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## Body Mass Index and Medical Care Expenditures Among North Carolina Adolescents Enrolled in Medicaid in 2004

by

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### ABSTRACT

**Objectives:** Previous studies have documented that overweight and obese adults have substantially higher medical care expenditures than adults of normal weight, but there is little comparable data for children or adolescents. This study examines medical care expenditure and utilization patterns in a sample of adolescents in North Carolina enrolled in Medicaid, stratified by body mass index (BMI) categories.

**Methods:** North Carolina public health department records, which include clinically measured height and weight, were linked to 2004 North Carolina Medicaid enrollment records. For the 3,528 adolescents ages 12-18 whose records matched, we examined their entire paid claims history for 2004. Total expenditures by gender and race, hospital expenditures, physician expenditures, and prescription drug expenditures were tabulated, stratified by BMI. We also examined the proportion of adolescents who had a paid claim in selected diagnosis categories by BMI.

**Results:** Overall, and in most demographic and service categories, overweight and at risk of overweight adolescents had substantially higher average Medicaid expenditures compared to normal weight adolescents. Overweight adolescents were significantly more likely to have a paid claim for services related to diabetes, asthma, and other respiratory conditions.

**Conclusions:** This study presents evidence of negative health consequences of overweight as early as adolescence.



## Introduction

Obesity is now recognized as a serious public health epidemic and a significant underlying cause of morbidity and mortality in the United States.<sup>1,2</sup> Prevalence of both overweight and obesity have grown dramatically in the last decade. Two-thirds of adults in the United States are overweight or obese.<sup>3</sup> The largest increases in overweight and obesity are now occurring in minorities and children.<sup>3</sup> Recent United States data show that 34 percent of persons ages 2-19 are overweight or at risk of overweight and 17 percent are overweight.<sup>3</sup> Overweight children are more likely to be obese as adults,<sup>4</sup> and being overweight in childhood increases the risk of adult cardiovascular morbidity.<sup>5</sup> Dietz found that there were also immediate consequences of overweight in childhood, including psychosocial problems, hypertension, high cholesterol, and abnormal glucose tolerance.<sup>6</sup>

Adults who are overweight and obese have higher medical care expenditures. In 1998, the direct medical costs of obesity accounted for 9.1 percent of United States medical expenditures. Medicare and Medicaid finance about one-half of these costs.<sup>7</sup> Among states, obesity-attributable expenses to the Medicaid system in 2003 ranged from \$23 million in Wyoming to \$3.5 billion in New York.<sup>8</sup> Most studies of the direct costs of obesity have focused on adults and use statistical modeling methods to estimate national costs and the costs for specific populations such as Medicaid. There are several studies on the cost and associated health care utilization patterns of adults in university-based systems and large health maintenance organizations.<sup>9,10,11</sup> These studies show that health care costs are significantly higher among obese persons compared to others. There is currently little data to document specific health care utilization and expenditures related to overweight among children.

The purpose of this study is to analyze the health care utilization patterns and related cost to the Medicaid program for overweight adolescents seen in public health department clinics. Medicaid paid claims and enrollment records are used to identify health care utilization patterns and determine whether medical care expenditures vary significantly among groups of North Carolina adolescents classified by measurements of body mass index (BMI).

## Methods

The North Carolina Nutrition and Physical Activity Surveillance System (NC-NPASS) is comprised of data collected on children seen in WIC clinics, public health department clinics, and some school-based health centers. Height and weight are measured in the clinics by health professionals. We linked the 2004 NC-NPASS records to the Medicaid records so that we could tabulate the Medicaid data by BMI category. We started with 7,628 records from the NC-NPASS data system for children ages 12-18. We focused on this adolescent population under the hypothesis that any association of BMI with medical care expenditures would be most prominent among these older children.

Approximately 80 percent of the children in the NC-NPASS system are ages 2-4; many of these are in the system because they participated in WIC. Eligibility for WIC ends at age 5, so all of the 12-18 year olds are in NC-NPASS because they had their height and weight measured in a public health department clinic, often in association with a well-child care visit.

We linked the NC-NPASS records to the Medicaid enrollment records using several iterations of name, date of birth, county of residence, and Medicaid ID number. Details of the matching algorithm are available from the authors. Medicaid records were included in the matching process only if the child had 11 or 12 months of enrollment during 2004. Children with fewer than 11 months of enrollment may not have very complete medical care expenditure data captured in the Medicaid paid claims records.

Of the 7,628 NC-NPASS records, 3,528 were linked to the Medicaid files. Some of the non-matching records were due to the imperfect matching variables; usually a matching rate of about 90 percent or more can be achieved with name and other personal identifiers. But most of the non-matching is due to the fact that many of these 12-18 year olds in the NC-NPASS system, who received health care at public health departments, were not enrolled in Medicaid at all or were enrolled for less than 11 months during 2004.

We compared our group of 3,528 adolescents with all 12-18 year olds enrolled in Medicaid in 2004 (for 11 or 12 months) to see how representative our sample was of the total.

For each of these 3,528 12-18 year olds, we used the Medicaid ID number to extract all of their claims paid by Medicaid for medical care during 2004. We then tabulated the average total Medicaid expenditures per child for the following BMI categories: overweight (95th or greater percentile), at risk of overweight (85th to 94th percentile), normal weight (5th to 84th percentile), and underweight (less than the 5th percentile). The percentiles were based on the Centers for Disease Control/National Center for Health Statistics 2000 BMI Reference. We also broke out these results by race and gender.

