The Relationship Among Child Weight Status, Psychosocial Functioning, and Pediatric Health Care Expenditures in a Medicaid Population

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Objectives To examine the association between weight status and health service use, while considering the influence of psychosocial functioning and demographic variables. Methods Two hundred child–parent dyads were recruited from pediatric primary care clinics and completed measures of height, weight, and questionnaires assessing psychosocial functioning. Claims and expenditure data over a 12-month retrospective period were extracted from the Medicaid claims database. Results Children who were obese incurred greater health service use and expenditures than children who were of a healthy weight, even after controlling for psychosocial functioning and other demographic variables. Children who were overweight (but not obese) did not have differing levels of claims or expenditures than their healthy weight peers. Conclusions Understanding the impact of pediatric obesity on long-term expenditures is critical. These results provide some indication of the financial savings that might be achieved if obese children were supported to achieve a healthier weight status.

Key words children; expenditures; medicaid; obesity; psychosocial functioning.

Pediatric obesity is a well-documented public health problem (Ogden, Carroll, & Flegal, 2008). While the focus on current and future health outcomes associated with childhood obesity is of primary concern, the economic burden of pediatric obesity on the health care system is also significant. Obesity-related hospital expenditures for children increased three-fold over the two decades prior to the year 2000 (Wang & Dietz, 2002), and more than doubled between 2001 and 2005 (Trasande, Liu, Fryer, & Weitzman, 2009). Yet, only a limited number of studies to date have examined the association between pediatric obesity and increased health care expenditures. Of these, both retrospective (Hampl, Carroll, Simon, & Sharma, 2007; Woolford, Gebremariam, Clark & Davis, 2007) and prospective (Estabrooks & Shetterly, 2007) studies have reported that children who are overweight or obese incur greater health care service use and expenditures than their healthy weight peers. However, findings of a positive association between weight status and increased health care expenditures in children are not universal. Skinner and colleagues (Skinner, Mayer, Flower, & Weinberger, 2008) found that obese children incurred significantly fewer health care expenditures relative to healthy weighty peers. Furthermore, Buescher and colleagues (Buescher, Whitmire, & Plescia, 2008) reported that only overweight, but not obese, adolescents in their sample experienced significantly higher mean expenditures than their healthy weight peers. Thus, while data are starting to accumulate suggesting that overweight or obese status in youth is linked to high service use and expenditures, research findings in this area are far from conclusive. As both the cost for providing health care and the rates of childhood obesity...
continue to increase, it becomes increasingly important to delineate if, and how, weight status is related to health care expenditures in children.

In addition to weight status, psychosocial functioning has also been linked to children’s health care expenditures. The use of children’s psychiatric services (Hankin et al., 1984; Starfield et al., 1985), mental health treatments (Kelleher & Starfield, 1990), and counseling services (Riley et al., 1993), as well as parent-reported internalizing and externalizing behavior symptoms (Lavigne et al., 1998) have been associated with greater health care utilization in children. Moreover, a recent study reported that children with an obesity-related health condition and a comorbid psychiatric diagnosis had higher nonpsychiatric health care expenditures and service use than did children with an obesity-related health condition but without a psychiatric diagnosis (Janicke, Harman, Kelleher, & Zhang, 2009). There are likely a number of contributing factors to these associations including unhealthy lifestyles, parenting practices, psychiatric illness, and weight gain associated with the use of antipsychotic medications (Correll, 2007). Regardless of the exact etiology, these relationships are especially troubling given that rates of psychiatric diagnosis appear to be more prevalent in children who are overweight or obese (Hesketh, Wake, & Waters, 2004; Janicke, Harman, Kelleher, & Zhang, 2008; Sjoberg, Nilsson, & Leppert, 2005).

While there is growing support suggesting that weight status and psychosocial functioning are associated with higher medical expenditures, to our knowledge there is no study examining both of these factors together within a general pediatric patient population. Given the increased rates of pediatric obesity, the high rates of psychosocial distress and psychiatric diagnosis in overweight and obese children, and the increasing costs of health care, developing a greater understanding of the relationships between these factors across the general population of children is increasingly important to informing health care policy, risk assessment, and treatment planning. Thus, the objectives of the current study were to determine (a) if children who are overweight or obese incur greater health care expenditures than their nonoverweight peers, and (b) whether parent-reported child psychosocial factors predict health care use above and beyond child weight status. It was hypothesized that, (a) overweight and obese status will be associated with greater Medicaid claims and expenditures relative to nonobese status, and (b) while controlling for weight status, the presence of clinically significant behavior and emotional problems will also be associated with greater Medicaid claims and expenditures.

