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Child Mental Health Problems and Obesity in Early Adulthood

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Abstract

Objective—To examine whether mental health problems in childhood increase the likelihood of overweight or obesity during early adulthood among male subjects.

Study design—In a national prospective population-based study conducted in Finland, child mental health, including depression, emotional problems, conduct problems, and hyperactivity (determined on the basis of child, parent, and teacher information), was assessed at age 8 years. Body mass index (BMI) was obtained from military examination records (n = 2209) conducted in early adulthood (age range, 18–23 years).

Results—Both moderate (50th–90th percentile) and high (>90th percentile) levels of conduct problems at age 8 years were prospectively associated with a young adult being obese (BMI ≥ 30; odds ratio [OR], 2.0; 95% CI, 1.2–3.2; and OR, 2.9; 95% Confidence interval [CI], 1.5–5.9; respectively). Conduct problems were also prospectively associated with a young adult being overweight (25 ≤ BMI < 30; OR, 1.5; 95% CI, 1.1–1.9 for moderate levels of conduct problems, and OR, 1.9; 95% CI, 1.2–2.8 for high levels), after controlling for hyperactive problems and sociodemographic factors.

Conclusions—Conduct problems in childhood are prospectively associated with overweight and obese in young adulthood. Future studies should address the potential for interventions to reduce obesity risk in young adulthood for boys who manifest conduct problems early in life.

The empirical examination of the association between obesity and psychopathology (mostly depression) produced negative findings until the early 1990s, probably reflecting methodological limitations of the studies conducted.[1] More recently, population-based studies with prospective designs have reported that mental health problems and obesity are related.[2–7] The existing evidence so far is convergent for the relationship between conduct

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problems and obesity later in life.[3–5] Findings about depression, however, are less clear. Some studies reported the relationship between depression and obesity in boys and girls,[2] whereas other studies reported the relationship in girls only.[5,7] Other studies found that boys with chronic obesity are more likely to be depressed,[4] and different studies described an inverse relationship, of marginal statistical significance, between BMI z-score and depression in boys.[6] No prospective study has examined the prospective relationship between hyperactivity and obesity later in life; however, cross-sectional results have suggested that the 2 conditions are related.[8]

The aim of this study is to examine whether depression, emotional problems, conduct problems, or hyperactivity at age 8 years predict obesity in early adulthood in a national sample of Finnish boys who had their height and weight measured when they were young adults. Preliminary results derived from an analysis of an overlapping sample indicated that conduct problems were related to clinical diagnosis (not based on height and weight measurement) of obesity.[9] On the basis of these earlier studies and the current literature, we expect that high levels of conduct or hyperactivity problems, experienced as early as age 8 years, will increase the risk of being overweight or obese in early adulthood.

Methods

This investigation is a part of the nation-wide “From Boy to Man” study, a follow-up study part of the Epidemiological Multi-Center Child Psychiatric Study in Finland. [10] The original study sample was drawn from the total population of Finnish children born during 1981 (n = 60 007). Of a representative sample of 6017 children, 5813 (97%) took part in the study in 1989. Of the 5813 children, 2946 were boys. Height and weight information to calculate body mass index (BMI) in early adulthood was obtained for 2209 participants (75.0% of the sample), of whom 40.1% were 18 to 19 years old, 57.0% were 20 to 21 years old, and 2.9% were 22 to 23 years old. To generate more conservative estimates, the 182 subjects who were underweight (BMI <18.5) were excluded. The Joint Commission on Ethics of Turku University and Turku University Central Hospital approved the research plan. Permission for the use of the military register data was obtained from the Finnish Defense Forces.

At age 8 years, child mental health was assessed by using information collected from 3 different sources: parents, teachers, and children. Parent- and teacher-informed psychopathology was assessed with the Rutter questionnaire, a well-tested instrument widely used in child psychiatric research.[11,12] Parents completed the 31-item parent version, and teachers completed the 26-item teacher version, which addresses behaviors that occur at school. Items on the parent and teacher questionnaires were rated in a scale of 0 to 2 and included 3 subscales: conduct, hyperkinetic (related to hyperactivity), and emotional symptom domains. Children also completed, in the classroom, the Children’s Depression Inventory, which assesses depressive symptoms in children by self-report.[13] Items are also rated on a scale of 0 to 2. The original Children’s Depression Inventory includes 27 items; however, the question about suicide was omitted for ethical reasons.

