TRENDS

Effects Of Childhood Obesity On Hospital Care And Costs, 1999–2005

Estimating the social costs of obesity allows us to determine whether investment in various interventions would be worth considering.

by Leonardo Trasande, Yinghua Liu, George Fryer, and Michael Weitzman

ABSTRACT: Childhood obesity is increasingly recognized as an epidemic, but the economic consequences have not been well quantified. We evaluated trends in obesity-associated hospitalizations, charges, and costs using 1999–2005 data from a nationally representative sample of admissions to U.S. hospitals. We detected a near-doubling in hospitalizations with a diagnosis of obesity between 1999 and 2005 and an increase in costs from $125.9 million to 237.6 million (in 2005 dollars) between 2001 and 2005. Medicaid appears to bear a large burden of hospitalizations for conditions that occur along with obesity, while private payers pay a greater portion of hospitalization costs to treat obesity itself. [*Health Affairs* 28, no. 4 (2009): w751–w760 (published online 9 July 2009; 10.1377/hlthaff.28.4.w751)]

OBESITY IS A MAJOR epidemic among American children.[1] Recent data suggest that the prevalence of obesity (defined by an American Medical Association [AMA] expert panel as body mass index [BMI], at or above the ninety-fifth percentile for age and sex)[2, 3] among children did not increase during the period 1999–2006.[4] However, it is not known whether the economic burden associated with childhood obesity has reached a similar plateau. Guijing Wang and William Dietz found that annual costs of obesity-associated hospitalizations for children and youth ages 6–17 increased from $35 million in 1979–1981 to $127 million in 1997–1999,[5] but no studies have analyzed subsequent trends in the economic burden of obesity-associated hospitalizations.

Since Wang and Dietz analyzed data from the National Hospital Discharge Survey (NHDS), the Nationwide Inpatient Sample (NIS) has emerged as the largest all-payer database for U.S. hospitalizations.[6] Trend analyses must be interpreted with caution because increases in coding and recognition of obesity as a contributor to disease could be major confounders. Even if confounding is extensive, then analyses of more recent data permit policymakers and practitioners to quantify more accurately obesity's impact on the health

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of children and to identify who bears the costs of hospitalization for obesity and other conditions that often accompany it.

We therefore analyzed data from the 1999–2005 NIS to determine whether obesity-associated hospitalizations (defined as discharges for which obesity was listed as a diagnosis)[7] have continued to increase. We also quantified the charges and economic costs of these hospitalizations, identified predictors of hospitalization with a diagnosis of obesity, and measured the impact of diagnosed obesity on lengths-of-stay, costs, and charges.

Study Data And Methods

■ **Data.** We constructed a multiyear data file from the 1999–2005 NIS data. A stratified sample approximating one-fifth of U.S. community hospitals is selected for each year; details regarding sample design, data collection, and weighting are described elsewhere.[6] Data from 3.1 million discharges of children ages 2–19 were included in our analysis. This research involved data that were already collected and deidentified, and, therefore, it was exempted from review by the Mount Sinai School of Medicine Institutional Review Board.

■ **Methods.** Discharge diagnoses and procedures were coded in accordance with the *International Classification of Diseases,* Ninth Revision (ICD-9). ICD-9 codes 278.00 or 278.01 were used to identify discharges with a primary or other (secondary) diagnosis of obesity. The Clinical Classifications Software (CCS) tool was used to cluster ICD-9 diagnoses into a manageable number of clinically meaningful categories. CCS categories 49 and 50 (diabetes mellitus with and without complications) were unified for this analysis, as were all pregnancy-related conditions (categories 181–196).

In all bivariate and multivariable analyses, each of the following independent variables was used: age (categorized as ages 2–5, 6–11, and 12–19, in the same way prevalence estimates for obesity are commonly presented in the literature),[1] sex, race/ethnicity, expected primary payer, hospital location, hospital teaching status, median household income for patient's ZIP code (defined by quartiles), and hospital region.[8] Frequencies of hospitalization are reported as a weighted number or percentage for a given year or for the period 1999–2005.[9]

Charges were adjusted to 2005 dollars to account for inflation using the Medical Care Consumer Price Index[10] and converted to costs using hospital-specific cost-to-charge ratios from the Centers for Medicare and Medicaid Services (CMS) for 2001–2005 (these are not available for 1999–2000).[11] Because of their skewed distribution, bivariate and multivariable analyses were performed after log(base 10)–transformation of lengths-of-stay, costs, and charges.