**Methods**

**Participants**

Participants were children enrolled in Florida Medicaid, aged 7–15 years, and their parent or legal guardian. These ages were chosen to cover a wide range of children and to be consistent with recent studies examining the relationship between weight status and health care use in children (Estabrooks & Shetterly, 2007; Hampel et al., 2007; Skinner et al., 2008). Exclusion criteria for children included: (a) being diagnosed with a rare chronic health condition (e.g., sickle cell disease, rheumatoid arthritis, and cystic fibrosis), cognitive delay or autistic spectrum disorder; (b) experiencing a significant trauma over the past 12 months requiring a prolonged inpatient hospitalization; (c) being underweight [body mass index (BMI) $z$-score below $-1.0$]; and, (d) being from a non-English speaking family. Of the 225 children who initially agreed to participate in the study and completed study questionnaires, 12 children were excluded due to a diagnosis of a specified exclusionary chronic health condition or because they had experienced a significant trauma resulting in hospitalization. Thirteen youth were excluded from analysis because they were underweight. This resulted in a sample of 200 children that were included in the present analysis.

**Procedure**

Families enrolled in Medicaid were recruited while attending two faculty/resident pediatric primary clinics associated with an academic medical center in the southeastern United States. These two clinics combined to see $\sim$400 children per month that were enrolled in the Florida Medicaid program. If the family agreed to participate, informed consent and assent were obtained, the child was measured for weight and height, and the child and their guardian completed a packet of questionnaires before, during, or immediately after the clinic visit. Recruitment and questionnaire data collection took place between March 2007 and December 2007. Each family received a $20 Wal-Mart gift card for participation in the study. The study was approved by the governing Institutional Review Board.

**Measures**

**Demographic Questionnaire**

This questionnaire assessed family background information including age, gender, grade, and race of child. Questions also asked about marital status and highest education completed by parents or guardians.

**Child Behavior Checklist**

The CBCL (CBCL, Achenbach, 1991) is a parent report questionnaire that assesses internalizing and externalizing
behavior problems in youth. Extensive reliability and validity data have shown the measure has good psychometric properties (Achenbach, 1991). For each scale, raw scores can be reported as: (a) on a continuum, or (b) either in the clinically significant range or not in the clinically significant range based on age and gender norms. In this study the internalizing and externalizing scores were entered as dichotomous variables (indicating whether or not symptoms levels reached clinical significance) for analysis based on a t-score cutoff of 70.

**Weight Status**
Each child was measured for height and weight by a trained research team member at the time of primary data collection. BMI z-scores were calculated for each child based on age and gender norms from the Center for Disease Control (Kuczmarski, et al., 2001). Children were classified into one of three weight categories: Healthy weight (children with a BMI z-score between −1.0 and 0.999), overweight (BMI z-score between 1.0 and 1.999), or obese (BMI z-score equal to or above 2.0).

**Health Care Claims and Expenditure Data**
For each participant Medicaid claims data was extracted for the 12 months immediately prior to the date of primary data collection. Children were included in this analysis if they were enrolled in Medicaid at any point during this 12 month retrospective period. Enrollment in Medicaid during the entire 12-month period was not a prerequisite for inclusion in this study.

**Medical Expenditures**
Medicaid expenditures were accrued during the 12-month period from claims data, using the amount that Medicaid paid to providers for services. Expenditures were accumulated and reported in the following categories: outpatient and medical/physician expenditures, pharmacy expenditures, and acute care expenditures. As there were only five children with inpatient expenditures, we did not report inpatient costs or claims.

**Volume of Health Service Use or Claims**
Health care use was accrued during the 12-month period from claims data. Total claims and/or health care visits were accumulated in the following categories: outpatients and medical/physician claims, outpatient emergency department visits, and acute care claims. The length of Medicaid enrollment was included as a control variable in all regression analyses.

