

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Overweight in Children and Adolescents in Relation to Attention-Deficit/Hyperactivity Disorder: Results From a National Sample

Molly E. Waring and Kate L. Lapane

Pediatrics 2008;122:e1

DOI: 10.1542/peds.2007-1955

The online version of this article, along with updated information and services, is
located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/122/1/e1.full.html>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2008 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



Overweight in Children and Adolescents in Relation to Attention-Deficit/Hyperactivity Disorder: Results From a National Sample

Molly E. Waring, MA, Kate L. Lapane, PhD

Department of Community Health, Brown Medical School, Providence, Rhode Island

The authors have indicated they have no financial relationships relevant to this article to disclose.

What's Known on This Subject

Previous research exploring the relationship between ADD/ADHD and childhood obesity has been conducted mainly on clinical samples and may not be generalizable to the general US population of children and adolescents.

What This Study Adds

In a large, nationally representative sample, youth with ADD/ADHD not currently medicated had ~1.5 times the odds of being overweight, and those currently medicated had ~1.6 times the odds of being underweight compared to youth without ADD/ADHD.

ABSTRACT

OBJECTIVE. As the prevalence of childhood obesity increases, identifying groups of children who are at increased risk of overweight is important. The current study estimated the prevalence of overweight in children and adolescents in relation to attention-deficit/hyperactivity disorder and medication use.

PATIENTS AND METHODS. This study was a cross-sectional analysis of 62 887 children and adolescents aged 5 to 17 years from the 2003–2004 National Survey of Children's Health, a nationally representative sample of children and adolescents in the United States. Attention-deficit disorder/attention-deficit/hyperactivity disorder was determined by response to the question "Has a doctor or health professional ever told you that your child has attention-deficit disorder or attention-deficit/hyperactive disorder, that is, ADD or ADHD?" Children and adolescents were classified as underweight, normal weight, at risk of overweight, or overweight according to BMI for age and gender.

RESULTS. After adjustment for age, gender, race/ethnicity, socioeconomic status, and depression/anxiety, children and adolescents with attention-deficit disorder/attention-deficit/hyperactivity disorder not currently using medication had ~1.5 times the odds of being overweight, and children and adolescents currently medicated for attention-deficit disorder/attention-deficit/hyperactivity disorder had ~1.6 times the odds of being underweight compared with children and adolescents without either diagnosis.

CONCLUSIONS. This study provides heightened awareness for pediatric providers about the relationship between attention-deficit disorder/attention-deficit/hyperactivity disorder, medication use, and weight status. Future work is needed to better understand the longitudinal and pharmacologic factors that influence the relationship between attention-deficit disorder/attention-deficit/hyperactivity disorder and weight status in children and adolescents. *Pediatrics* 2008;122:e1–e6

www.pediatrics.org/cgi/doi/10.1542/peds.2007-1955

doi:10.1542/peds.2007-1955

Key Words

attention deficit disorder, attention deficit hyperactivity disorder, obesity, child, adolescent

Abbreviations

ADHD—attention-deficit/hyperactivity disorder

ADD—attention-deficit disorder

NSCH—National Survey of Children's Health

OR—odds ratio

CI—confidence interval

SES—socioeconomic status

Accepted for publication Jan 4, 2008

Address correspondence to Molly E. Waring, MA, Brown Medical School, Department of Community Health, Box G-5121, Providence, RI 02912. E-mail: molly.waring@brown.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275). Copyright © 2008 by the American Academy of Pediatrics

IN THE UNITED States, the prevalence of overweight among children aged 6 to 11 years has risen dramatically in the past few decades; in 1980, 7% were overweight, and that number rose to 16% in 2002.¹ Over the same time period, the prevalence of overweight among adolescents more than tripled, from 5% to 16%.¹ Childhood overweight has negative consequences for physical and mental health. Relative to their normal-weight peers, overweight children and adolescents are at an elevated risk for many disorders and conditions including hypertension, dyslipidemia, high cholesterol levels, metabolic syndrome, diabetes, nonalcoholic fatty liver disease, reproductive problems, bone and joint problems, and sleep apnea.^{1–3} Overweight children and adolescents are also at increased risk for lower self-esteem, compromised peer relationships, and problems at school, including poorer attendance and performance.^{1,2,4,5}

