Bedtime in Preschool-Aged Children and Risk for Adolescent Obesity

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Objective To determine whether preschool-aged children with earlier bedtimes have a lower risk for adolescent obesity and whether this risk reduction is modified by maternal sensitivity.

Study design Data from 977 of 1364 participants in the Study of Early Child Care and Youth Development were analyzed. Healthy singleton-births at 10 US sites in 1991 were eligible for enrollment. In 1995-1996, mothers reported their preschool-aged (mean = 4.7 years) child's typical weekday bedtime, and mother-child interaction was observed to assess maternal sensitivity. At a mean age of 15 years, height and weight were measured and adolescent obesity defined as a sex-specific body-mass-index-for-age ≥95th percentile of the US reference.

Results One-quarter of preschool-aged children had early bedtimes (8:00 p.m. or earlier), one-half had bedtimes after 8:00 p.m. but by 9:00 p.m., and one-quarter had late bedtimes (after 9:00 p.m.). Children's bedtimes were similar regardless of maternal sensitivity (P = .2). The prevalence of adolescent obesity was 10%, 16%, and 23%, respectively, across early to late bedtime groups. The multivariable-adjusted relative risk (95% CI) for adolescent obesity was 0.48 (0.29, 0.82) for preschoolers with early bedtimes compared with preschoolers with late bedtimes. This risk was not modified by maternal sensitivity (P = .99).

Conclusions Preschool-aged children with early weekday bedtimes were one-half as likely as children with late bedtimes to be obese as adolescents. Bedtimes are a modifiable routine that may help to prevent obesity. *(J Pediatr 2016;176:17-22)*.

The need to begin obesity prevention early, before children are overweight, is well-established,[1] and health care providers play an important role.[2] Poor sleep, especially short sleep duration, is one risk factor associated with increased risk for obesity.[3-5] Numerous prospective studies have documented an association in children between short nighttime sleep duration and obesity.[6-10] Bedtimes have a greater impact on children's sleep duration than do wake times,[11,12] are more modifiable than wake times, and thus, are the likely behavioral target of clinicians and parents. In a prospective study of adolescents, later bedtimes predicted increases in body mass index (BMI) in adulthood that were not explained by sleep duration.[13] In a study of younger children (3-8 years of age at baseline and followed for half a decade), later bedtimes were associated with higher BMI and risk for overweight.[11] Using data from a cohort with a longer follow-up period, we sought to extend the evidence for an association between young children's bedtimes and later obesity.

Although the routine of early bedtimes for young children may reduce the risk of later obesity, the emotional climate[14] in which parents establish and maintain this routine may affect its impact. The combined effect of earlier bedtimes and maternal sensitivity has not been investigated. Our objectives are to determine: (1) whether preschool-aged children with earlier bedtimes have a lower risk of obesity in adolescence; and (2) whether this risk reduction is modified by the level of maternal sensitivity.

Methods

The *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Study of Early Child Care and Youth Development (SECCYD) was a prospective cohort study designed to examine the impact of nonmaternal-care on children's developmental outcomes. Families were recruited from 24 hospitals in 9 US states at their child's birth in 1991.[15] Inclusion criteria were maternal age ≥18 years, English fluency, no plans for adoption, singleton and term (≥37 weeks' gestation) birth, and postbirth hospitalization ≤6 days.[15] Each of 10 participating universities secured institutional review board approval for all SECCYD protocols. Mothers provided written consent. Our analyses include 977 children (72% of 1364 enrolled) who had height and weight information available during adolescence.

Height and weight were measured, without shoes and wearing only light clothing, in a laboratory setting using a standardized protocol; height was measured to the nearest 1/8 inch using a wall-mounted stadiometer or measuring stick, and weight was measured to the nearest 4 ounces using a balance scale.[16]

BMI	Body mass index
RR	Relative risk
SECCYD	Study of Early Child Care and Youth Development

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Supported by the National Institutes of Health (R01DK088913 and R21DK104188). The Study of Early Child Care and Youth Development (SECCYD) Early Child Care Research Network was conducted by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development through a cooperative agreement that calls for scientific collaboration between grantees and the NICHD staff (U01 HD019897). The Ohio State University and Temple University have restricted data-use agreements to analyze the SECCYD data. The authors declare no conflicts of interest.

http://dx.doi.org/10.1016/j.jpeds.2016.06.005

We calculated BMI (kg/m^2) and defined adolescent obesity as a sex-specific BMI-for-age ≥95th percentile of the US Centers for Disease Control and Prevention growth reference.[17] Height and weight data were extracted from the 15-year assessment whenever possible, but for those missing anthropometric data at 15 years of age, we used height and weight measured at the oldest age between 12.0 and 15.9 years. Almost two-thirds of youth (62%) were measured at age 15.0-15.9 years, but 29% were 14.0-14.9 years, and 9% were 12.0-13.9 years.