In our calculation of medical/physician claims, each unique combination of a medical/physician claim and procedure code was reported as one claim. Thus, if there were six procedures codes associated with one medical/physician claim, we assigned a value of six claims in our accumulation of claims for this child. For example, if a patient had procedures codes for a general physical examination, prophylactic vaccination, and removal of sutures filed on one claim, this was counted as three medical/physician claims. This strategy was chosen as we felt it more accurately reflected that level of intervention required to address the presenting health needs of each child. However, this strategy did not account for the length of patient contact associated with each procedure code.

**Acute Care** claims and expenditures were identified using claims data and were based on procedure codes. Specifically, any claim with one of the following ICD-9 procedure codes was considered an Acute Care claim: 99201-99205; 99211-99215; 99241-99244.

**Data Analysis**
Negative binominal regression analyses were used to calculate incident rate ratios to allow for the comparison of the frequency of Medicaid claims and health care visits across weight status groups and levels of psychosocial functioning. Negative binomial regressions are useful for analyzing count data which tend to not meet the assumptions necessary for ordinary least squares regression (Gardner, Mulvey, & Shaw, 1995). Negative binomial regression, unlike Poisson regression, does not rely on the assumption that the mean of the count variable is equal to the variance. A negative binomial regression model also allows the coefficients to be presented in terms of incidence rate ratios, which is simply the ratio of two incidence rates based on alternative values of the independent variable. These analyses control for the influence of the other predictor variables included in the model on the dependent variable. The current analyses also controlled for age, gender, race, ethnicity, the receipt of supplemental security insurance (SSI), and the length of Medicaid enrollment. For each of the three claims categories, two models were run. Model one included the two weight status groups (i.e., obese children and overweight children). In both of these cases, the healthy weight group served as the reference group. Model two included the two weight status groups along with the two psychosocial functioning groups to determine if the association of weight with service use was mediated by psychosocial functioning. Specifically, internalizing and externalizing scores were each entered as dichotomous variables (indicating whether or not symptoms levels reached clinical significance) in the regression analyses.
Gamma regression analyses were used to compare Medicaid expenditures across weight status groups. As expenditure data tend to be highly skewed, ordinary least squares regression often produces biased results. Instead, we used $\gamma$-regression which is a nonlinear regression model that directly accounts for the skewed distribution, produces unbiased estimates, and does not require predictions to be retransformed (Manning, Basu, & Mullahy, 2004). Age, gender, race/ethnicity, receipt of SSI, and Medicaid enrollment period were entered as control variables in the analyses. Similar to analysis examining the number of claims or visits, for each of the three expenditure categories two models were run. Model one included the two weight status groups with the healthy weight group serving as the reference group. Model two included the two weight status groups along with the two psychosocial functioning groups.

Finally, negative binomial regression analyses were used to calculate incident rate ratios to allow for the comparison of the number of different ICD-9 diagnoses per child across weight status and psychosocial functioning groups, while controlling for age, gender, race, ethnicity, receipt of SSI, and length of Medicaid enrollment.

**Results**

The descriptive statistics of the study sample, broken down by weight class, are presented in Table I. The mean age of children in the sample was 11.2 years. There were slightly more males (52.5%) than females. A majority of the sample was African American (65%), with the next largest racial group consisting of Caucasian children (25%). The mean and modal length of Medicaid Enrollment was 11 months ($SD = 2.3$) and 12 months, respectively. There were no differences on demographic variables among the three weight status groups.

Overall, 34% of the children in the sample were overweight, while an additional 22.5% were obese. There were no differences in Medicaid claims and expenditures by gender, race, and ethnic status. Nor were there differences based on the interactions of weight status and race. Child age was not associated with any of the expenditure or claims categories.

**Weight Status, Psychosocial Functioning, and Medicaid Claims and Visits**

The unadjusted mean Medicaid claims and expenditures by weight status group are displayed in Table II. The adjusted mean Medicaid expenditures by weight status group are displayed in Table III. The Incident Rate Ratios (IRR) comparing medical claims data across weight status groups while controlling for age, sex, race, SSI, and Medicaid Enrollment Period are displayed in Table IV. Within Table IV, Model 1 includes only child weight status, while Model 2 includes both child weight status and psychosocial functioning. In Model 1, children who were obese had 21% more outpatient and medical/physician claims, 51% more acute care claims, and well