To identify demographic and hospital factors associated with more frequent hospitalization with a primary/secondary diagnosis of obesity, multivariable logistic regressions were performed with a primary/secondary diagnosis of obesity as the dependent variable and the above independent variables (regardless of their significance on bivariate analysis). By including the year in the model, we endeavored to quantify annual increases in hospitalization with a primary/secondary diagnosis of obesity, controlling for hospital and demographic factors.

We also identified the eleven most frequent CCS diagnoses for which obesity was a secondary diagnosis, and we evaluated whether obesity was increasing as a comorbidity for these diagnostic categories. To take time trends in the primary diagnoses into account, we separately assessed increases in hospitalizations for the primary CCS diagnosis and for the combination of the primary CCS diagnosis plus obesity as a secondary diagnosis during 1999–2005. To assess for changes in discharges with the primary CCS diagnosis, we performed logistic regressions with presence of the primary CCS diagnosis as the dependent variable. To determine whether annual increases in hospitalizations for which both the primary CCS and secondary obesity diagnoses occurred, we performed logistic regressions with simultaneous presence of the primary CCS diagnosis and obesity as a secondary diagnosis as the dependent variable. We con-

trolled for hospital and demographic factors by including them in the model, and we included the year to measure annual changes for increases in the frequency of these hospitalizations over time. Statistical analyses were conducted using SAS 9.1.3 and SUDAAN 9.0.3 to account for the complex sample design used in the NIS.

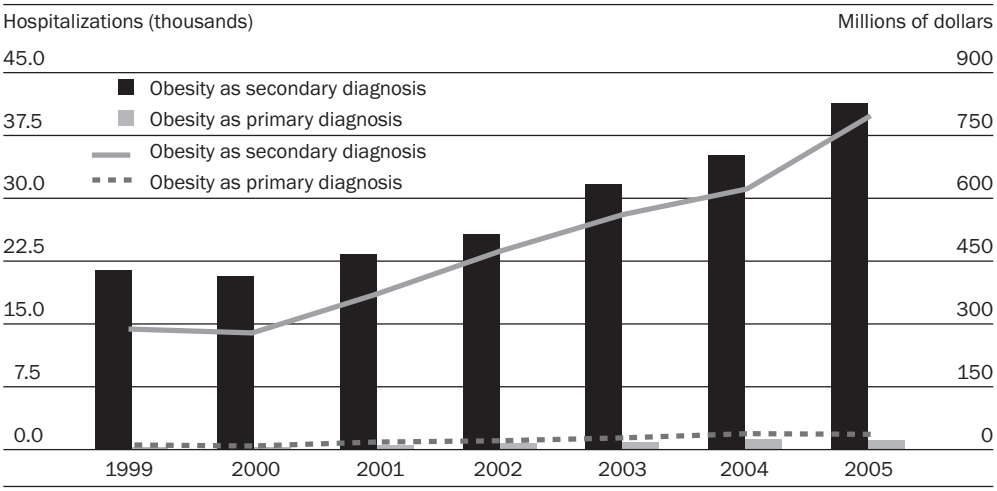
Study Results

We detected an increase in the number of hospitalizations of children and youth ages 2–19 for which obesity was listed as a diagnosis, from 21,743 in 1999 to 42,429 in 2005 (Exhibit 1). Charges for hospitalizations with a primary diagnosis of obesity increased by 66.3 percent annually, while charges for hospitalizations with obesity as a secondary diagnosis increased 48.0 percent annually. Total costs for hospitalizations with any diagnosis of obesity increased from $125.9 million in 2001 to $237.6 million in 2005 (2005 dollars). Although hospitalizations for which obesity was a primary and secondary diagnosis increased 23.9 percent and 11.5 percent per year (respectively, both $p < 0.0001$) between 1999 and 2005, charges increased 42.4 percent and 36.5 percent per year, respectively, for primary and secondary diagnosis as a result of utilization per obesity-associated hospitalization.