Parent and teacher information was combined to generate emotional, conduct, and hyperactivity scales, whereas the depressive scale was based only on child self-report. The emotional scale asks about shyness, anxiety, and withdrawal behaviors (5 questions to parents and 4 to teachers). The conduct scale assesses the presence of behaviors such as disobedience, defiance, fits of temper, aggression, and cruelty toward others, destruction of property, stealing, and lying (5 questions to parents and 6 to teachers). The hyperactivity scale includes questions related to inattentive behavior, short attention span, distractibility, restlessness, and hyperactivity (3 questions to parents and 3 to teachers). The Cronbach alphas for the 4 mental health scales were in the range of 0.80 to 0.83, with the exception of

the emotional scale (approximately 0.6). Pearson correlations between scales were in the 0.16 to 0.27 range, and between hyperactivity and conduct scales it was 0.63.

Because even moderate levels of behavior problems in childhood appear to be associated with adverse outcomes later in life,[14] in addition to high levels of mental health problems, we examined symptom levels in the moderate range. To generate clinically interpretable measures of psychopathology, results of the 4 mental health scales were categorized as <50th percentile (absence or low level of mental health problem), 50th to 90th percentile (moderate level), and >90th percentile (high level). The cutoff points were based on the distribution of scores in the entire obtained study sample, with attrition of only approximately 3% at baseline (n = 3000 boys).[15] To ensure results were not purely an artifact of the selected cutoff points, continuous variables representing number of symptoms were also analyzed.

Additional variables included father's and mother's education (completion of at least 12 years of education, labeled upper secondary) and family structure (categorized as intact with 2 biological parents or non-intact).

Finnish men born in 1981 received their obligatory military service call-up in 1999 at age 18 years. It is estimated that approximately 9% of men get a permanent or temporary exemption from military service,[16] which in approximately 60% of the cases will be related to psychiatric problems. Of those men regarded as fit for service, approximately 80% start their military service within 2 years after the call-up. Information to calculate BMI was obtained in this sample for all men who had started their military service within 5 years after military call-up (age 18–23 years) and for whom identifying information and BMI measurement could be linked. Height and weight are usually measured during the first 2 weeks of military service. Weight is measured in light clothing, without shoes. Because subjects are weighed clothed, we subtracted 1 kg from weight before calculating BMI. Information about weight and height was abstracted from the military registry database. BMI was calculated with the standard weight/height^2 formula and classified as recommended by the World Health Organization.[17] When the 6 single-year age groups (18–23 years) were compared, the difference between mean BMI scores across age groups was <0.5 BMI unit.

Compared with the 2209 young adults for whom BMI information was obtained, those not followed in young adulthood (ie, those who took part in the study in 1989, but BMI was not available at follow-up, 25% of the original sample) had significantly more parent/teacher reported conduct (28.3%/17.6%; $P < .001$), hyperactive (31.8%/17.2%;$P < .001$), and emotional (25.5%/17.8%, $P < .001$) symptoms categorized as high level. The difference in self-reported depressive symptoms was marginally significant (18.0% versus 22.4%; $P = .058$).

Bivariate prospective associations of child mental health at age 8 years with obesity and being overweight in early adulthood were examined with multinomial logistic regression analysis. The multinomial logistic regression analysis for a polytomous response variable (3 categories of BMI: normal, overweight, and obese) is a generalization of the methodology of logistic regression analysis for a dichotomous response variable. Initial models examined the univariate associations between BMI status (response variable) and mother's education, father's education, and family structure. For mental health problems, the initial models included each type of mental health problems (depressive, emotional, and conduct problems and hyperactivity) using as covariates maternal education and age at BMI assessment. The final model included all significant mental health variables, maternal education level, and age at BMI assessment, with the aim of determining which mental health variables would be independently associated with BMI status. Mental health was examined as categorical (low,

moderate, and high symptom levels) variables, and results' consistency was tested by including continuous versions of these variables in the same models (standardized so that odds ratios [ORs] could be interpreted as an increase of 1 SD in the scale). To check whether obtained results could merely be an artifact of missing data, multiple imputation of the main regression models was conducted. Multiple imputation was performed by using SAS Proc MI software with the Markov Chain Monte Carlo technique with 5 imputations (SAS Institute, Inc., Cary, North Carolina).