Understanding which groups of children are at increased risk for being overweight may help pediatricians and parents prevent the development of obesity. Children with attention-deficit/hyperactivity disorder (ADHD) may be 1 such risk group. Attention-deficit disorder (ADD)/ADHD is characterized by persistent patterns of inattention

and/or hyperactivity-impulsivity that cause impairment in at least 2 settings (eg, school and home).⁶ It has been suggested that the impulsivity and poor behavioral regulation often found in youth with ADD/ADHD may lead to the development of eating patterns that put youth at increased risk for obesity.⁷ Because weight loss and decreased appetite are known adverse effects of the common stimulant medications used to treat children and adolescents with ADD/ADHD,^{8,9} we expected that medication use would be associated with underweight. Previous research exploring the relationship between ADD/ADHD and childhood obesity has been conducted mainly on clinical samples and may not be generalizable to the general US population of children and adolescents.^{7,10-13} Using the National Survey of Children's Health (NSCH), a large nationally representative sample, we estimated the extent to which children and adolescents with ADD/ADHD are at increased risk of being overweight and the extent to which treatment with stimulant medications alters this association.

PATIENTS AND METHODS

The Maternal and Child Health Bureau and the National Center for Health Statistics sponsored the NSCH to produce national and state-level prevalence estimates of a variety of physical, emotional, and behavioral indicators of children's health and information about the child's family context and neighborhood.¹⁴ Because the public-use data set contains no personally identifiable information, the Brown University institutional review board determined that this study did not require review.

NSCH used the State and Local Area Integrated Telephone Survey (SLAITS) program for the sampling and data collection.¹⁴ The sampling frame was identical to that of the National Immunization Study.¹⁴ Briefly, trained interviewers called telephone numbers at random to identify households with ≥ 1 child under the age of 18. In each eligible household, interviewers randomly selected 1 child and interviewed the adult in the household who knew the most about the child's health and well-being. Interviewers completed a total of 102 353 interviews in English or Spanish from January 2003 to July 2004.

Because the clinical criteria for making a diagnosis of ADHD require that the child experience impairment in at least 2 settings, such as home and school,⁶ and studies examining children seeking treatment for ADHD have reported a youngest age of seeking treatment of ~ 4 years,¹⁵ we restricted our sample to children and adolescents aged 5 to 17 years. After exclusion because of ineligible age ($n = 28\ 089$) or missing BMI ($n = 5264$), ADD/ADHD ($n = 281$), ADD/ADHD medication use ($n = 26$), depression or anxiety ($n = 123$), race/ethnicity ($n = 635$), or household income ($n = 5048$) information, our analytic sample consisted of 62 887 children and adolescents.

Trained interviewers asked parents or guardian respondents a series of questions regarding the physical, emotional, and behavioral health of their child and about access to health care, parental health, and neighborhood characteristics.¹⁴ Interviewers asked respon-

dents, "Has a doctor or health professional ever told you that your child has attention-deficit disorder or attention-deficit/hyperactive disorder, that is, ADD or ADHD?" Other large population-based surveys have used this question to assess diagnosis of ADD/ADHD in children and adolescents.^{16,17} Respondents who reported that their child had ADD or ADHD were asked, "Is your child currently taking medication for ADD or ADHD?"

Parents or guardians answered the questions, "How tall is your child now?" and "How much does your child weigh now?"; BMI was calculated from the answers as weight in kilograms divided by height in meters squared. The Centers for Disease Control and Prevention created gender- and age-specific growth charts that are used for children and adolescents aged 2 to 20 years.¹⁸ A child with a BMI in the <5 th percentile for gender and age is considered underweight, in the >5 th and <85 th percentile for gender and age is considered normal weight, in the ≥ 85 th to <95 th percentile is considered at risk for overweight, and in the ≥ 95 th percentile is considered overweight.¹⁸⁻²⁰ We used the precoded variable in the NSCH data set that classified children into BMI classes according to the Centers for Disease Control and Prevention growth charts.

