Socioeconomic Status is not Inversely Associated with Overweight in Preschool Children

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Objective To assess whether socioeconomic inequalities were already present in preschool children.
Study design We used data from 2954 Dutch children participating in a longitudinal birth cohort study. Indicators of socioeconomic status were mother's educational level and household income. Body mass index (BMI)-for-age standard deviation scores were derived from a national reference. Overweight was defined at 24 and 36 months according to age- and sex-specific cut-off points for BMI. Multivariable regression analyses were performed.
Results Relative to children from mothers with the highest educational level, mean BMI standard deviation scores was lower at age 24 months in children from mothers with the low, mid-low, and mid-high educational level, and in the mid-low group at 36 months ($P < .001$). Prevalence of overweight was lower in children from mothers with the mid-low educational level at age 24 and 36 months (adjusted odds ratio at 24 months: 0.61; 95% confidence interval: 0.43-0.87 and at 36 months: 0.65; 95% confidence interval: 0.44-0.96) but was not significantly different for the other educational levels. There were no significant differences in childhood overweight by income level.
Conclusions The inverse association between socioeconomic status and childhood overweight presumably emerges after age 3 years. Before this age, the gradient may be the reverse. *(J Pediatr 2010;157:929-35)*.

Overweight and obesity are a major public health problem worldwide, and associated cardiovascular and psychosocial problems are well documented.[1,2] Although overweight and obesity may affect all people in society, it disproportionally affects the socially disadvantaged.[3] Moreover, the latter group also experience the largest increase in prevalence of overweight and obesity over time.[3,4] Socioeconomic inequalities in overweight have been extensively described for adults, adolescents, and children.[5,6] In adults, there is a clear inverse association between socioeconomic status and overweight, and it is suggested that socioeconomic inequalities in adult obesity have their origins in childhood.[7] Indeed, this association in children is often reported,[4,6,8-12] whereas others found no association between social disadvantage and childhood overweight.[13] Only a few studies have explored socioeconomic inequalities in overweight in preschool children.[4,8,11]

Given the presence of a clear socioeconomic gradient in overweight in adults (with a relatively high prevalence of overweight in disadvantaged subgroups), it is important to know at what age this socioeconomic gradient emerges. This will help elucidate the underlying pathways and subsequently enable preventive interventions.

Therefore this study evaluates socioeconomic differences in overweight in children at the age of 24 and 36 months and assesses the contribution of known risk factors for childhood obesity in this association. In addition, body mass index (BMI) curves were constructed between 1 and 36 months of age to determine whether these curves differed for educational subgroups. This was done in a longitudinal birth cohort study with multiple weight and height measurements in the first years after birth. The main hypothesis is that socially-disadvantaged children are more often overweight, even at this young age.

Methods

This study was embedded in The Generation R study, a population-based prospective cohort study from fetal life onward. The Generation R study was designed to identify early determinants of growth, development, and health. Invitations to participate in the study were made to all pregnant mothers who had an expected delivery date between April 2002 and January 2006 and who lived in the study area (Rotterdam, the Netherlands) at time of delivery. Details of the study are described elsewhere.[14] The study was conducted in accordance with the guidelines proposed in the World Medical Association Declaration of Helsinki, and was ap-

BMI	Body mass index
CI	Confidence interval
OR	Odds ratio
SDS	Standard deviation score

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proved by the Medical Ethical Committee at Erasmus MC, University Medical Centre Rotterdam. Written consent was obtained from all participants.

We restricted our analyses to children with a native Dutch mother, because the association between socioeconomic position and overweight may differ in and between certain ethnic subpopulations.[15-17] Consent for postnatal follow-up was available for 3877 children with a native Dutch mother. Twins (n = 116) were excluded from the analyses. To avoid clustering, the analyses excluded data on the second or third pregnancy of any woman who was participating in The Generation R study with more than one child (n = 389). Also excluded were data of participants with no information on educational level (n = 16), as well as children without height or weight measures between 24 and 36 months of age (n = 402). Finally, data of 2954 subjects were available for analyses.