Results

At age 18 to 23 years, 4.4% of the sample was obese (BMI ≥ 30), and 15.5% were overweight (25 ≤ BMI <30).

The Table displays the frequency of obesity, overweight, and normal weight in early adulthood by sociodemographic and mental health variables at age 8 years. We fitted 1 model for each sociodemographic factor as explanatory variables (3 models), and 1 model for each mental health variable (emotional, depressive, conduct, and hyperactivity) adjusted by maternal education and age at BMI measurement (models A). Children with high levels of conduct problems at age 8 years were more likely to be overweight or obese between ages 18 and 23 years, compared with children who were below the 50th percentile. Even moderate levels of conduct problems (50th–90th percentiles) were associated with both obesity and being overweight. A similar, although less consistent, pattern was observed for hyperactive symptoms. The same models were tested with multiple imputation of missing data, and the results were highly consistent with non-imputed models.

Subsequent analyses, undertaken to assess the robustness of the results, indicated that our findings were not a function of our specific categorization of the mental health variables. A very similar pattern was observed when continuous, instead of a categorical, measures of mental health problems were examined. Continuous measures of internalizing psychopathology were not prospectively associated with relative weight status in early adulthood (also controlling for maternal education level and age at BMI measurement). There was neither an association between earlier emotional problems and being overweight (OR, 1.0; 95% Confidence interval [CI], 0.9–1.1) or obese (OR, 1.1; 95% CI, 0.9–1.3) in young adulthood, nor were depressive symptoms at age 8 years associated with being overweight (OR, 1.1; 95% CI, 0.98–1.2) or obese (OR, 0.9; 95% CI, 0.7–1.2). Continuous measures of conduct problems were prospectively associated with being overweight (OR, 1.3; 95% CI, 1.1–1.4) and obese (OR, 1.3; 95% CI, 1.1–1.6). The same pattern was observed for hyperactive symptoms that were prospectively associated with being overweight (OR, 1.2; 95% CI, 1.03–1.3) and obese (OR, 1.3; 95% CI, 1.1–1.6).

On the basis of results of the initial models, we developed and fitted model B (Table) to examine the combined effect of the different types of early child mental health symptoms on early adulthood relative weight. Model B included the mental health variables that were statistically significant in the earlier (models A) analysis (depressive, conduct, and hyperactive problems), controlling for maternal education level and age of BMI measurement. Only conduct symptoms at age 8 years were prospectively associated with being overweight and obese in early adulthood. Hyperactive symptoms did not independently predict elevated weight after adjustment for conduct problems.

A similar pattern of associations was identified when model B was examined with multiple imputation: the association between conduct problems and obesity in the imputed model (OR, 1.9; 95% CI, 1.1–3.2 for moderate levels and OR, 2.4; 95% CI, 1.0–6.0 for high levels) was very similar to the results of the non-imputed model. Furthermore, conduct problems

were also associated with being overweight, at least marginally for moderate levels (OR, 1.4; 95% CI, 0.9–1.8) and significantly for high levels (OR, 1.7; 95% CI, 1.1–2.7). In agreement with the non-imputed model, hyperactive problems were not associated with being overweight (OR, 1.3; 95% CI, 0.9–1.5 for moderate levels, and OR, 1.2; 95% CI, 0.8–1.9 for high levels) or obesity (OR, 1.1; 95% CI, 0.7–1.9 for moderate levels and OR, 1.3; 95% CI, 0.6–3.0 for high levels). Depressive problems were also not associated with being overweight (OR, 1.1; 95% CI, 0.8–1.4 for moderate levels and OR, 1.0; 95% CI, 0.7–1.4 for high levels) or obesity (OR, 0.9; 95% CI, 0.6–1.4 for moderate levels and OR, 0.7; 95% CI, 0.3–1.4 for high levels) in young adulthood.