Among hospitalizations for which obesity was listed as a secondary diagnosis, affective disorders were the most frequent primary diagnoses (Exhibit 2), followed by pregnancy-associated conditions, asthma, and diabetes. Depressive disorder, not otherwise classified, was the most common diagnosis in the "other mental disorders" category, and the leading diagnosis in the "other bone disorders" hospitalization group was slipped capital femoral epiphysis (SCFE; ICD-9 732.1–2), a well-known comorbidity of childhood obesity.[12]

Controlled for potential confounders, statistically significant increases in obesity-associated hospitalizations were detected for asthma, pregnancy-related conditions, diabetes, pneumonia, skin/subcutaneous tissue infections, appendicitis, other mental disorders, and biliary tract disease. None of these increases could be explained by increases in hospitalizations for the primary condition. Asthma hospitalizations decreased by 3.9 per-

EXHIBIT 1
Trends In Hospitalizations And Charges Among Children And Youth Ages 2–19, Where Obesity Was A Primary Or Secondary Diagnosis, In 2005 Dollars, 1999–2005



SOURCE: Authors' analysis of data from the National Inpatient Sample (NIS), 1999–2005.
NOTES: Hospitalizations (thousands) are represented by bars and relate to the left-hand *y* axis. Millions of dollars in hospitalization charges are represented by the line graph and relate to the right-hand *y* axis.

EXHIBIT 2
Trends In Primary Diagnosis Among Obesity-Associated Hospitalizations, 1999–2005

CCS diagnosis (number)	Obesity-associated hospitalizations, 1999–2005	Percent of all hospitalizations in CCS diagnoses for which obesity was a secondary diagnosis, 1999–2005	Annual percent change in frequency of obesity-associated hospitalization in this CCS diagnosis (95% CI)[a]	Annual percent change in frequency of all hospitalizations in this CCS diagnosis (95% CI)[a]
Affective disorders (69)	29,074	4.47	+5.7 (−0.4, +12.1)	−1.0 (−4.9, +3.0)
Pregnancy-related conditions (181–196)	18,086	0.51	+11.7 (+6.7, +16.9)****	−7.4 (−9.5, −5.3)****
Asthma (128)	16,257	1.94	+7.2 (+3.9 +10.5)****	−3.9 (−5.3, −2.5)****
Diabetes mellitus (49 and 50)	9,503	3.70	+12.7 (+8.0, +17.7)****	+4.5 (+2.7, +6.3)****
Appendicitis (142)	7,801	1.22	+17.1 (+12.4, +21.9)****	+2.5 (+1.2, +3.9)***
Other mental disorders (74)	7,455	2.73	+12.2 (+5.3, +19.5)***	−0.9 (−4.5, +2.8)
Pneumonia (122)	5,679	0.83	+10.4 (+7.0, +13.9)****	−0.0 (−1.2, +1.2)
Skin and subcutaneous infections (197)	5,914	2.26	+22.2 (+17.3, +27.3)****	+11.6 (+9.1, +14.1)****
Biliary tract disease (149)	5,663	6.89	+17.9 (+13.8, +22.2)****	+3.6 (+2.2, +5.0)****
Schizophrenia (70)	4,808	7.26	+2.4 (−2.8, +8.0)	−3.9 (−6.9, −0.8)**
Other bone diseases (212)	4,319	4.36	+5.9 (−0.2, +12.3)	+1.6 (−1.4, +4.8)

SOURCE: Authors' analysis of data from the National Inpatient Sample (NIS), 1999–2005.

NOTES: CCS is Clinical Classifications Software. CI is confidence interval.

[a] Controlled for race/ethnicity, hospital location, hospital teaching status, hospital region, age group, sex, primary expected payer, and income quartile for patient ZIP code.

$^{**}p < 0.05$ $^{***}p < 0.01$ $^{****}p < 0.0001$

cent annually, pregnancy-related hospitalizations decreased by 7.4 percent annually, and hospitalizations for other mental disorders and pneumonia did not increase. Although hospitalizations for diabetes, appendicitis, skin/subcutaneous tissue infections, and biliary tract disease did increase over the same time period, the annual increases for obesity-associated hospitalizations within these diagnostic categories consistently exceeded the annual increases in all hospitalizations (confidence intervals did not overlap).