All analyses of the NSCH data used SUDAAN,²¹ which produces variance estimates for complex survey designs. The public-use NSCH data set provided the sampling weights used in these analyses. These weights consist of a base sampling weight and adjustment for multiple telephone lines per household and for nonresponse.¹⁴ The weights are poststratified so that the sum of weights for each state equals the number of children in that state as estimated by the July 2003 US census.¹⁴ First, we compared the characteristics of children and adolescents according to ADD/ADHD and medication use. Next, we used polytomous logistic regression models to estimate odds ratios (ORs) and 95% confidence intervals (CIs) to compare the odds of being underweight, at risk for overweight, or overweight with being of normal weight. In polytomous logistic regression the outcome takes 1 of ≥ 3 categories, and models are simultaneously fit by using maximum likelihood to estimate ORs for each group compared with a common reference group.²² We calculated crude ORs and 95% CIs of underweight, at risk of overweight, and overweight versus normal weight among children and adolescents with ADD/ADHD compared with those without ADD/ADHD.

Finally, we used polytomous logistic regression models to control for confounding. The final model included all covariates whose inclusion changed the estimate of the OR for ADD/ADHD by $\geq 10\%$. We evaluated the following variables for confounding: race/ethnicity, low socioeconomic status (SES), gender, age, and depression or anxiety. Known risk factors for childhood overweight include nonwhite race/ethnicity and low SES.^{19,20,23-26} To ensure the confidentiality of the participants, the NSCH collapsed responses to the question about the child's race into white only, African American or black only, other race, and multiple race.¹⁴ The NSCH coded race and Hispanic/Latino origin separately.¹⁴ In our study, race/ethnicity was coded as non-Hispanic white, non-His-

panic black, Hispanic, or multiracial/other race. In addition to being a risk factor for overweight, low SES has been associated with diagnosis of ADD/ADHD.²⁷ Interviewers asked respondents about household income.¹⁴ Income to household size was compared with the Department of Health and Human Services federal poverty guidelines.¹⁴ We dichotomized SES into “low SES” and “not low SES” by using a cutoff of <200% of the federal poverty level.¹⁶ Diagnosis of ADD/ADHD is more common among boys^{6,16,28,29} and older children.^{6,16} To allow for nonlinearity, we entered age as both a linear and quadratic term. However, because of a lack of significance, we did not include the quadratic term in the final model. Because depression and anxiety are common comorbidities of ADD/ADHD^{28,30} and depression is a risk factor for the development of obesity among adolescents,³¹ we evaluated depression/anxiety as a potential confounder. Interviewers asked respondents whether a doctor or health professional had ever told them that their child had depression or anxiety problems.

Because a number of otherwise-eligible participants ($n = 5683$) did not provide information on their race/ethnicity and/or household income, we duplicated the analysis including indicator variables in the models representing missing race/ethnicity and missing SES. After this study was conducted, the Centers for Disease Control and Prevention published a multiple imputation of the missing household-poverty-level variable.³² We repeated our analysis by using this imputed data set. Although these methods prevented the loss of participants caused by item nonresponse, the results were not materially different from the complete case analysis. Therefore, for ease of interpretation, we present the analysis of the 62 887 youth who had valid responses for all variables of interest.

RESULTS

The prevalence of ADD/ADHD among children and adolescents was estimated to be 8.8% (95% CI: 8.4%–9.2%). A little more than half of the children and adolescents with ADD/ADHD were taking medication for ADD/ADHD (57.2% [95% CI: 54.9%–59.4%]). Compared with children and adolescents without ADD/ADHD, the youth with ADD/ADHD were more likely to be male, to be non-Hispanic white, and to have low SES (Table 1). The children and adolescents with ADD/ADHD were ~9 times as likely to report depression/anxiety as those without ADD/ADHD (28.0% vs 3.1%). A little more than half of the children and adolescents (56.7% [95% CI: 56.0%–57.4%]) were of normal weight, 6.7% (95% CI: 6.4%–7.1%) were underweight, 15.6% (95% CI: 15.1%–16.1%) were at risk of overweight, and 21.0% (95% CI: 20.4%–21.6%) were overweight. At the crude level, the children and adolescents with ADD/ADHD who were not taking medication at the time had increased odds of overweight (OR: 1.35 [95% CI: 1.12–1.62]), and those who were taking medication for ADD/ADHD at the time had increased odds of underweight (OR: 1.48 [95% CI: 1.20–1.81]) relative to the children and adolescents without ADD/ADHD (Table 2).