Discussion

Our results indicate that conduct problems in childhood are prospectively associated with both being overweight and obesity in early adulthood in male subjects in Finland. A similar pattern of findings had been identified earlier with 2 longitudinal community-based studies in the United States.[3–5] Our study reports that childhood conduct problems, at as early an age as 8 years, predict measured (not self-reported) statuses as overweight and obese later in life, on the basis of a large country-wide probabilistic sample of boys. Depressive or emotional problems in childhood did not predict being overweight or obese later in life in this population, nor did hyperactive symptoms, after controlling for conduct problems.

Conduct problems in childhood may result in obesity later in life through different mechanisms. Disordered eating may be a manifestation of oppositional behaviors in antisocial children. The impulsivity that usually characterizes conduct problems may also be related to unhealthy and binge eating. Physical activity that involves social interaction may be reduced in children with conduct problems. Conduct problems can also be related to obesity later in life through use of substances or low educational achievement. Overeating and lack of physical activity or sedentary behaviors can easily become chronic, resulting in the development or maintenance of obesity later in life.

Early manifestations of conduct problems, such as opposition and defiance, precede the development of a more severe and chronic condition named conduct disorder.[18] A small number of all children with conduct problems go on to exhibit conduct disorder, and a few of them will have overt antisocial behavior later in life.[19] More frequently, children with early conduct problems will have some level of impairment of social and relationship functioning in adulthood.[20] Consistent with our finding on moderate conduct symptom level, even children with sub-threshold diagnostic conduct symptoms levels may experience later adverse outcomes.[14]

Our analysis also indicates that conduct symptoms, and not hyperactive ones, predict elevated risk of overweight and obesity in young male adults, when we considered the combined contribution of both types of externalizing problems on obesity. Hyperactivity and conduct problems are frequently co-morbid in childhood.[18] Recent reports on cross-sectional data detected an association between attention deficit/hyperactivity disorder and obesity in children.[8] Our finding highlights the importance of considering conduct problems when examining the relationship between hyperactivity and obesity and reinforces the need for prospective investigations.

Despite the assessment of mental health at a young age and the prospective design of the study, there are alternative ways how the association between mental health problems and obesity could be explained. It is conceivable that obese children react to stigmatization by developing conduct problems. Thus, the reverse causal pathway is possible, with obesity resulting in conduct problems later in life.[21,22] Because of the absence of information about

the children's relative weight at age 8 years, we were only able to examine whether conduct problems in childhood were antecedents of future obesity or overweight. The pattern of results observed could also be the result of common precursors to conduct problems and obesity. Common factors that could explain both conditions include serotonin abnormalities, impulsivity, peer rejection, parental disengagement, maternal smoking during pregnancy, and neighborhood quality.

The lack of evidence of an association between depression in childhood and obesity in early adulthood among male subjects is consistent with some of the earlier studies, which have detected such associations only in female subjects.[5,7] A cross-sectional association between depressive symptoms and obesity in male and female subjects has been observed in adults in the United States.[23] It is possible that later in development (adult life), a relationship between depression and obesity in men emerges, but we did not find that self-reported depressive symptoms in boys at age 8 years predicted being overweight or obese as young adults. Because of the large sample size, it is unlikely that this non-significant finding reflects lack of statistical power.

A number of limitations should be considered when interpreting our results. First, because participants' relative weight status at age 8 years is unknown, we do not know whether conduct problems were associated with new cases of being overweight, with the maintenance of obesity, or both.

