Overweight and Obesity in a Sample of Children With Autism Spectrum Disorder

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ABSTRACT

OBJECTIVE: To determine the prevalence of overweight/obese status in children with autism spectrum disorders (ASD), identify associated characteristics, and develop a model to predict weight status.

METHODS: The prevalence of overweight and obesity was determined in 2769 children with ASD enrolled in the Autism Speaks Autism Treatment Network, a collaboration of 17 academic centers, and compared with a national sample matched for age, sex, and race. Associations in the ASD sample between weight status and demographic and clinical variables, such as age, race, head circumference, and adaptive functioning, were tested using ordinal logistic regression. The accuracy of a final model that predicted weight status based on early life variables was evaluated in a validation sample.

RESULTS: The prevalence of overweight and obesity were 33.9% and 18.2%, respectively; ASD was associated with a higher risk of obesity (but not overweight) relative to the national sample (odds ratio [OR], 1.16; 95% confidence interval [CI], 1.05–1.28; $P = .003$). In the adjusted analysis, over-weight/obese status was significantly associated with Hispanic ethnicity (OR, 1.99; 95% CI, 1.37–2.89), parental high school education (OR, 1.56; 95% CI, 1.09–2.21), high birth weight (OR, 1.56; 95% CI, 1.11–2.18), macrocephaly (OR, 4.01; 95% CI, 2.96–5.43), and increased somatic symptoms (OR, 1.41; 95% CI, 1.01–1.95). A prediction model designed to have high sensitivity predicted low risk of overweight/obesity accurately, but had low positive predictive value.

CONCLUSIONS: The prevalence of obesity in children with ASD was greater than a national sample. Independent associations with increased weight status included known risk factors and macrocephaly and increased level of somatic symptoms. A model based on early life variables accurately predicted low risk of overweight/obesity.

KEYWORDS: autism; obesity; overweight; macrocephaly; NHANES

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WHAT'S NEW

Children with autism spectrum disorders in a well-described sample were more likely to be obese than matched national control subjects. Overweight/obesity was associated with macrocephaly, increased level of somatic symptoms, and known risk factors in the general population.

OVERWEIGHT AND OBESITY in children and youth is a major public health concern in the United States. Recent literature suggests that children with certain neurodevelopmental conditions, including autism spectrum disorders (ASD), are at an increased risk of being or becoming overweight/obese.[1–9] This has not been a uniform finding in children with ASD.[10,11] A large study to examine well characterized participants is necessary to determine if children with ASD are, in fact, at increased risk of overweight/obesity.

Additionally, risk factors for overweight/obesity among children with ASD might differ from those in the general population.[4,7,9] Unique risk factors for overweight/obesity in children with ASD might include unusual or restricted diets, decreased physical activity secondary to poor motor skills, low muscle tone, and decreased ability to participate in structured sports, and treatment with medications that have weight gain as a side effect.[9,12–14] Metabolic or genetic conditions and other factors, such as ASD severity or associated conditions (eg, intellectual disability [ID], poor adaptive functioning, or behavioral difficulties) might also affect the likelihood of obesity in this population.

Although recent studies of the weight status of children with ASD have examined large national population samples,[2,3,5] most have obtained data on diagnoses, heights, and weights from parental report, which can result in classification errors.[2,3,5,6,8,15] In addition, the clinical descriptions of children have been limited, so

few associations have been examined, and when examined the results have been conflicting.[1,4,7,9] For example, Ho et al studied 54 school-aged children with ASD and determined that obesity correlated with autism severity,[9] and Xiong et al found no relationship between weight and autism symptoms in a sample of 429 children.[7]

The current study had 3 purposes: 1) to determine if the prevalence of overweight and obesity is greater in children with ASD than in the general population, 2) to identify associations between demographic and clinical characteristics and weight status in children with ASD, and 3) to develop a model to predict which children with ASD are at greater or lower risk of overweight/obesity to focus anticipatory guidance.