TABLE 1 Characteristics of Children and Adolescents With and Without ADD/ADHD

Characteristic	Without ADD/ADHD	With ADD/ADHD
<i>n</i>	57 204	5680
Weighted <i>n</i>	39 295 797	3 790 859
Male, %	49.0	72.3
Adolescent (aged 13–17 y), %	40.3	46.3
Race/ethnicity, %		
Non-Hispanic white	65.1	73.1
Non-Hispanic black	15.0	13.9
Hispanic	12.1	7.0
Multiracial/other race	7.7	8.7
Low SES, % ^a	35.8	42.0
Depression or anxiety, %	3.1	28.0

Data were weighted to represent children aged 5 to 17 years nationally. 95% CIs around proportions are within ± 5 percentage points.

^a Low SES was defined as <200% of the Federal Poverty Line according to Department of Health and Human Services guidelines.

Data source: Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey, National Survey for Children's Health, 2003.

We found that ADD/ADHD and medication use were associated with weight status in the children and adolescents independent of the effect of gender, age, race/ethnicity, SES, or depression or anxiety. Children and adolescents with ADD/ADHD who were not using medications at the time had 1.5 times the odds for overweight (Table 2) compared with the children and adolescents without ADD/ADHD. The children and adolescents with ADD/ADHD tended to have increased odds of being at risk for overweight (OR: 1.13; Table 2). Compared with the children and adolescents without ADD/ADHD, those with ADD/ADHD who were taking medications had ~1.6 times the odds of being underweight (Table 2). Those who were taking medications for ADD/ADHD were not at increased odds for being either at risk of overweight or overweight.

DISCUSSION

We found that children and adolescents with ADD/ADHD who do not currently take medications are at increased risk for being overweight and that children and adolescents who currently take medication for ADD/ADHD are more likely to be underweight than children and adolescents without ADD/ADHD. Our finding that unmedicated children and adolescents with ADD/ADHD are more likely to be overweight is in accordance with previous research that linked overweight and ADD/ADHD.^{7,10,13,17,33,34} Because weight loss and reduced appetite are known adverse effects of common stimulant medications used to treat ADD/ADHD,^{8,9} the finding that the children and adolescents on medication for ADD/ADHD were more likely to be underweight was expected. However, we were unable to explore medication use further, because the NSCH did not obtain information about the type and timing of medication use.

From these findings, we suggest a possible mechanism by which ADD/ADHD and medication use may influence weight status in children and adolescents. It has been suggested that the impulsivity and poor behavioral regulation often found in youth with ADD/ADHD

TABLE 2 Results From Polytomous Logistic Regression: Weight Status in Children and Adolescents in Relation to Diagnosis of ADD/ADHD and Medication Use

	Underweight OR (95% CI)	At Risk of Overweight OR (95% CI)	Overweight OR (95% CI)
ADD/ADHD (unadjusted)			
ADD/ADHD, not currently medicated	0.92 (0.65–1.28)	1.08 (0.88–1.32)	1.35 (1.12–1.62)
ADD/ADHD, currently medicated	1.48 (1.20–1.81)	0.95 (0.81–1.12)	1.02 (0.86–1.20)
No ADD/ADHD	(Referent)	(Referent)	(Referent)
ADD/ADHD (adjusted) ^a			
ADD/ADHD, not currently medicated	1.25 (0.89–1.75)	1.13 (0.92–1.39)	1.51 (1.24–1.86)
ADD/ADHD, currently medicated	1.63 (1.30–2.04)	0.92 (0.77–1.09)	0.94 (0.78–1.13)
No ADD/ADHD	(Referent)	(Referent)	(Referent)
Gender			
Male	1.26 (1.12–1.41)	1.22 (1.13–1.33)	1.57 (1.45–1.70)
Female	(Referent)	(Referent)	(Referent)
Age ^b	0.83 (0.82–0.85)	0.93 (0.92–0.94)	0.82 (0.81–0.83)
Race/ethnicity			
Non-Hispanic black	1.29 (1.08–1.54)	1.42 (1.26–1.61)	2.53 (2.26–2.82)
Hispanic	1.19 (0.98–1.44)	1.32 (1.14–1.51)	1.75 (1.54–1.99)
Multiracial/other race	1.38 (1.05–1.80)	1.11 (0.91–1.36)	1.18 (0.98–1.42)
Non-Hispanic white	(Referent)	(Referent)	(Referent)
SES ^c			
Low SES	1.22 (1.07–1.39)	1.28 (1.17–1.40)	1.69 (1.55–1.83)
Not low SES	(Referent)	(Referent)	(Referent)
Depression or anxiety			
Yes	0.80 (0.59–1.07)	1.11 (0.92–1.33)	1.48 (1.23–1.77)
No	(Referent)	(Referent)	(Referent)

The reference group is children and adolescents of normal weight as determined by BMI for age and gender.