**Table I. Descriptive Statistics by Weight Status Group**

<table>
<thead>
<tr>
<th></th>
<th>Healthy Weight Mean (SE) or % (n = 87)</th>
<th>Overweight Mean (SE) or % (n = 68)</th>
<th>Obese Mean (SE) or % (n = 45)</th>
<th>Total Mean (SE) or % (n = 200)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child age</td>
<td>11.31 (0.28)</td>
<td>11.04 (0.29)</td>
<td>11.38 (0.32)</td>
<td>11.24 (0.17)</td>
</tr>
<tr>
<td>Child gender (Female) (%)</td>
<td>44.8</td>
<td>51.5</td>
<td>51.1</td>
<td>47.5</td>
</tr>
<tr>
<td>Child race/ethnicity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian (n = 50)</td>
<td>24.1</td>
<td>29.4</td>
<td>15.6</td>
<td>25.0</td>
</tr>
<tr>
<td>African American (n = 130)</td>
<td>66.7</td>
<td>51.5</td>
<td>75.6</td>
<td>65.0</td>
</tr>
<tr>
<td>Hispanic (n = 12)</td>
<td>5.7</td>
<td>7.4</td>
<td>4.4</td>
<td>6.0</td>
</tr>
<tr>
<td>Other (n = 8)</td>
<td>3.4</td>
<td>11.8</td>
<td>4.4</td>
<td>4.0</td>
</tr>
<tr>
<td>Children with SSI (%)</td>
<td>21.8</td>
<td>19.1</td>
<td>24.4</td>
<td>21.5</td>
</tr>
<tr>
<td>Child BMI</td>
<td>18.45 (0.22)</td>
<td>23.15 (0.36)</td>
<td>32.77 (0.95)</td>
<td>23.23 (0.47)</td>
</tr>
<tr>
<td>Parent age (n = 189)</td>
<td>37.91 (1.2)</td>
<td>41.82 (1.3)</td>
<td>37.71 (1.2)</td>
<td>39.25 (0.76)</td>
</tr>
<tr>
<td>Parent marital status (Married) (%)</td>
<td>44.7</td>
<td>35.8</td>
<td>40.9</td>
<td>40.8</td>
</tr>
<tr>
<td>Guardian education (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not complete HS</td>
<td>15.5</td>
<td>17.6</td>
<td>23.3</td>
<td>17.9</td>
</tr>
<tr>
<td>HS or some college</td>
<td>72.6</td>
<td>67.6</td>
<td>65.1</td>
<td>69.2</td>
</tr>
<tr>
<td>College graduate</td>
<td>11.9</td>
<td>14.7</td>
<td>11.6</td>
<td>12.9</td>
</tr>
<tr>
<td>Relationship to child (Parent) (%)</td>
<td>81.6</td>
<td>80.9</td>
<td>82.2</td>
<td>81.5</td>
</tr>
</tbody>
</table>

*Note: SSI, Supplemental Security Insurance.*
over twice as many outpatient emergency department visits compared to their healthy weight peers. However, children who were only overweight (but not obese) did not exhibit statistically different levels of Medicaid claims in any of the three categories measured compared to their healthy weight peers.

When psychosocial functioning (as measured by clinically significant levels of internalizing and externalizing symptoms) was added to the model (Model 2) the IRRs for obese and overweight children by claims category were very similar to the results in Model 1. The IRRs for psychosocial functioning were not significant for any of the three expenditure categories, with the exception that youth with clinically significant levels of parent-reported externalizing symptoms had over twice as many pharmacy expenditures relative to their peers without clinically significant levels of externalizing symptoms.

### Clinically Significant Internalizing and Externalizing Problems by Weight Status

Overall, 13.3% of obese children exhibited clinically significant parent-reported internalizing symptoms, relative to 8.8% for overweight children, and 8.0% for healthy weight children. Exploratory ANOVA found that these differences were not statistically significant ($p = .66$). Similarly, 8.9% of obese children exhibited clinically significant parent-reported externalizing symptoms, relative to 13.2% for overweight children, and 9.2% for healthy weight children. These differences were not statistically significant ($p = .60$).