In our multivariate analyses,[13] major differences were noted in the logistic regression results between hospitalization with a primary diagnosis and hospitalization with a secondary diagnosis of obesity (Exhibit 3). Private insurance and self-pay status were both associated with higher frequency of hospitalization with a primary diagnosis of obesity and lower frequency of hospitalization for secondary diagnosis of obesity. Hispanic ethnicity was inversely associated with primary diagnosis of obesity, while those in the lower income quartile and blacks/Native Americans were more frequently hospitalized with a secondary diagnosis of obesity. The only major consistencies across primary and secondary diagnosis were

EXHIBIT 3
Characteristics Of Hospitalizations Of Children And Youth Ages 2–19 Admitted With A Primary Or Secondary Diagnosis of Obesity (Multivariate Logistic Regression Analysis), 1999–2005

	Odds ratio (95% CI) for hospitalization with primary diagnosis of obesity	Odds ratio (95% CI) for hospitalization with secondary diagnosis of obesity
Year	1.26 (1.18, 1.35)****	1.11 (1.09, 1.13)****
Race/ethnicity		
White	Reference	Reference
Black	0.78 (0.59, 1.02)	1.48 (1.38, 1.58)****
Hispanic	0.55 (0.41, 0.76)****	1.05 (0.95, 1.16)
Asian/Pacific Islander	0.17 (0.07, 0.44)****	0.74 (0.57, 0.95)**
Native American	1.46 (0.63, 3.39)	1.28 (1.03, 1.59)**
Other	1.05 (0.70, 1.56)	1.13 (0.86, 1.47)
Unreported	0.78 (0.52, 1.16)	0.99 (0.90, 1.10)
Sex		
Male	0.55 (0.47, 0.64)****	1.24 (1.20, 1.29)****
Female	Reference	Reference
Unreported	0.15 (0.02, 1.13)	0.72 (0.54, 0.95)**
Age group		
2–5	Reference	Reference
6–11	1.42 (0.88, 2.28)	4.81 (4.49, 5.16)****
12–19	12.24 (6.68, 22.44)****	7.16 (6.59, 7.78)****
Location		
Rural	0.24 (0.13, 0.47)****	0.81 (0.71, 0.92)***
Urban	Reference	Reference
Region of hospital		
Northeast	Reference	Reference
Midwest	0.50 (0.29, 0.85)**	1.19 (1.02, 1.38)**
South	0.67 (0.45, 1.01)	1.10 (0.96, 1.26)
West	0.93 (0.55, 1.59)	1.20 (1.04, 1.39)**
Median income for patient's ZIP code		
Quartile 1	0.90 (0.64, 1.27)	1.37 (1.25, 1.51)****
Quartile 2	0.88 (0.67, 1.15)	1.30 (1.23, 1.39)****
Quartile 3	0.85 (0.69, 1.04)	1.24 (1.18, 1.31)****
Quartile 4	Reference	Reference
Unreported	0.73 (0.43, 1.23)	1.35 (1.14, 1.59)****
Primary expected payer		
Medicare	0.79 (0.11, 5.58)	1.08 (0.81, 1.44)
Medicaid	Reference	Reference
Private insurance	4.60 (3.54, 5.98)****	0.89 (0.85, 0.94)****
Self-pay	4.09 (2.63, 6.38)****	0.81 (0.73, 0.91)****
No charge	3.20 (0.94, 10.96)	0.64 (0.64, 0.96)**
Other	3.51 (2.30, 5.37)****	1.07 (0.97, 1.18)
Teaching status of hospital		
Nonteaching	Reference	Reference
Teaching	1.06 (0.79, 1.42)	1.12 (1.02, 1.23)**

SOURCE: Authors' analysis of data from the National Inpatient Sample (NIS), 1999–2005.
NOTES: CCS is Clinical Classifications Software. CI is confidence interval.
$^{**}p < 0.05$ $^{***}p < 0.01$ $^{****}p < 0.0001$

regional variability and the inverse association of hospitalization with Asian American ancestry. Controlling for potential confounders in the regression analysis, 26 percent and 11 percent annual increases, respectively, in hospitalizations with primary and secondary diagnoses of obesity were identified. Hospitalizations for comorbidities of obesity increased 8.8 percent per year among children ages 2–5, 10.4 percent among children ages 6–11, and 11.4 percent among adolescents.