^a ORs were adjusted for all other variables in the regression.

^b OR for children 1 year older.

^c Low SES was defined as <200% of the federal poverty line according to Department of Health and Human Services guidelines.

Data source: Centers for Disease Control and Prevention, National Center for Health Statistics, State and Local Area Integrated Telephone Survey, National Survey for Children's Health, 2003.

may lead to the development of eating patterns that put youth at increased risk for obesity.⁷ In addition, youth with ADD/ADHD, especially those who are not taking medications for the condition, may spend more time watching television or playing computer or video games.

This study has several strengths. Our results are generalizable to children and adolescents across the United States. Previous research included children and adolescents from tertiary clinics for children with developmental or psychiatric disorders^{10,11} or inpatient units for children and adolescents with eating disorders or weight problems,⁷ included only boys,¹⁰ or were conducted in other countries (eg, Germany,^{10,34} Israel,⁷ Spain,¹² and China¹³). Our sample was drawn from the general population of the United States, thus minimizing the selection biases of clinical samples. In addition, we explored medication use and distinguished between underweight and normal weight.¹⁷ Our results confirm previous research on the prevalence and correlates of childhood obesity. Our prevalence estimates of 15% at risk of overweight and 20% overweight among youth aged 5 to 17 years are similar to prevalence estimates based on measured height and weight.^{24,35} Non-Hispanic black and Hispanic youth and those who had low SES were more likely to be at risk of overweight or overweight compared with non-Hispanic white youth and youth with higher SES.^{19,23–26} Our findings also agree with literature

that linked depression and the development of childhood overweight.^{2,31}

The limitations of this study relate primarily to limitations in the NSCH. Because of the cross-sectional nature of the NSCH, we cannot determine the temporal relationship between ADD/ADHD and weight status. The NSCH calculated BMI by using height and weight reported by the parent/guardian respondent,¹⁴ which may be less accurate than measured height and weight.³⁶ The NSCH and other large population-based surveys^{16,17} assessed ADD/ADHD by asking parent/guardian respondents whether a doctor or health professional had ever told them that their child had ADD/ADHD rather than conducting standardized clinical interviews with each respondent. We estimated the national prevalence of ADD/ADHD among 5- to 17-year-olds to be 8.8%, which is similar to estimates from population-based surveys that assessed ADD/ADHD by using clinical interviews.³⁷ Although the majority of medications prescribed for children and adolescents with ADD/ADHD are stimulants,^{38,39} we were unable to explore the effect of type or dosing of medication or medication history on weight status.

CONCLUSIONS

Both the management of ADD/ADHD and the prevention of childhood obesity are important topics in the field of pediatric research and health care.⁴⁰ This study pro-

vides heightened awareness for pediatric providers that children and adolescents with ADD/ADHD who are not currently taking medication may be at increased risk for overweight compared with children and adolescents without ADD/ADHD. In light of these findings, children and adolescents with ADD/ADHD should be monitored for overweight and underweight/weight loss. By monitoring weight status of these youth, clinicians will be better prepared to prevent the development of childhood obesity and the negative physical health¹⁻³ and psychosocial^{1,2,4,5} consequences. Future work is needed to better understand the longitudinal and pharmacologic factors that influence the relationship between ADD/ADHD and weight status in children and adolescents.

ACKNOWLEDGMENT

We are grateful to Karen L. Schneider, PhD, for assistance with SUDAAN.

