



Overweight trajectories and psychosocial adjustment among adolescents

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ABSTRACT

Objectives. Few studies have investigated overweight trajectories and psychosocial adjustment among adolescents. We conducted analyses with data from the multisite Study of Early Child Care and Youth Development (SECCYD).

Methods. The sample included 1350 youths born in 1991. Data consisted of repeated measures of weight, height, and multiple subscales of internalizing and externalizing behavioral problems measured by the Child Behavior Checklist (CBCL) from age 9 to age 15.

Results. Three trajectory patterns were identified: never/rarely overweight/obese (59.5%), late start/light overweight/obese (12.1%), and chronically/heavy overweight/obese (28.4%). Youths with chronically/heavy overweight/obese trajectory pattern had significantly higher scores of internalizing problems over time, as well as syndrome subscales of somatic complaints, social problems and social withdrawal over time than youths with the never/rare overweight/obese trajectory pattern. There was no significant difference in either broad-band behavioral problems or narrow-band syndrome subscales between youths with the never/rare overweight/obese trajectory pattern and those with the late start/light overweight/obesity trajectory pattern.

Conclusions. Study findings may advance knowledge on the distinct developmental trajectory patterns of overweight youth and their linkages to the psychosocial adjustment during the period of pubertal transition. The results highlight the need for future prevention research to improve the physical development and mental well-being of adolescents.

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Introduction

More than 17% of US adolescents are considered obese (Ogden et al., 2006). Given the fact that obesity is viewed as a non-desirable and stigmatizing characteristic in the American culture, and that many youths are preoccupied with cultural expectations of a slim body as the standard of beauty, being obese has been assumed to predispose youth to depressive symptoms (Merikangas et al., 2012; Roberts, 2000; Sanchez-Villegas et al., 2012; Ting et al., 2012), social isolation (Strauss and Pollack, 2003; Xie et al., 2005), low self-esteem (Lau et al., 2004), poor health-related quality of life (Pinhas-Hamiel et al., 2006; Tyler et al., 2007), and psychosocial adjustment problems (Erermis et al., 2004). With the development of cognitive functioning during adolescence, the process of self-appraisal and social comparison of body image and physical attractiveness is presumed more operative and relevant to psychosocial adjustment problems among adolescents

than among children (Bradley et al., 2008; Harter, 2006). However, mixed empirical findings concerning the extent and nature of psychosocial adjustment problems among obese youth are reported in the literature. Several cross-sectional studies reported a modest relationship (Eisenberg et al., 2003; Falkner et al., 2001) while others report no relationship (Daniels, 2005; Erickson et al., 2000; Lamertz et al., 2002) between being obese in adolescence and psychosocial adjustment problems in that population segment. Few studies have been conducted utilizing longitudinal design and the direction of causality remains unresolved. Early history of obesity and chronic obese or overweight status may lead to the risk of psychosocial adjustment problems (Bradley et al., 2008; Mustillo et al., 2003; Zimetkin et al., 2004), whereas early psychosocial adjustment problems may also shape subsequent overweight or obese status (Goodman and Whitaker, 2002; Pine et al., 1997).

Bradley and the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Network examined the complex interrelationships between obesity and internalizing and externalizing problems from infancy to middle childhood with data from the multisite NICHD Study of Early Child Care and Youth Development (SECCYD) (Bradley et al., 2008). Longitudinal analyses were conducted on relationships between BMI and scores on the Child Behavior Checklist

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(CBCL) from age 2 years through the 6th grade. There was no consistent association between BMI and psychosocial adjustment problems prior to school entry and modest significant lagged associations from BMI to internalizing problems were observed as early as in 1st grade, although no relation was found between being overweight and conduct problems. In this paper, we used the SECCYD data and applied the advanced group-based growth mixture and mixed-effect modeling approaches to further investigate the obesity trajectories and their links to multiple psychosocial adjustment problems in adolescents during the period of pubertal transition.