Exhibit 4 presents regression analysis of lengths-of-stay, charges, and costs for hospitalizations of children and youth ages 2–19 in the 1999–2005 NIS. Obesity as a secondary diagnosis was associated with a mean 0.85 day increase in length-of-stay, a $1,634 increase in charges, and a $727 increase in costs (all $p < 0.0001$). Obesity was associated with significantly greater lengths-of-stay,

EXHIBIT 4
Lengths-Of-Stay, Charges, And Costs For Hospitalizations Among Children And Youth Ages 2–19 With A Secondary Diagnosis Of Obesity (Regression Analysis), 1999–2005

Diagnostic category	Increment (95% CI) in length-of-stay associated with secondary diagnosis of obesity (days)[a]	Increment (95% CI) in charges associated with secondary diagnosis of obesity[a]	Increment (95% CI) in costs associated with secondary diagnosis of obesity[a]
All hospitalizations	+0.85 (+.74, +.97)****	+$1,634 (+1,281 to +2,048)****	+$727 (+468 to +1,068)
Pregnancy-related conditions	+0.73 (+0.61, +0.86)****	+3,265 (+2,488, +4,208)****	+2,319 (+1,520, +3,434)****
Affective disorders	+0.45 (+0.22, +0.75)****	+1,847 (+756, +3,340)****	+1,031 (+261, +2,234)***
Asthma	+0.72 (+0.60, +0.85)****	+2,859 (+2,104, +3,762)****	+1,479 (+789, +2,436)****
Diabetes	+0.87 (+0.64, +1.14)****	+79 (−511, +891)	−98 (−484, +552)
Appendicitis	+0.78 (+0.52, +1.07)****	+2,683 (+1,816, 3,686)****	+995 (+490, +1,635)****
Other mental disorders	+0.24 (−0.08, +0.73)	+2,058 (+284, +4,837)**	+995 (−10, +2,876)
Pneumonia	+0.13 (+0.00, +0.28)**	+1,300 (+629, +2,148)****	+679 (+177, +1,386)***
Skin and subcutaneous infections	+0.83 (+0.63, +1.05)****	+3,287 (+2,230, +4,602)****	+1,554 (+954, +2,340)****
Biliary tract disease	+0.18 (+0.00, +0.41)**	+1,070 (+398, +1,971)****	+677 (+101, +1,764)**
Schizophrenia	−0.12 (−0.20, +0.02)	−248 (−928, +932)	−245 (−733, +822)
Other bone disorders	−0.26 (−0.37, −0.10)***	−2,110 (−2,215, −1,742)****	−603 (−1.290, −207)****
SCFE	+0.92 (+.039, +1.71)****	+3,365 (+663, 8,212)***	+1,700 (+186, +4,963)**

SOURCE: Authors' analysis of data from the National Inpatient Sample (NIS), 1999–2005.

NOTES: CI is confidence interval. SCFE is slipped capital femoral epiphysis.

[a] Controlled for race/ethnicity, hospital location, hospital teaching status, hospital region, age group, gender, primary expected payer, and income quartile for patient ZIP code.

$^{**}p < 0.05$ $^{***}p < 0.01$ $^{****}p < 0.001$

charges, and costs, and for affective disorders, asthma, pregnancy-related conditions, pneumonia, appendicitis, biliary tract disease, and skin and subcutaneous infections. Obesity was associated with increases in charges but in neither lengths-of-stay nor costs for other mental disorders. For diabetes, an increase in lengths-of-stay was detected, but no significant increase in charges or costs was found. For other bone disorders, a secondary diagnosis of obesity was associated with a decrease in lengths-of-stay, charges, and costs. When the subset of SCFE diagnoses were analyzed, however, a secondary diagnosis of obesity was associated with significant increases in lengths-of-stay, charges, and costs.

"A diagnosis of obesity does not routinely result in additional reimbursement or risk adjustment."

Discussion And Policy Implications

We detected a near-doubling in hospitalizations of U.S. children with a diagnosis of obesity between 1999 and 2005. Whereas obesity prevalence did not increase over the same time span, charges for obesity-associated hospitalizations more than doubled, and inflation-adjusted economic costs increased on the order of 90 percent over the period 2001–2005.

Obesity as a diagnosis is different from the AMA definitions of *overweight* and *obese*.[2, 3] Diagnosis is a product of clinical judgment and reimbursement by hospital payers and is subject to inaccuracy. The trends described are to be interpreted with caution because they could represent trends in diagnosis rather than an increase in patients in which obesity is causing other medical conditions. Even if increased recognition has contributed to these trends, our analysis suggests that obesity has a much more immediate impact on the health of children, especially adolescents, than previously understood.