REFERENCES

- Centers for Disease Control and Prevention, Division of Adolescent and School Health. Health schools: healthy youth! Available at: www.cdc.gov/HealthyYouth. Accessed December 8, 2005
- Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. *JAMA*. 2003;289(14):1813-1819
- Wright CM, Parker L, Lamont D, Craft AW. Implications of childhood obesity for adult health: findings from thousand families cohort study. *BMJ*. 2001;323(7324):1280-1284
- Falkner NH, Neumark-Sztainer D, Story M, Jeffery RW, Beuhring T, Resnick MD. Social, educational, and psychological correlates of weight status in adolescents. *Obes Res*. 2001;9(1):32-42
- Strauss RS. Childhood obesity and self-esteem. *Pediatrics*. 2000;105(1). Available at: www.pediatrics.org/cgi/content/full/105/1/e15
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4th ed. Washington, DC: American Psychiatric Association; 2000
- Agranat-Meged AN, Deitcher C, Goldzweig G, Leibenson L, Stein M, Galili-Weisstub E. Childhood obesity and attention deficit/hyperactivity disorder: a newly described comorbidity in obese hospitalized children. *Int J Eat Disord*. 2005;37(4):357-359
- Poulton A, Cowell CT. Slowing of growth in height and weight on stimulants: a characteristic pattern. *J Paediatr Child Health*. 2003;39(3):180-185
- Barkley RA, McMurray MB, Edelbrock CS, Robbins K. Side effects of methylphenidate in children with attention deficit hyperactivity disorder: a systemic, placebo-controlled evaluation. *Pediatrics*. 1990;86(2):184-192
- Holtkamp K, Konrad K, Müller B, et al. Overweight and obesity in children with attention-deficit/hyperactivity disorder. *Int J Obes Relat Metab Disord*. 2004;28(5):685-689
- Curtin C, Bandini LG, Perrin EC, Tybor DJ, Must A. Prevalence of overweight in children and adolescents with attention deficit hyperactivity disorder and autism spectrum disorders: a chart review. *BMC Pediatr*. 2005;5:48
- Rojo L, Ruiz E, Domínguez JA, Calaf M, Livianos L. Comorbidity between obesity and attention deficit/hyperactivity disorder: population study with 13-15-year-olds. *Int J Eat Disord*. 2006;39(6):519-522
- Lam LT, Yang L. Overweight/obesity and attention deficit and hyperactivity disorder tendency among adolescents in china. *Int J Obes (Lond)*. 2007;31(4):584-590
- Blumberg SJ, Olson L, Frankel MR, Osborn L, Srinath KP, Giambo P. Design and operation of the National Survey of Children's Health, 2003. *Vital Health Stat*. 2005;(43)
- Schertz M, Adelman AR, Alfieri NE, Bienkowski RS. Predictors of weight loss in children with attention deficit hyperactivity disorder treated with stimulant medication. *Pediatrics*. 1996;98(4 pt 1):763-769
- Dey AN, Schiller JS, Tai DA. Summary health statistics for U.S. children: National health interview survey, 2002. *Vital Health Stat*. 2004;(221):1-78
- Bandini LG, Curtin C, Hamad C, Tybor DJ, Must A. Prevalence of overweight in children with developmental disorders in the continuous National Health and Nutrition Examination Survey (NHANES) 1999-2002. *J Pediatr*. 2005;146(6):738-743
- Centers for Disease Control and Prevention. Overweight and obesity. Available at: www.cdc.gov/nccdphp/dnpa/obesity. Accessed December 12, 2005
- Wang Y. Cross-national comparison of childhood obesity: the epidemic and the relationship between obesity and socioeconomic status. *Int J Epidemiol*. 2001;30(5):1129-1136
- Haas JS, Lee LB, Kaplan CP, Sonneborn D, Phillips KA, Liang SY. The association of race, socioeconomic status, and health insurance status with the prevalence of overweight among children and adolescents. *Am J Public Health*. 2003;93(12):2105-2110
- Research Triangle Institute. *SUDAAN Language Manual*. Release 9. Research Triangle Park, NC: Research Triangle Institute; 2004
- Kutner MH, Nachtsheim CJ, Neter J, Li W. *Applied Linear Statistical Models*. 5th ed. New York, NY: McGraw-Hill Irwin; 2005
- Dwyer JT, Stone EJ, Yang M, et al. Prevalence of marked overweight and obesity in a multiethnic pediatric population: findings from the Child and Adolescent Trial for Cardiovascular Health (CATCH) study. *J Am Diet Assoc*. 2000;100(10):1149-1156
- Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA*. 2006;295(13):1549-1555
- Kimm SY, Obarzanek E, Barton BA, et al. Race, socioeconomic status, and obesity in 9- to 10-year-old girls: the NHLBI Growth and Health Study. *Ann Epidemiol*. 1996;6(4):266-275
- Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food-insufficient, low-income families: prevalence, health, and nutrition status. *Arch Pediatr Adolesc Med*. 2001;155(4):508-514
- Seahill L, Schwab-Stone M, Merikangas KR, Leckman JF, Zhang H, Kasl S. Psychosocial and clinical correlates of ADHD in a community sample of school-age children. *J Am Acad Child Adolesc Psychiatry*. 1999;38(8):976-984
- Wolraich ML, Hannah JN, Pinnock TY, Baumgaertel A, Brown J. Comparison of diagnostic criteria for attention-deficit hyperactivity disorder in a county-wide sample. *J Am Acad Child Adolesc Psychiatry*. 1996;35(3):319-324
- St Sauver JL, Barbaresi WJ, Katusic SK, Colligan RC, Weaver AL, Jacobsen SJ. Early life risk factors for attention-deficit/hyperactivity disorder: a population-based cohort study. *Mayo Clin Proc*. 2004;79(9):1124-1131
- Biederman J, Monuteaux MC, Mick E, et al. Psychopathology in females with attention-deficit/hyperactivity disorder: a controlled, five-year prospective study. *Biol Psychiatry*. 2006;60(10):1098-1105
- Goodman E, Whitaker RC. A prospective study of the role of depression in the development and persistence of adolescent obesity. *Pediatrics*. 2002;110(3):497-504
- Pedlow S, Luke JV, Blumberg SJ. *Multiple Imputation of Missing*

