;21(6):862–871. [PubMed: 17032706]
22. Chen J, Kennedy C. Family functioning, parenting style, and Chinese children's weight status. *Journal of Family Nursing* 2004;10:262–279.
23. Gable S, Lutz S. Household, parent and child contributions to childhood obesity. *Family Relations* 2000;4:293–300.
24. Kremers SPJ, Brug J, deVries H, Engels RCME. Parenting style and adolescent fruit consumption. *Appetite* 2003;41:43–50. [PubMed: 12880620]
25. Mellin AE, Neumark-Sztainer D, Story M, Ireland M, Resnick MD. Unhealthy behaviors and psychosocial difficulties among overweight adolescents: The potential impact of familial factors. *Journal of Adolescent Health* 2002;31:145–153. [PubMed: 12127384]
26. Berge J, Wall M, Bauer K, Neumark-Sztainer D. Parenting Characteristics in the Home Environment and Adolescent Overweight: A Latent Class Analysis. *Obesity*. In press.
27. Neumark-Sztainer D, Story M, Hannan PJ, Croll J. Overweight status and eating patterns among adolescents: Where do youth stand in comparison to the Health People 2010 Objectives? *American Journal of Public Health* 2002;92:844–851. [PubMed: 11988458]
28. Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices of adolescents: Findings from focus-groups discussions with adolescents. *Journal of American Dietetic Association* 1999;99(8):929–937.
29. Bandura, A. Social Learning Theory. Prentice-Hall International Inc; Englewood Cliffs, NJ: 1977.
30. Resnick M, Harris L, Blum R. The impact of caring and connectedness on adolescent health and well being. *Journal of Paediatrics and Child Health* 1993;29(suppl1):S3–9. [PubMed: 8268019]
31. Chassin L, Presson CC, Sherman SJ. Cognitive and social influence factors in adolescent smoking cessation. *Addictive Behaviors* 1984;9:383–390. [PubMed: 6532145]
32. McGuire MT, Hannan PJ, Neumark-Sztainer D, Falkner Crossrow NH, Story M. Parental correlates of physical activity in a racially/ethnically diverse adolescent sample. *Journal of Adolescent Health* 2002;30:253–261. [PubMed: 11927237]
33. Himes J, Hannan P, Wall M, Neumark-Sztainer D. Factors associated with errors in self-reports of stature, weight and body mass index in Minnesota adolescents. *Ann Epidemiol* 2005;15:272–278. [PubMed: 15780774]
34. Rockett H, Breitenbach M, Frazier A, Witschi J, Wolf A, Field A, Colditz G. Validation of a youth/ adolescent food frequency questionnaire. *Prev Med* 1997;26:808–816. [PubMed: 9388792]
35. Godin G. Godin Leisure-Time Exercise Questionnaire. *Med Sci Sport Exerc* 1997;29(6):S36–38.
36. Breiman, L.; Friedman, J.; Olshen, R.; Stone, C. Classification and Regression Trees. Wadsworth International Group; Belmont, CA: 1984.
37. SAS Institute. SAS/STAT software: changes and enhancements. Release 9.1. SAS Institute; Cary, NC: 1997.
38. Little R. Survey nonresponse adjustments for estimates of means. *International Statistical Review* 1986;54:137–139.

39. Temple JL, Wrotniak BH, Paluch RA, Roemmich JN, Epstein LH. Relationship between sex of parent and child on weight loss and maintenance in a family-based obesity treatment program. *International Journal of Obesity* 2006;30:1260–1264. [PubMed: 16491111]
40. Keery H, Eisenberg ME, Boutelle K, Neumark-Sztainer D, Story M. Relationships between maternal and adolescent weight-related behaviors and concerns: The role of perception. *Journal of Psychosomatic Research* 2006;61:105–111. [PubMed: 16813852]

Table 1

Demographic Characteristics at Time 1 and Probabilities of Parenting Style (%) by Adolescent Gender at Time 1