The CMS only officially recognized obesity as an illness in late 2004,[14] and a diagnosis of obesity does not routinely result in additional reimbursement or risk adjustment. Obesity is unlikely to be included to justify an adverse outcome that might have occurred, because coding is unlikely to protect from litigation or otherwise exaggerate the impact of obesity on lengths-of-stay, charges, or costs. However, providers may reserve a diagnosis of obesity for those most severely affected. This possibility merits further study using data sets that measure BMI, or consideration of adding BMI to the NIS.

As a conservative measure, we included only hospitalizations for which obesity was listed as a primary or secondary diagnosis, whereas Wang and Dietz[5] also included all hospitalizations for gallbladder disease and obstructive sleep apnea. We therefore may have underestimated charges and costs of obesity-associated hospitalizations. For example, increases in hospitalization for children and young adults with diabetes have been documented and are likely to be related to increases in obesity prevalence.[15]

Another major finding of this study is that obesity remains undercoded, despite increasing awareness among providers. If obesity prevalence among children with asthma is roughly equal to that for all American children, then one would expect about 20 percent of children hospitalized with asthma to be obese, yet we found less than 2 percent of asthma hospitalizations with obesity listed as a comorbidity. Obesity may also be undercoded when it is involved with the incidence of a hospitalization. For example, obesity is known to contribute to cholelithiasis,[16] yet obesity was coded in only less than 7 percent of hospitalizations for biliary tract disease.

Our analysis identified continued increases in obesity-associated hospitalizations for asthma, diabetes, and gallbladder disease as well as a broader array of disease categories. Obesity during pregnancy has been identified as a risk factor for a host of perinatal complications,[17–22] and increases in hospitalizations for skin infections are not surprising, given that obesity can greatly affect skin functioning and

has been implicated in a number of dermatologic conditions.[23] Although obesity is not a risk factor for appendicitis, it has been associated with increased risk of postoperative complications[24] and increased charges.[25] Obesity may also result in selection of inpatient rather than outpatient postoperative management.

Increases in other mental disorders complicated by obesity also merit further attention, especially because obesity has been documented to carry a strong social stigma.[26, 27] The magnitude of obesity as exacerbating or precipitating mental health conditions such as depression in children is largely unknown. The relative infrequency of obesity-associated hospitalizations for obstructive sleep apnea contrasts with the findings of Wang and Dietz[5] and may be the result of increasing outpatient management.

"Obesity-related hospitalizations cost Medicaid $118.1 million in 2005, up from $53.6 million in 2001."

Use of the NIS data is complicated by the frequent absence of race/ethnicity data. Thus, the simultaneous finding of more frequent hospitalization with obesity as a primary diagnosis (that is, for obesity treatment) among whites along with more frequent hospitalization with secondary diagnosis of obesity (that is, for comorbidities of obesity) among blacks and Native Americans should be interpreted with caution. However, our results are consistent with well-described racial/ethnic disparities in the prevalence of obesity.[28, 29] Although income quartile for a patient's ZIP code does not necessarily represent a family's poverty status, the persistence of a relationship with a potential marker for socioeconomic status when race/ethnicity was included in the final model does suggest a separate relationship.

Medicaid appears to bear a large burden of hospitalizations with a secondary diagnosis of obesity, while private payers pay a greater portion of costs for hospitalizations with obesity as a primary diagnosis. Obesity-related hospitalizations cost Medicaid $118.1 million in 2005, up from $53.6 million in 2001—a 120 percent increase. Indeed, just as growth in the elderly population has contributed to increases in health care costs,[30] increasing obesity among children appears to be driving increases in Medicaid spending. Given the increasing burden of obesity-associated hospitalizations, our findings suggest that additional federal support of prevention programs could reduce obesity treatment costs borne by federal and state governments.

Obesity was associated with increases in charges and lengths-of-stay in more diagnostic categories than Susan Woolford and colleagues[25] examined in the 2000 Kids Inpatient Database. Our decision to study the impact of obesity on those diagnoses for which obesity was frequently a secondary diagnosis rather than those for which all children are frequently hospitalized augmented our capacity to assess differences over a broader range of conditions. Our choice of a heterogeneous CCS category with a disproportionate number of scoliosis hospitalizations appears to have skewed our results for "other bone disorders," and this hypothesis was confirmed when hospitalizations with a diagnosis of SCFE were analyzed.