### Weight Status, Psychosocial Functioning, and Medicaid Expenditures

Table V displays the β-coefficients resulting from the γ-regression analysis that examined the relationships of child weight status and psychosocial functioning to Medicaid expenditures. Within Table V, Model 1 includes only child weight status, while Model 2 includes both child weight status and psychosocial functioning. In Model 1, children who were obese had higher mean outpatient and medical/physician expenditures, as well as higher acute care expenditures, than their healthy weight peers. There was no difference in pharmacy expenditures between obese and non-overweight groups. Moreover, there was no significant difference between overweight and non-overweight groups across expenditure categories.

When psychosocial functioning was added to the model (Model 2), the β-weights for obese and overweight groups by claims category were again similar to the results in Model 1, with significantly higher mean outpatient and medical/physician and acute care expenditures for obese versus healthy weight children. The β-weights for psychosocial functioning were not significant for any of the three expenditure categories, with the exception that youth with clinically significant levels of parent-reported externalizing symptoms had over twice as many pharmacy expenditures relative to their peers without clinically significant levels of externalizing symptoms.

### Number of ICD Diagnoses

Negative binomial regression analyses were conducted to calculate IRRs comparing the number of unique ICD-9 codes for obese and overweight groups relative to the healthy weight group, while controlling age, sex, race, SSI, and Medicaid Enrollment Period. Children who were obese received more unique ICD-9 diagnoses ($M = 9.02; SE = 1.00$) over the 12 month retrospective period than healthy weight children ($M = 6.45; SE = 0.4$) [IRR = 1.39, $p < .01$ (95% CI, 1.14, 1.70)]. Children

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### Table II. Unadjusted Mean Medicaid Visits, Claims and Expenditures by Weight Status Group

<table>
<thead>
<tr>
<th></th>
<th>Healthy Weight</th>
<th>Overweight</th>
<th>Obese</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SE) or %</td>
<td>Mean (SE) or %</td>
<td>Mean (SE) or %</td>
<td>Mean (SE) or %</td>
</tr>
<tr>
<td></td>
<td>(n = 87)</td>
<td>(n = 68)</td>
<td>(n = 45)</td>
<td>(n = 200)</td>
</tr>
<tr>
<td>Outpatient &amp; Medical/Physician Claims</td>
<td>41.41 (3.0)</td>
<td>39.33 (2.2)</td>
<td>49.42 (5.0)</td>
<td>42.42 (1.90)</td>
</tr>
<tr>
<td>Outpatient Emergency Dept Visits</td>
<td>0.4 (0.6)</td>
<td>0.2 (0.5)</td>
<td>0.8 (1.3)</td>
<td>0.4 (1.3)</td>
</tr>
<tr>
<td>Acute Care Claims</td>
<td>3.28 (0.3)</td>
<td>3.38 (0.4)</td>
<td>4.91 (0.7)</td>
<td>3.68 (0.2)</td>
</tr>
<tr>
<td>Outpatient &amp; Medical/Physician Expenditures</td>
<td>$1170 (122)</td>
<td>$1069 (141)</td>
<td>$1647 (257)</td>
<td>$1243 (93)</td>
</tr>
<tr>
<td>Pharmacy Expenditures</td>
<td>$1212 (283)</td>
<td>$904 (193)</td>
<td>$1047 (354)</td>
<td>$1070 (160)</td>
</tr>
<tr>
<td>Acute Care Expenditures</td>
<td>$126 (13)</td>
<td>$122 (14)</td>
<td>$200 (29)</td>
<td>$142 (10)</td>
</tr>
</tbody>
</table>

Unadjusted means do not control for age, sex, race, SSI, and Medicaid Enrollment Period.

### Table III. Adjusted Mean Expenditures by Weight Status Group

<table>
<thead>
<tr>
<th></th>
<th>Outpatient &amp; Medical/Physician Expenditures</th>
<th>Acute Care Expenditures</th>
<th>Pharmacy Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Weight</td>
<td>$1176</td>
<td>$132</td>
<td>$1270</td>
</tr>
<tr>
<td>Overweight</td>
<td>$1070</td>
<td>$122</td>
<td>$1070</td>
</tr>
<tr>
<td>Obese</td>
<td>$1813</td>
<td>$212</td>
<td>$1017</td>
</tr>
</tbody>
</table>

Note: Expenditures adjusted for age, gender, race/ethnicity, SSI, and length of Medicaid enrollment.
who were overweight did not receive more ICD-9 diagnoses ($M = 5.97; SE = 0.5$) than healthy weight children [IRR = 0.90 (95% CI, 0.75, 1.09)]. The most common diagnoses for normal weight and overweight youth were the same: attention deficit-hyperactivity disorder, acute pharyngitis (sore throat), and asthma. The most common diagnoses for obese children were abnormal weight gain, acanthosis nigricans, and lower back pain.