	Total (n = 2,516) (%) (n)	Females (n = 1,386) (%) (n)	Males (n = 1,130) (%) (n)
<u>Characteristic:</u>			
<i>Race/Ethnicity</i>			
White	48.4 (1218)	46.0 (638)	51.5 (582)
Asian	19.2 (483)	20.1(279)	18.1 (204)
African America	18.7 (470)	19.6 (271)	17.2 (194)
Latino	5.8 (146)	5.7 (79)	6.2 (70)
Native American	3.6 (91)	3.6 (50)	3.5 (40)
Mixed/Other	4.3 (108)	5.0 (69)	3.5 (40)
<i>SES</i>			
Upper	13.3 (335)	13.5 (187)	13.5 (153)
Upper-middle	23.4 (589)	21.6 (300)	25.5 (288)
Middle	26.7 (671)	25.5 (353)	28.2 (319)
Lower-middle	18.9 (476)	19.1 (265)	18.6 (210)
Lower	17.7 (445)	20.3 (281)	14.2 (160)
		Adolescent Females (%) (n)	Adolescent Males (%) (n)
<u>Parenting Style:</u>			
<i>Mother</i>			
1. Authoritative		42.5 (892)	40.6 (869)
2. Authoritarian		20.9 (440)	21.8 (467)
3. Permissive		24.3 (512)	24.3 (522)
4. Neglectful		12.5 (255)	13.1 (282)
		p = .56	
<i>Father</i>			
1. Authoritative		26.1 (549)	34.5 (740)
2. Authoritarian		35.6 (748)	27.1 (581)
3. Permissive		15.2 (319)	20.8 (447)
4. Neglectful		23.0 (483)	17.3 (372)
		p ≤ .001	

Table 2

Regression Models of Parenting Style at Time 1 Predicting Adolescent BMI, Dietary Intake and Physical Activity at Time 2

	Time 2 Mean BMI ⁺			Time 2 Mean Servings of Fruits & Vegetables (F/V) ⁺		Time 2 Mean Hrs. of Physical Activity (PA)/Week ⁺	
	Non-adjusted for Time 1 BMI (Model 1)	Adjusted for Time 1 BMI (Model 2)		Non-adjusted for Time 1 Servings of F/V (Model 1)	Adjusted for Time 1 Servings of F/V (Model 2)	Non-Adjusted for Time 1 Hrs. of PA/week (Model 1)	Adjusted for Time 1 Hrs. of PA/week (Model 2)
SONS							
<u>Mothers' Parenting Style:</u>							
<i>Authoritative</i>	24.1 ^a	24.6		3.28	3.13	7.16	7.18
<i>Authoritarian</i>	25.2 ^b	24.4		3.38	3.30	6.05	6.50
<i>Permissive</i>	24.4 ^{ab}	24.5		3.03	3.00	6.76	6.76
<i>Neglectful</i>	24.2 ^{ab}	24.4		3.05	3.04	6.65	6.92
p-value	.030	.936		.258	.498	.053	.348
<u>Fathers' Parenting Style:</u>							
<i>Authoritative</i>	24.4	24.8		3.60	3.23	7.34 ^a	7.56
<i>Authoritarian</i>	24.3	24.5		3.57	3.35	6.70 ^{ab}	7.01
<i>Permissive</i>	24.4	24.5		3.40	3.24	6.93 ^{ab}	7.09
<i>Neglectful</i>	24.6	24.2		3.02	2.94	5.88 ^b	6.56
p-value	.933	.201		.050	.336	.013	.137

DAUGHTERSMothers' Parenting Style:

<i>Authoritative</i>	23.9	23.6		3.88 ^a	3.52	4.59	4.57
<i>Authoritarian</i>	24.4	24.1		3.54 ^a	3.44	4.26	4.35
<i>Permissive</i>	24.6	23.9		3.47 ^a	3.41	3.99	4.17
<i>Neglectful</i>	24.8	23.8		3.48 ^a	3.43	4.09	4.23
p-value	.082	.371		.033	.864	.117	.444
<u>Fathers' Parenting Style:</u>							
<i>Authoritative</i>	24.0	23.7		3.76 ^{ab}	3.43 ^{ab}	4.64	4.64
<i>Authoritarian</i>	23.8	23.7		3.32 ^a	3.21 ^a	4.02	4.24

	Time 2 Mean BMI ⁺		Time 2 Mean Servings of Fruits & Vegetables (F/V) ⁺		Time 2 Mean Hrs. of Physical Activity (PA)/Week ⁺	
	Non-adjusted for Time 1 BMI (Model 1)	Adjusted for Time 1 BMI (Model 2)	Non-adjusted for Time 1 Servings of F/V (Model 1)	Adjusted for Time 1 Servings of F/V (Model 2)	Non-Adjusted for Time 1 Hrs. of PA/week (Model 1)	Adjusted for Time 1 Hrs. of PA/week (Model 2)
<i>Permissive</i>	23.8	23.6	3.90 ^b	3.84 ^b	4.05	4.07
<i>Neglectful</i>	24.0	23.5	3.50 ^{ab}	3.42 ^{ab}	4.50	4.50
p-value	.905	.916	.008	.006	.086	.266