Our primary determinant was the educational level of the mother as an indicator of socioeconomic status. Level of maternal education was established at enrollment. The Dutch Standard Classification of Education[18] was used to categorize 4 subsequent levels of education: low (less than 4 years of high school), mid-low (college), mid-high (Bachelor's degree), and high (Master's degree). Household income was included as a second indicator of socioeconomic status. Data on household income was obtained at enrollment and was dichotomized, with the 2005 monthly general labor income used as the cut-off point (< €1600, ≥ €1600). Households that earn less than €1600 per month are considered low-income.[19]

Height and weight were measured with standardized methods at each visit to the Child Health Centers. Standard visits at the Child Health Centers take place at 1, 2, 3, 4, 6, 11, 18, 24, and 36 months of age. BMI was calculated as weight/height^2. We calculated BMI-for-age standard deviation scores (SDS), which were calculated from a national reference[20] using the Growth Analyzer program (http://www.growthanalyser.org). SDS (or z-scores) reflect differences from the population mean. The population mean is 0, and 95% of children will be in the range from −2 SD to +2 SD.

The main outcomes were overweight at age 24 and 36 months. International age and sex-specific cut-off points for BMI were used to define overweight (including obesity).[21] These cut-off points are extrapolated from the adult cut-off point (which is at 25 kg/m2) to age and sex-specific cut-off points for children. The advantage of using this measure compared with weight-for-height SDS from population-based growth studies is that it is internationally comparable, and cut-off points are based on health risk instead of time-dependent cut-off points.[22]

Selection of covariates was based on reports of early determinants of childhood overweight and obesity.[10,13] The child's sex and exact age at measurement were treated as confounders. The effect of socioeconomic status on the development of overweight is likely to act through more proximal determinants, so-called mediators. To elucidate possible mechanisms on how socioeconomic status is associated with childhood overweight, the following covariates were considered as mediators (categorized in prenatal, perinatal, and postnatal mediators):

Prenatal mediators were parental BMI and maternal smoking during pregnancy. Mothers reported their prepregnancy weight. Height was measured at enrollment. Mother's BMI was calculated as weight (in kilograms)/height (in meters)^2. Father's BMI was calculated from measured weight and height at enrollment. Smoking during pregnancy (yes, no) was derived from prenatal questionnaires.

Perinatal mediators were birth weight (grams) and gestational age (weeks). Both were obtained from medical records.

Postnatal mediators were breastfeeding and change in BMI SDS between 1 and 6 months after birth. Information on breastfeeding was obtained by a combination of questionnaires administered at 2, 6 and 12 months after birth. We considered breastfeeding duration in months, and exclusive breastfeeding for 2 months. BMI SDS change was calculated as the difference in BMI-for-age SDS between 1 month after birth and 6 months after birth.

Associations between educational level and subject characteristics were explored. The χ^2 tests were used to test for differences in categorical variables, analysis of variance was used to test for differences in continuous variables, and the Kruskal-Wallis test was used to test for differences in non-normally distributed continuous variables.

The association between mother's educational level and child's BMI SDS was assessed at 24 and 36 months with multivariable linear regression. Unstandardized beta coefficients and 95% confidence intervals (CI) are reported for each educational level compared with the reference category (highest educational level). The association between mother's educational level and child's overweight status at 24 and 36 months was assessed by multivariable logistic regression. Odds ratios (OR) and 95% CIs were obtained for each educational level compared with the reference category (highest educational level). Analyses for BMI SDS and overweight were not stratified for sex, as results were similar for boys and girls and the interaction term was not significant ($P > .30$). In model 1, we adjusted for exact age at measurement and sex. Then, the mediators were added according to a hierarchical structure. In model 2, we adjusted for model 1 + the prenatal risk factors for overweight (smoking during pregnancy, parental BMI). In model 3, we adjusted for model 2 + the perinatal risk factors (birth weight, gestational age). In model 4, we adjusted for model 3 + postnatal risk factors (breastfeeding, infant BMI SDS change between 1 to 6 months after birth).

Repeated measurements analysis ('PROC MIXED' procedure in SAS, version 9.1.3 for windows [(SAS Institute, Cary, North Carolina]) was performed to calculate whether BMI curves differ per educational level throughout the first 3 years of life. The best fitting model for BMI as a function of age was built with fractional polynomials.[23] The best fitting model for BMI was $BMI = ß_0 + ß_1 \times \ln(age) + ß_2 \times \sqrt{age}$. To this model, educational level was added as a main determinant (reference: high education), and an interaction term