Our analysis calculated aggregate charges for 1999–2005 and costs for 2001–2005, using historical cost-to-charge ratios. Wang and Dietz[5] calculated economic costs by multiplying an extrapolated mean cost per day against the number of hospital days for obesity-associated hospitalizations; thus, their findings cannot be compared with our results. Besides hospitalization, outpatient therapy and medication for obesity and its comorbidities represent additional burdens, and indirect costs such as lost school and workdays have not been fully quantified. Because obese children are at greater risk of adult obesity,[31–38] a portion of economic costs associated with adult obesity may also be attributable to childhood obesity.

Our analysis provides data that can be used to estimate the economic benefits of interventions. Continued research is needed to develop

successful initiatives to prevent and treat obesity; however, estimating the social costs allows us to determine whether investment in various interventions would be worth considering. As new methods are found to improve diet and physical activity, a framework in which to compare them will be extremely useful to policymakers and practitioners alike.

NOTES

1. 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 Apr 5;295(13):1549–55.
2. Centers for Disease Control and Prevention. About BMI for children and teens [Internet]. Atlanta (GA): CDC; 2009 Jan 27 [cited 2009 Jun 11]. Available from: http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html.
3. American Medical Association. Appendix: expert committee recommendations on the assessment, prevention, and treatment of child and adolescent overweight and obesity [Internet]. Chicago (IL): AMA; 2007 Jan 25 [cited 2009 Jun 11]. Available from: http://www.ama-assn.org/ama1/pub/upload/mm/433/ped_obesity_recs.pdf.
4. Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003–2006. JAMA. 2008 May 28;299(20):2401–5.
5. Wang G, Dietz WH. Economic burden of obesity in youths aged 6 to 17 years: 1979–1999. Pediatrics. 2002 May;109(5):E81–1.
6. Health Care Utilization Project. 1999–2005 Nationwide Inpatient Sample (NIS) [Internet]. Rockville (MD): Agency for Healthcare Research and Quality; 2007 Jul 11 [cited 2009 Jun 11]. Available from: http://www.hcup-us.ahrq.gov/nisoverview.jsp.
7. Although the CDC defines *overweight* by BMI for age and sex, the NIS does not provide data on BMI and relies on diagnostic codes. In the remainder of this paper we refer to "obesity-associated hospitalizations" as those for which obesity is a primary or secondary diagnosis.
8. With the exception of race/ethnicity, which was missing for 25.5 percent of observations, variables were missing in fewer than 2 percent of the cases.
9. Additional details regarding the methods are provided in the Appendix, online at http://content.healthaffairs.org/cgi/content/full/hlthaff.28.4.w751/DC2.
10. U.S. Department of Labor, Bureau of Labor Statistics. Consumer Price Index, Medical Care [Internet]. Washington (DC): BLS; 2008 Feb 8 [cited 2009 Jun 11]. Available from: http://data.bls.gov/cgi-bin/surveymost?cu.
11. Agency for Healthcare Research and Quality. Cost-to-charge ratio files: 2004 Nationwide Inpatient Sample (NIS) user guide [Internet]. Rockville (MD): AHRQ; 2008 Dec 12 [cited 2009 Jun 11]. Available from: http://www.hcup-us.ahrq.gov/db/state/costtocharge.jsp.
12. Manoff EM, Banffy MB, Winell JJ. Relationship between body mass index and slipped capital femoral epiphysis. J Pediatr Orthop. 2005 Nov–Dec;25(6):744–6.
13. Data and results of the bivariate analysis are presented in the Appendix, online as in Note 9.
14. U.S. Department of Health and Human Services [Internet]. Washington (DC): HHS. Press release, HHS announces revised Medicare obesity coverage policy; 2004 Jul 15 [cited 2009 Jun 11]; [about 2 screens]. Available from: http://www.hhs.gov/news/press/2004pres/20040715.html.
15. Lee JM, Okumura MJ, Freed GL, Menon RK, Davis MM. Trends in hospitalizations for diabetes among children and young adults: United States, 1993–2004. Diabetes Care. 2007 Dec;30(12):3035–9.
16. Palasciano G, Portincasa P, Vinciguerra V, Velardi A, Tardi S, Baldassarre G, et al. Gallstone prevalence and gallbladder volume in children and adolescents: an epidemiological ultrasonographic survey and relationship to body mass index. Am J Gastroenterol. 1989 Nov;84(11):1378–82.
17. Ehrenberg HM, Dierker L, Milluzzi C, Mercer BM. Prevalence of maternal obesity in an urban center. Am J Obstet Gynecol. 2002 Nov;187(5):1189–93.
18. Baeten JM, Bukusi EA, Lambe M. Pregnancy complications and outcomes among overweight and obese nulliparous women. Am J Public Health. 2001;Mar;91(3):436–40.
19. Dempsey J, Ashiny Z, Qiu CF, Miller R, Sorensen T, Williams M. Maternal pre-pregnancy overweight status and obesity as risk factors for cesarean delivery. J Matern Fetal Neonatal Med. 2005;17(3):179–85.
20. Jensen DM, Damm P, Sørensen B, Mølsted-Pedersen L, Westergaard JG, Ovesen P, et al. Pregnancy outcome and prepregnancy body mass index in 2459 glucose-tolerant Danish women. Am J Obstet Gynecol. 2003;189(1):239–44.
21. Rosenberg TJ, Garbers S, Chavkin W, Chiasson MA. Prepregnancy weight and adverse perinatal outcomes in an ethnically diverse population.