Methods

Sample and data

The SECCYD followed a sample of 1364 children from infancy (1 month) through age 15 (about grade 9) and their families, who were recruited from 10 locations in the US in 1991. The initial cohort includes 24% ethnic minority children (13% African American, 6% Hispanic, 2% Asian or Native American, and 3% Other), 11% mothers who had not completed high school, and 14% single-parent mothers. Additional details about the data collection procedures and instruments can be found in the study's Manuals of Operations and Instrument Documentation (<http://secc.uci.org/summary.cfm>) and in previous publications (O'Brien et al., 2007). Although we focused our analyses on the pubertal transition period (age 9 to 15), data on socio-demographic characteristics, overweightness and psychosocial adjustment collected prior to adolescence were also included in our analyses. There were only 14 underweight cases at grade 3 (about age 9), a number insufficient to achieve sufficient statistical power. To avoid misclassification with normal cases, we excluded underweight cases and included only normal and overweight/obese cases in the analysis. As age 9 served as the baseline for the analysis period of the developmental trajectory, we excluded cases based only on underweight at age 9 and not underweight at other ages. As a result, the final sample used for this analysis was 1350 (697 boys and 653 girls). Not all 1350 subjects had valid height and weight measures, creating a smaller, but statistically robust, subset of 1350 total subjects. The exact number of subjects with valid weight and height measures varied from age group to age group, as grouped by grade 3 through grade 9 to age 15 years (i.e. 924 at grade 3, 916 at grade 5, 905 at grade 6, 791 at grade 7, 732 at grade 8 and 836 at grade 9). There was no significant difference in gender ($\chi^2 = 3.07, p = 0.08$) and ethnicity ($\chi^2 = 0.56, p = 0.46$) between subjects with and without complete weight and height data, but subjects with missing data reported significantly higher income-to-need ratio at grade 3 than those without missing cases in weight and height (5.38 ± 5.14 vs. $4.15 \pm 3.32, p = 0.002$). The full information maximum likelihood (FIML) was applied to compute maximum likelihood parameter estimates and standard errors from data with missing values. FIML provides efficient estimation of statistical parameters from incomplete data, and parameter estimates from FIML provide less biased information than ad hoc procedures, such as listwise deletion, pairwise deletion, or single imputation of means (Little and Rubin, 2002; Muthen and Muthen, 2001; Schafer, 1997).

Measures

Weight and *Height* were measured following standardized procedures and measures at grades 3, 5, 6, 7, 8 and age 15 were included in our analysis. BMI was calculated by dividing weight (kg) by height (m) squared. Overweight and obesity were defined based on BMI values between 85th and 95th, and ≥ 95 th for age- and gender-specific percentile cutoffs referenced in the 2000 CDC Growth Charts of children and adolescents in the United States (Committee, B.S.a.t.E., 2007; Kuczmarski et al., 2002). The categories of overweight and obesity were combined in the analysis to create a single overweight/obesity category.

Internalizing and Externalizing Problems were measured by the Child Behavior Checklist (CBCL) (Achenbach, 1991). The CBCL is a parental report of child function that includes measures of social competence, school function, emotional adjustment, and behavior problems. Standardized scores can be produced in eight syndrome subscales, which include withdrawn, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. The standardized scores are also produced for three total scales combining the eight syndromes: internalizing scales based on syndrome subscales such as withdrawn, somatic complaints, and anxious/depressed syndromes, the externalizing scale based

on syndrome subscales such as the delinquent and aggressive behaviors, and a total social competence score based on all eight syndromes. Average scores of child ratings from mother and father/other adults at grades 3, 4, 5, 6 and age 15 (coded as time 0, 1, 2, 3, 6) were used in our analysis. The inter-rater correlation coefficients between mother's and father/other adult's ratings ranged from 0.40 to 0.47 for internalizing problems and from 0.55 to 0.61 for externalizing problems from grade 3 (about age 9 years) to age 15 years.