METHODS

SAMPLE

A secondary analysis was conducted using data collected on children enrolled in the Autism Speaks Autism Treatment Network (AS ATN), a collaboration of 17 sites in the United States and Canada. The data included enrollees from December 2007 through September 2012. The study was approved by each site's institutional review board. Informed consent was obtained per AS ATN protocol. Inclusion criteria for the secondary data analysis were: 1) age 2 to 17 years, 2) *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* diagnosis of autistic disorder, Asperger disorder, or pervasive developmental disorder-not otherwise specified confirmed by experienced clinicians with direct clinical assessment and supported by the administration of the Autism Diagnostic Observation Schedule, 3) clinician-measured height, weight, and head circumference, and 4) complete data on age, sex, race/ethnicity, intelligence quotient (IQ), insurance, and primary caregiver's education status.

VARIABLES

DEMOGRAPHIC CHARACTERISTICS

Demographic variables included age, sex, and caregiver-reported child race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, Asian and other/multicultural), primary caregiver education status (less than high school, high school, less than college, Bachelor's degree, postgraduate), and insurance type (public and private, private only, public only, and no insurance). In the analysis, insurance was examined as 2 different variables (any public vs none and any private vs none). This approach was used to capture the range of insurance status because insurance was also used as a proxy for socioeconomic status. Age was used as a continuous variable to describe the sample demographic characteristics and categorized into the following intervals: 2 to 5, 6 to 11, and 12 to 17 years for analysis.

GROWTH AND PHYSICAL EXAMINATION MEASURES

Height, weight, and head circumference were directly measured at the time of enrollment. Body mass index (BMI) percentile for age and sex, calculated from the

2000 Centers for Disease Control,[16] was the primary study outcome with 3 categories: normal weight (BMI < 85th percentile for age and sex), overweight (BMI ≥ 85th percentile), and obese (BMI ≥ 95th percentile). Children with unverified BMI percentiles with z score below −4.0 or >5.0 based on the World Health Organization's fixed-exclusion ranges were excluded. Head circumference was defined as macrocephalic when ≥97th percentile for age and sex. Birth weight was obtained from parental report and stratified as <4000 g or ≥4000 g. Additionally, clinicians completed a sequential algorithm with high sensitivity and specificity to identify dysmorphic features,[17] and categorized children as "dysmorphic" versus "nondysmorphic."

CHILD CLINICAL VARIABLES

Intellectual functioning.—Intellectual functioning was measured using one of several IQ tests accepted by the AS ATN protocol,[18] and full-scale IQ was dichotomized as <70 or ≥70 based on diagnostic criteria for ID.

Adaptive functioning.—Adaptive functioning was measured using the Vineland Adaptive Behavior Scales, second edition.[19] Standard scores with a mean of 100 and standard deviation of 15 were calculated. Higher scores represent a higher level of functioning. Scores for communication, daily living skills, socialization, and adaptive composite were analyzed as continuous variables to describe the adaptive functioning of this population.

Behavioral symptoms.—The severity of behavioral symptoms was evaluated using the parent-completed Child Behavior Checklist,[20] which is used to assess a broad range of emotional and behavioral symptoms. T scores were calculated with a mean of 50 and standard deviation of 10. Higher scores of ≥70 denote increased risk of behavior problems. Two versions were used, the preschool checklist is intended for use with children 18 months to 5 years of age, and the school-age version is for children aged 6 to 18 years. We analyzed the total problem score, internalizing and externalizing domain scores, somatic complaints, and aggression subdomain scores. The somatic complaints subdomain records physical symptoms, including dizziness and discomfort related to specific organ systems.

Sleep habits.—Sleep difficulties were assessed using the parent-completed Children's Sleep Habits Questionnaire,[21] a 33-item validated questionnaire with scores >41 indicating sleep difficulties. Because children with ASD are at increased risk of various sleep difficulties, the overall Children's Sleep Habits Questionnaire total score was used as a proxy for the presence versus absence of any sleep problems.

Eating problems.—A question that endorsed "eating problems" on the AS ATN parental history was used as a proxy for any atypical feeding behaviors or dietary concerns (eg, restricted diet, overeating).

Medications.—Psychotropic medication use was reported by parents at the time of the initial ATN visit. Four categories of medication use were analyzed: any psychotropic medication, stimulant medication, atypical antipsychotic, and use of >1 psychotropic medication.