When rerunning the analyses with psychosocial functioning included in the model along with weight status, the IRRs for obese [IRR = 1.36, $p < .01$ (95% CI, 1.12, 1.66)] and overweight groups [IRR = 0.90 (95% CI, 0.74, 1.08)] remained virtually unchanged. The IRR for externalizing behavior symptoms was significant [IRR = 1.32, $p < .05$ (95% CI, 1.02, 1.72)], showing that children with clinically significant externalizing symptoms had 32% more ICD diagnoses than those children without clinically significant levels of externalizing symptoms. IRRs for internalizing behavior symptoms was not significant [IRR = 1.08 (95% CI, 0.83, 1.40)].

**Discussion**

There remains a growing need to understand the health care expenditures incurred by overweight and obese youth, as this is an important first step in determining cost-effective treatment and preventive interventions (US Preventive Services Task Force, 2005). Only a few studies have examined the association between weight status and health care use in children (Estabrooks & Shetterly, 2007; Hampl et al., 2007; Skinner et al., 2008). The results of these studies have been mixed. Moreover, many studies in this area did not consider the potential impact of child psychosocial functioning, a factor
that has been shown to influence children’s health service use (Janicke & Finney, 2000), along with weight status. Furthermore, to our knowledge there are no studies examining the relationships among weight status, psychosocial functioning, and health care expenditures in the general pediatric patient population.

The current study provides new information about the association between pediatric weight status and health service use. A significant strength of this study is that we used actual measurement of height and weight rather than self-report which has been used in a majority of other studies. We found that children who were obese incurred significantly higher health care services and expenditures in a variety of categories. Children who were obese had 21% more outpatient/medical claims, 132% more outpatient ED visits, and 51% more acute claims than children who were a healthy weight. Obese children were also found to incur 41% more outpatient/medical expenditures, and 59% more acute care expenditures relative to their healthy weight peers. After adjusting expenditures for age, gender, race, SSI, and Medicaid enrollment period, obese child experienced 62–64% more outpatient and acute care expenditures relative to their nonobese peers. This differential could have substantial cost implications if it exists in the larger population of children enrolled in Medicaid.

Importantly, the inclusion of child psychosocial functioning added very little to the predictive power of these models, not detracting from or adding to, the predictive power of weight status in these models. This is inconsistent with a number of previous studies examining this issue (Janicke & Finney, 2000). This may reflect that small sample size used in this study. Alternatively, it may be that in this low income Medicaid population, elevated internalizing and externalizing behavior problems do not differentiate between high and lower users of health care services as these symptoms may not be seen as problematic relative to the other potential stressors faced by these families (Newacheck, Pearl, Hughes, & Halfon, 1998). In addition, it is important to note that we used t-score cutoffs for clinical significance on the CBCL to ascertain psychosocial status. Another approach to classifying psychosocial status, such as examining psychiatric medication use or psychiatric diagnosis, may have yielded different findings.

Our results are consistent with those reported by Estabrooks and Shetterly (2007), who found that obese, but not overweight, youth had more outpatient and acute care visits than nonobese youth over both 1 and 3 year prospective periods. However, our data contrast with the retrospective data reported by Hampl and colleagues (2007) which found no difference between obese and healthy weight children in outpatient visits and ED visits, although these authors did find that overall expenditures were higher for obese relative to healthy weight children. Collectively, these data suggest that increased expenditures and claims are more likely to be seen in obese youth, but not overweight youth. The reasons for these associations are not clear, and were not specifically examined in this study. Numerous studies have suggested that children who are obese are at increased risk for myriad adverse health outcomes (Fagot-Campagna, 2000; Freedman et al., 1999). In the current sample, children who were obese had 39% more unique ICD-9 codes than those normal weight participants. These relationships did not change when controlling for child psychosocial functioning. One possibility is that children who are obese may experience additional health complications that results from their obese status. It is also possible the children who are obese may be more likely to receive a referral for assessment relative to their healthy weight peers. Alternatively, children with additional health conditions worthy of ICD-9 diagnosis may require treatments that lead to weight gain. Certainly future research on the clinical basis for these differences is warranted.