During the phone follow-up to the 54-month home-visit, mothers were asked, "What time does your child go to bed on most weekday evenings?" The response was open-ended, but reported bedtimes were primarily on the whole, half, or quarter hour. We examined the distribution and created bedtime categories based on natural break-points and to facilitate application of our findings. The most frequently reported bedtimes were 8:00 p.m. (n = 171), 8:30 p.m. (n = 194), and 9:00 p.m. (n = 235), but reported bedtimes ranged from 6:45 p.m. to 1:30 a.m. Only 52 children had bedtimes before 8:00 p.m. (≤7:00 p.m. = 13; 7:30 p.m. = 36; 7:45 p.m. = 3), but 220 had bedtimes after 9:00 p.m. (9:15 p.m. = 8; 9:30 p.m. = 109; between 9:31 p.m. and 10:00 p.m. = 62; >10:00 p.m. = 41). We defined a late bedtime as after 9:00 p.m. and an early bedtime as at or before 8:00 p.m. We conducted sensitivity analyses to understand the impact of our bedtime categorization on our results; in these analyses we divided each bedtime category into an earlier and later segment (eg, the early bedtime category was split into "before 8:00 p.m." and "at 8:00 p.m."). These sensitivity analyses did not yield meaningful differences and are not presented.

Maternal sensitivity was coded from a standardized, videotaped, 15-20 minute, play-session conducted in a child development laboratory during the 54-month assessment. Without the child present, mothers were shown the contents of 3 boxes: (1) an Etch-A-Sketch maze; (2) wooden blocks for building towers; and (3) 6 animal puppets. Mothers were asked to play with their child using the contents of each box in the following order: first have their child attempt the maze, then build as many towers as he/she could, and finally play with the puppets. Researchers explained that the maze and tower-building activities could be difficult for some children, but that mothers should let their child try each activity on his/her own as much as possible before helping as needed.[18] Videotapes were coded at a central location by trained coders who were blind to other information about the family. Coders met regularly with an investigator who ensured that consistent rating-standards were maintained.[18] Maternal sensitivity was computed as the sum of three 7-point ratings of observed maternal behavior toward the child: supportive presence, respect for autonomy, and hostility (reverse coded).[18] Maternal sensitivity scores were skewed toward high values; we defined low maternal sensitivity as the lowest quartile (scores ≤15), consistent with previous reports.[14]

Mothers reported their own educational attainment, as well as their child's sex and racial-ethnic group at study enrollment. Children's birth weights were recorded from birth certificates. Mothers reported household size and income when the child was preschool-aged, and we calculated the household income-to-poverty ratio. When the children were 15-years-old, mothers self-reported their own current height and weight, which we used to assess maternal obesity (BMI ≥30 kg/m^2).

Statistical Analyses

We restricted our analyses to participants with information available on our outcome variable—adolescent obesity. In the resulting sample (n = 977), there were missing data on 4 analytic variables: income-to-poverty ratio (n = 65, 7%), bedtime (n = 78, 8%), maternal sensitivity (n = 82, 8%), and maternal obesity (n = 89, 9%). These missing data were multiply imputed using fully conditional specification.[19] Logistic regression and ordinal logistic regression were employed to impute, respectively, the binary and ordinal variables. Imputation models included all analytic variables, as well additional variables chosen for their association with the outcome or predictors. Ten imputations were performed, and all analyses involving imputed variables were aggregated using multiple imputation combining rules to account for imputation uncertainty.[20] We also performed a complete-case-analysis (n = 810), and our conclusions were robust to this sensitivity test.

We used χ^2 tests to assess how children in the analytic sample (n = 977) differed from children who were excluded because they lacked information on adolescent BMI (n = 387). Associations between adolescent obesity, late bedtime, and sociodemographic characteristics were assessed using logistic regression. We used log-binomial regression and Poisson regression with robust variance[21] to estimate the relative risk (RR) and 95% CIs for adolescent obesity associated with bedtime at preschool age. Bedtime was modeled as a categorical variable with the latest bedtime category as the reference group. We examined the interaction between maternal sensitivity (low or adequate) and bedtime category to assess whether maternal sensitivity modified the relationship between preschool bedtime and risk for adolescent obesity. Using this model with adjustment for adolescent age, sex, racial/ethnic group, birth weight, maternal education, and maternal obesity, we estimated the covariate-adjusted prevalence of adolescent obesity in each of the 6 bedtime by maternal sensitivity groups. There was no evidence of an interaction between bedtime and maternal sensitivity, and thus, for parsimony, we present the RR (95% CIs) for adolescent obesity omitting this interaction term. Analyses were conducted using SAS Version 9.3 (SAS Institute, Cary, North Carolina).

Results

Children excluded from the analytic sample were more likely to be male and have less-educated mothers, but did not significantly differ in birth weight, race/ethnicity, or household income-to-poverty ratio (results not shown). **Table I**