Pubertal Timing was measured by an annual physical exam and Tanner staging by a nurse practitioner starting at 9 1/2 years of age, following the standard instructions from the American Academy of Pediatrics Manual Assessment of Sexual Maturity States in Girls (Herman-Giddens and C. J., 1995) and Tanner's original criteria (Tanner, 1990) in boys. The age of onset of menarche was asked annually by a nurse starting at 10 1/2 years of age. Adolescents who did not agree to participate in the Tanner staging assessment were asked to complete the self-reported Pubertal Development Scale (PDS) (Petersen et al., 1988). Stages of pubertal status can be approximated from the PDS based on self-reported growth spurt, body and facial hair development, and skin and voice changes. Specific stages include pre-puberty, beginning puberty, mid-puberty, end of puberty, and post-puberty. A high reliability of PDS (range = .68–.78) as well as validity (median correlation = .70) were reported. The PDS also included a question assessing girls' menstrual status and their age (in months) at first menstruation. A total of 432 girls and 427 boys had valid pubertal assessments for at least 1 of the 7 assessments (taken annually from age 9 1/2 years) (Susman et al., 2010). The sample size of PDS reports varied from year to year (271–495 for boys and 254–482 for girls). The timing of pubertal onset was quantified as a variable created by the NICHD SECCYD with the latent transition analysis and nonlinear mixed modeling based on two dimensions of development (genital and pubic hair for boys and breast and pubic hair for girls) (Blozis, 2004; Collins and Flaherty, 2002). The variable provided an estimated age of pubertal onset for the 959 subjects (476 girls and 483 boys) with values ranging from 1 (began puberty at <9.5 years) to 6 (began puberty at >13.5 years). We used this variable for the present analysis.

Other socio-demographic variables including *gender*, self-reported *ethnicity*, and *income-to-needs ratios* as a proxy measure of socioeconomic status were also included in the analysis. An income-to-needs ratio was calculated by dividing self-reported income by the poverty level for that family size based on the Federal Poverty Guidelines (O'Brien et al., 2007).

Data analysis

Descriptive statistics (mean, standard deviation and percentage) were calculated to reflect the background characteristics of the sample. Group-based Growth Mixture Modeling (GMM) approach implemented in SAS Proc Traj was employed to classify the growth trajectory patterns of overweight/obese status subjects (Jones et al., 2001; Nagin, 1999). We used GMM because the estimated response growth curve from conventional longitudinal models is based on the assumption that all individuals in the sample come from a single population, which may not be able to capture the heterogeneity of growth trajectories of behavioral outcomes during adolescence. The GMM approach is able to identify the underlying growth curves of overweight/obese status (i.e. the average growth trajectory class or membership) as a categorical latent variable, and estimate posterior probabilities of class membership for all individuals (Muthen, 2001; Nagin, 1999). The heterogeneity of developmental trajectory in growth factors (i.e. initial status and slope) was captured in a categorical latent class variable. The number of latent classes was determined by Bayesian Information Criterion (BIC) which is derived using the likelihood function ($-2\ln L$), number of parameters (k) and the sample size (n) (Schwarz, 1978). The model with the smallest BIC indicates that the specified model is the best fit with the data (Muthen, 2001; Nagin, 1999). The BIC generally penalizes free parameters more strongly than does the Akaike Information Criterion (AIC), though it depends on the size of n and relative magnitude of n and k . Preliminary analyses suggested that linear trajectory pattern rather than other patterns (e.g. quadratic and cubic) best fit with the data. Additionally, theoretical justification and interpretability were also considered to determine the number of latent classes (Bauer and Curran, 2003; Jung and Wickrama, 2008; Muthen, 2003; Rindskopf, 2003). Each adolescent was assigned to a most probable trajectory class of overweight/obese status based on the estimated posterior probability of trajectory class membership. Misclassification of group membership was evaluated by the average posterior probability with close to 1 being considered as an acceptable value for adequate classification (Nagin, 1999). Similar trajectory patterns were observed with either categorical overweight/obese status or continuous BMI z-scores. In this study we reported the patterns analyzed with categorical overweight/obese

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