Second, information about BMI in early adulthood was less frequently available for children who had any type of mental health problem at age 8 years. Although the impact of such selection bias, if any, on the results is uncertain, if the most severely impaired were not present at follow-up, the magnitude of the association would likely have been diminished. In addition the selective loss to follow-up occurred for all 4 types of mental health problems examined, suggesting that the study attrition was not responsible for the specific prospective associations identified. Furthermore, when the data were analyzed with whole sample, by using multiple imputation of missing information, the pattern of associations did not change. A third limitation arises because we were able only to examine parental educational level as possible common precursors of both conditions. Finally, our sample was restricted to male subjects, so we do not know whether the same pattern of associations would also apply to female subjects, although, for conduct problems and obesity, earlier investigations have not identified sex differences.[4,24]

Conduct problems and oppositional behaviors in childhood are preventable[25] and treatable,[26] particularly when problems are addressed in early childhood.[27] Clinical research has supported the communication of positive, easily conveyed parenting principles as an effective approach.[28] In contrast, available evidence on behavioral intervention for obesity shows limited long-term success for strategies targeting adolescents.[29,30] Studies should examine how the consideration of mental health issues involved in childhood obesity may improve intervention efforts. Directly addressing obesity-related behaviors in children with moderate and high levels of conduct problems in childhood may have a significant impact on the prevention of obesity later in life.

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Glossary

BMI	Body mass index
CI	Confidence interval
OR	Odds ratio

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Table

Childhood factors (at age 8 years) and overweight or obesity in early adulthood

	Total	Normal*	Overweight†	Obese‡	Models A		Model B	
Childhood factors	**n**	**%**	**%**	**%**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Mother's education								
Upper secondary	565?	80.7	16.3	3.0				
Lower	1346	77.2	17.6	5.2	1.1 (0.8–1.5)	1.8 (1.1–3.1)		
Father's education								
Upper secondary	380	81.1	15.3	3.6				
Lower	1393	78.1	16.9	5.0	1.1 (0.8–3.0)	1.2 (0.7–2.5)		
Family structure								
2 biological parents	1668	78.5	16.6	4.9				
Other	292	77.0	19.2	3.8	1.2 (0.9–1.6)	1.8 (0.4–1.5)		
Depressive problems								
<50th percentile	1094	80.0	15.3	4.7				
50th–90th percentile	668	76.1	19.0	4.9	1.3 (1.01–1.70)	1.0 (0.6–1.6)	1.2 (0.9–1.6)	0.9 (0.6–1.5)
≥90th percentile	227	78.0	17.6	4.4	1.2 (0.8–1.8)	0.6 (0.2–1.4)	1.0 (0.7–1.5)	0.4 (0.2–1.1)
Emotional problems								
<50th percentile	1266	78.3	17.1	4.6				
50th–90th percentile	458	77.3	17.7	5.0	1.0 (0.8–1.4)	1.1 (0.7–1.8)		
≥90th percentile	217	81.6	14.3	4.2	0.8 (0.5–1.3)	0.8 (0.4–1.8)		
Conduct problems								
<50th percentile	953	82.6	14.3	3.1				
50th–90th percentile	819	75.6	18.7	5.7	1.5 (1.1–1.9)	2.0 (1.2–3.2)	1.4 (1.03–1.8)	1.8 (1.1–3.1)
≥90th percentile	175	69.7	22.9	7.4	1.9 (1.2–2.8)	3.0 (1.5–6.0)	1.8 (1.1–3.1)	3.0 (1.2–7.3)
Hyperactive problems								
<50th percentile	1108	81.1	15.0	3.9				
50th–90th percentile	671	75.6	19.5	4.9	1.4 (1.1–1.8)	1.3 (0.8–2.1)	1.2 (0.9–1.6)	1.0 (0.6–1.7)
≥90th percentile	156	73.1	18.6	8.3	1.4 (0.9–2.2)	2.3 (1.2–4.6)	1.0 (0.6–1.7)	1.4 (0.6–3.3)

Underweight adults (BMI < 18.5) were excluded.

All models including mental health variables are adjusted with mother's education level and young adult's age at follow-up.

Models A include only 1 mental heath variable at a time. Model B includes all mental health variables that were statistically significant in the previous step.

[*] BMI <25; n = 1770.

[†] 15 ≤ BMI <30; n = 343.

[‡] BMI ≥ 30; n = 98.