Letter superscripts indicate results of post-hoc comparison of means. Means with **different** letters are significantly different at $p < .01$. For all means, higher means indicate higher BMI, servings of F/V, and PA/week

⁺ Adjusted for Ethnicity/Race, Age and SES

Table 3

Regression Models of Parenting Style at Time 1 Predicting Adolescent BMI, Dietary Intake and Physical Activity at Time 2 Controlling for Reciprocal Parent Effects

	Time 2 Mean BMI ⁺			Time 2 Mean Servings of Fruits & Vegetables (F/V) ⁺		Time 2 Mean Hrs. of Physical Activity (PA)/Week ⁺	
	Non-adjusted for Time 1 BMI (Model 3)	Adjusted for Time 1 BMI (Model 4)		Non-adjusted for Time 1 Servings of F/V (Model 3)	Adjusted for Time 1 Servings of F/V (Model 4)	Non-Adjusted for Time 1 Hrs. of PA/week (Model 3)	Adjusted for Time 1 Hrs. of PA/week (Model 4)
SONS							
<u>Mothers' Parenting Style:</u>							
<i>Authoritative</i>	23.9 ^a	24.3		3.22	3.10	6.98	7.20
<i>Authoritarian</i>	25.4 ^b	24.6		3.47	3.30	6.32	6.89
<i>Permissive</i>	24.3 ^{ab}	24.5		3.12	3.06	6.76	6.95
<i>Neglectful</i>	24.6 ^{ab}	24.8		3.30	3.06	6.39	6.91
p-value	.008	.626		.469	.672	.461	.876
<u>Fathers' Parenting Style:</u>							
<i>Authoritative</i>	24.8	25.0		4.00	3.21	7.08	7.42
<i>Authoritarian</i>	24.1	24.5		3.34	3.26	6.67	6.97
<i>Permissive</i>	24.6	24.6		3.30	3.10	6.76	6.98
<i>Neglectful</i>	24.5	24.1		3.00	2.95	5.93	6.57
p-value	.443	.100		.076	.532	.143	.362
DAUGHTERS							
<u>Mothers' Parenting Style:</u>							
<i>Authoritative</i>	23.5 ^a	23.4		3.80	3.56	4.55	4.55
<i>Authoritarian</i>	24.0 ^{ab}	23.9		3.61	3.50	4.34	4.36
<i>Permissive</i>	24.4 ^{ab}	23.7		3.38	3.34	4.00	4.14
<i>Neglectful</i>	25.1 ^b	23.9		3.55	3.50	4.16	4.26
p-value	.011	.361		.125	.605	.289	.531
<u>Fathers' Parenting Style:</u>							
<i>Authoritative</i>	24.6	23.9		3.62 ^{ab}	3.39 ^{ab}	4.46	4.50
<i>Authoritarian</i>	24.1	23.7		3.26 ^a	3.18 ^a	3.97	4.20

	Time 2 Mean BMI ⁺		Time 2 Mean Servings of Fruits & Vegetables (F/V) ⁺		Time 2 Mean Hrs. of Physical Activity (PA)/Week ⁺	
	Non-adjusted for Time 1 BMI (Model 3)	Adjusted for Time 1 BMI (Model 4)	Non-adjusted for Time 1 Servings of F/V (Model 3)	Adjusted for Time 1 Servings of F/V (Model 4)	Non-Adjusted for Time 1 Hrs. of PA/week (Model 3)	Adjusted for Time 1 Hrs. of PA/week (Model 4)
<i>Permissive</i>	24.0	23.6	3.94 ^b	3.89 ^b	4.11	4.11
<i>Neglectful</i>	24.2	23.6	3.51 ^{ab}	3.44 ^{ab}	4.50	4.51
p-value	.556	.712	.006	.002	.197	.486

Letter superscripts indicate results of post-hoc comparison of means. Means with **different** letters are significantly different at $p < .01$. For all means, higher means indicate higher BMI, servings of F/V, and PA/week

⁺ Adjusted for Ethnicity/Race, Age and SES