Obstet Gynecol. 2003;102(5 5 Pt 1):1022–7.

22. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. Int J Obesity Relat Metab Disord. 2001; 25(8):1175–82.
23. Yosipovitch G, DeVore A, Dawn A. Obesity and the skin: skin physiology and skin manifestations of obesity. J Am Acad Dermatol. 2007 Jun;56(6): 901–16.
24. Davies DA, Yanchar NL. Appendicitis in the obese child. J Pediatr Surg. 2007 May;42(5):857–61.
25. Woolford SJ, Gebremariam A, Clark SJ, Davis MM. Incremental hospital charges associated with obesity as a secondary diagnosis in children. Obesity. 2007 Jul;15(7):1895–901.
26. Strauss RS, Pollack HA. Social marginalization of overweight children. Arch Pediatr Adolesc Med. 2003 Aug;157(8):746–52.
27. Schwartz MB, Puhl R. Childhood obesity: a societal problem to solve. Obes Rev. 2003 Feb;4(1): 57–71.
28. Strauss RS, Pollack HA. Epidemic increase in childhood overweight, 1986–1998. JAMA. 2001 Dec 12;286(22):2845–8.
29. Freedman DS, Khan LK, Serdula MK, Ogden CL, Dietz WH. Racial and ethnic differences in secular trends for childhood BMI, weight, and height. Obesity. 2006 Feb;14(2):301–8.
30. Borger C, Smith S, Truffer C, Keehan S, Sisko A, Poisal J, et al. Health spending projections through 2015: changes on the horizon. Health Aff (Millwood) 2006;25(2):w61–73.
31. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med. 1997 Sep 25;337(13):869–73.
32. Morrison JA, Sprecher DL, Barton BA, Waclawiw MA, Daniels SR. Overweight, fat patterning, and cardiovascular disease risk factors in black and white girls: the National Heart, Lung, and Blood Institute Growth and Health Study. J Pediatr. 1999 Oct;135(4):458–64.
33. Freedman DS, Khan LK, Serdula M, Dietz W, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. Pediatrics. 2005 Jan;115(1):22–7.
34. Lauer RM, Clarke WR, Burns TL. Obesity in childhood: the Muscatine Study. Zhonghua Min Guo Xiao Er Ke Yi Xue Hui Za Zhi. 1997 Nov–Dec;38(6):432–7.
35. Parsons TJ, Power C, Logan S, Summerbell CD. Childhood predictors of adult obesity: a systematic review. Int J Obes Relat Metab Disord. 1999 Nov;23 Suppl 8:S1–107.
36. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. Int J Obes Relat Metab Disord. 1999 Mar;23 Suppl 2:S2–11.
37. Power C, Lake JK, Cole TJ. Measurement and long-term health risks of child and adolescent fatness. Int J Obes Relat Metab Disord. 1997 Jul; 21(7):507–26.
38. Guo SS, Wu W, Chumlea WC, Roche AF. Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. Am J Clin Nutr. 2002 Sep;76(3): 653–8.