Household Poverty Level Values From the National Survey of Children With Special Health Care Needs, 2001, and the National Survey of Children's Health, 2003. Hyattsville, MD: Department of Health and Human Services, Centers for Disease Control and Prevention; 2007

33. Troiano RP, Flegal KM. Overweight children and adolescents: description, epidemiology, and demographics. *Pediatrics*. 1998; 101(3 pt 2):497–504
34. Hubel R, Jass J, Marcus A, Laessle RG. Overweight and basal metabolic rate in boys with attention-deficit/hyperactivity disorder. *Eat Weight Disord*. 2006;11(3):139–146
35. Swallen KC, Reither EN, Haas SA, Meier AM. Overweight, obesity, and health-related quality of life among adolescents: the National Longitudinal Study of Adolescent Health. *Pediatrics*. 2005;115(2):340–347
36. Huybrechts I, De Bacquer D, Van Trimpont I, De Backer G, De Henauw S. Validity of parentally reported weight and height for preschool-aged children in Belgium and its impact on classification into body mass index categories. *Pediatrics*. 2006;118(5): 2109–2118
37. Barbaresi WJ, Katusic SK, Colligan RC, et al. How common is attention-deficit/hyperactivity disorder? Incidence in a population-based birth cohort in Rochester, Minn. *Arch Pediatr Adolesc Med*. 2002;156(3):217–224
38. Hoagwood K, Kelleher KJ, Feil M, Comer DM. Treatment services for children with ADHD: a national perspective. *J Am Acad Child Adolesc Psychiatry*. 2000;39(2):198–206
39. Zito JM, Safer DJ, DosReis S, Magder LS, Gardner JF, Zarin DA. Psychotherapeutic medication patterns for youths with attention-deficit/hyperactivity disorder. *Arch Pediatr Adolesc Med*. 1999;153(12):1257–1263
40. Chien A, Coker T, Choi L, et al. What do pediatric primary care providers think are important research questions? A perspective from PROS providers. *Ambul Pediatr*. 2006;6(6):352

Overweight in Children and Adolescents in Relation to Attention-Deficit/Hyperactivity Disorder: Results From a National Sample

Molly E. Waring and Kate L. Lapane

Pediatrics 2008;122:e1

DOI: 10.1542/peds.2007-1955

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/122/1/e1.full.html
References	This article cites 31 articles, 7 of which can be accessed free at: http://pediatrics.aappublications.org/content/122/1/e1.full.html#ref-list-1
Citations	This article has been cited by 12 HighWire-hosted articles: http://pediatrics.aappublications.org/content/122/1/e1.full.html#related-urls
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Development/Behavioral Issues http://pediatrics.aappublications.org/cgi/collection/development:behavioral_issues_sub Attention-Deficit/Hyperactivity Disorder (ADHD) http://pediatrics.aappublications.org/cgi/collection/attention-deficit:hyperactivity_disorder_adhd_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://pediatrics.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://pediatrics.aappublications.org/site/misc/reprints.xhtml

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2008 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