It is important to note that over half of our sample met criteria for being overweight or obese, well above the national average of 32% (Ogden et al., 2008). Although the current study included a relatively small sample size of parents both accessing health care and agreeing to participate in the study, it still speaks to the substantial problem of pediatric obesity in the Medicaid population. The higher rate of pediatric overweight and obesity in this study is consistent with other published studies reporting higher rates of obesity and health service use in Medicaid populations relative to national norms (Hampl et al., 2007; Woolford et al., 2007). Also of note, none of the children in the current sample received an ICD-9 diagnosis of obese or morbidly obese. This is most likely is due to a lack of reimbursement for these diagnostic codes. Rather obese youth received diagnoses of abnormal weight gain, acanthosis nigricans, and lower back pain as these codes were more likely to be reimbursed by insurers.

There are limitations of this study that must be noted. First, the sample size was small compared to previous studies in this area due to the desire to collect height and weight data measured by a trained member of the research team. Second, the relatively small sample size limited our statistical power and may have hindered our ability to detect important associations or differences between groups. Third, the study results reported here are based on a retrospective design, which does not...
allow for prediction of future health service use based on the independent variables. Fourth, as the data are limited to children enrolled in Medicaid, care must be taken when generalizing to other pediatric populations. The findings are also limited by the fact that data are limited to children enrolled in Medicaid and that approximately two-thirds of the sample was African American, which limits generalizability to children from other racial and ethnic backgrounds or insurers. Moreover, as billing limits to Medicaid are set at a lower dollar amount in faculty/resident training clinics relative to nontraining clinics, the data in this study may underestimate actual expenditures relative to other nontraining clinical settings. Finally, it is possible that our analysis may have captured claims and expenditures incurred when a given child was at a different weight status than they were at the point claims were submitted. This may be especially true for the younger children in this cohort, given the increase in prevalence of overweight and obesity as children age.

Despite the limitations noted above, these findings have implications for policy, research, and practice. Although this study does not provide evidence of causation, these data provide some indication of the financial savings that might be achieved if obese children were supported to achieve a healthier weight status (Estabrooks & Shetterly, 2007; Hampl et al., 2007). Greater financial support for programs that prevent or treat pediatric obesity may lead to potential for cost savings or cost realignment. Given the wide variability in enrollment patterns for children and adolescents enrolled in Medicaid, there is understandable concern that dollars spent to prevent and treat pediatric obesity may not ultimately impact Medicaid expenditures, as many of these children may not remain enrolled in the Medicaid system. However, previous research suggests that Medicaid beneficiaries account for a significantly higher proportion of hospital discharges associated with obesity than they do for discharges without obesity (Woolford et al., 2007). Combined with data showing higher rates of obesity in the Medicaid population relative to children not enrolled in Medicaid, these data suggest that Medicaid may shoulder a disproportionate burden of the economic consequences associated with obesity.

There are a number of areas for future research. Understanding the impact of pediatric obesity on long-term expenditures is critical. Prospective longitudinal research is needed to determine if the variables examined in the present study predict future health care use over a longer period of time. While this study demonstrated that obese status in children was associated with higher health care expenditures relative to children who are a healthy weight, we can only speculate on the causes of this association. Certainly research to determine the clinical basis for higher expenditures associated with obesity in children before the onset of the classic comorbidities of obesity is warranted (Woolford et al., 2007). Future research should also examine how obesity complicates care for common childhood illnesses. For clinicians, the higher charges may reflect the additional time and management challenges in caring for children who are obese (Skinner et al., 2008). Finally, future research is necessary to determine if change in weight status causes a reduction in the use patterns reported in this study (Estabrooks & Shetterly, 2007). Given the rising costs of health care and the growing recognition of the need for cost-effective health investments, evidence that identifies successful and cost-effective prevention and treatment strategies seems especially pertinent (Cawley, 2007; Haby et al., 2006). Such research has the potential to not only reduce short-term health care utilization for youth, but it could also help reduce the anticipated enormous socio-economic burden as obese youth transition into adulthood and beyond (Hampl et al., 2007).

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