For all of the 3,528 12-18 year olds, we divided the expenditure results into several categories: hospital expenditures, physician expenditures, and prescription drug expenditures. We also broke out the data by major diagnosis categories.

In computing average expenditures, we used total expenditures for adolescents in the weight group in the numerator and the total number of adolescents in the weight group in the denominator. Some adolescents did not have any expenditures during the year but they are still included in the denominator since our aim is to show average expenditures across all adolescents in the group, not just among those who had a claim. This measure accounts for both differences in service utilization and differences in cost per service. For hospital expenditures and for some of the diagnosis categories, many adolescents had zero expenditures during the year. For the diagnosis categories, we tabulated the percentage of adolescents in each weight group who had one or more Medicaid claims with a primary diagnosis in the category.

We used difference of means tests to see which expenditure differences by BMI category were statistically significant at the 90 and 95 percent confidence levels, using normal weight as the reference group. Using the more conservative two-tail test, we tested for differences in the percentages who had a claim in a diagnosis group using chi square tests with Yates' correction, comparing each BMI category to the normal weight group. It should be emphasized that this descriptive study shows only associations of BMI with medical care expenditures. We cannot demonstrate that differences in medical care expenditures are caused by the adolescents' weight, as opposed to other factors that are associated with weight.

## Results

In 2004, there were 184,523 12-18 year olds who were enrolled in Medicaid for 11 or 12 months of the year. Our sample of 3,528 adolescents enrolled in Medicaid in 2004 represents those who had their height and weight measured in a public health department clinic, often in association with a well-child care (Health Check or EPSDT) visit. Children who received services in a public health department and did not have their height and weight measured (more than 40 percent of all the 12-18 year-olds seen in health departments) were not in the NC-NPASS system. The 184,523 adolescents enrolled in Medicaid received all types of medical services during 2004, and many did not have a well-child care visit during the year.

Comparing our sample of 3,528 with the 184,523 total 12-18 year olds enrolled in Medicaid for 11 or 12 months during 2004, we found that our sample was younger: 45 percent were ages 12 and 13 versus 35 percent in the total Medicaid group. Conversely, 12 percent of our sample were ages 17 and 18, compared to 21 percent in the total Medicaid group. These results are consistent with the pattern of well-child care service use dropping off as children grow older.

Table 1 shows the distribution by BMI category of all children ages 6-11 and 12-18 included in the 2004 NC-NPASS data base. This describes the weight distribution

	<b>Number of Children</b>	<b>Percentage by Weight Category</b>
<b>Ages 6-11, Total</b>	8,033	100.0
Underweight	233	2.9
Normal Weight	4,286	53.4
At Risk	1,290	16.1
Overweight	2,224	27.7
<b>Ages 12-18, Total</b>	7,628	100.0
Underweight	117	1.5
Normal Weight	4,037	52.9
At Risk	1,396	18.3
Overweight	2,078	27.2

of children who used public health department clinics in North Carolina and had their height and weight measured. Approximately 27 percent of the children in each age group were overweight.

Table 2 shows the number and percentage of adolescents in the matched sample by weight category and the average total Medicaid expenditures per child. Overall, 28.9 percent of the adolescents in our sample were overweight, 17.5 percent were at risk of

overweight, 52.2 percent were normal weight, and 1.4 percent were underweight. There was little variation in these percentages by gender and race.

Average expenditures during 2004 were lowest for the normal weight group and consistently higher for the at-risk and overweight groups. Average expenditures were by far the highest for the underweight group. A similar pattern is seen for each of the gender and race categories. The only notable exception is that males had higher average expenditures for the normal weight group compared to the at-risk group, with much higher expenditures in the overweight group. African American adolescents had average Medicaid expenditures that were 27 percent lower than the average expenditures for white adolescents (\$3,609 vs. \$4,963). The statistically significant differences in Table 2 are: overall, at-risk adolescents had higher average expenditures than normal weight adolescents ( $p < .10$ ); at-risk female adolescents had higher average expenditures than normal weight female adolescents ( $p < .05$ ); and at-risk white adolescents had higher average expenditures than normal weight white adolescents ( $p < .10$ ).

Table 3 shows the average expenditures results by BMI category and major service types. The same pattern by BMI category is apparent for hospital, physician, and prescription drug expenditures, i.e., normal weight adolescents had the lowest expenditures; at-risk and overweight adolescents had consistently higher expenditures; and underweight adolescents had by far the highest average expenditures. Comparing the “Total” rows in Tables 2 and 3, it can be seen that physician expenditures represent 52 percent of all Medicaid expenditures for this sample of adolescents (\$2,154 out of \$4,113). The statistically significant differences in Table 3 are: at-risk adolescents had higher average prescription drug expenditures than normal weight adolescents ( $p < .10$ ) and overweight

	<b>Number of Children</b>	<b>Percentage by Weight Category</b>	<b>Average Total Medicaid Expenditures per Child</b>
<b>Total</b>	3,528	100.0	\$4,113
Underweight	49	1.4	\$6,598
Normal Weight	1,841	52.2	\$3,604
At Risk	619	17.5	\$4,791*
Overweight	1,019	28.9	\$4,491
<b>Male</b>	1,682	100.0	\$4,193
Underweight	28	1.7	\$7,532
Normal Weight	946	56.2	\$3,904
At Risk	243	14.4	\$3,751
Overweight	465	27.6	\$4,661
<b>Female</b>	1,846	100.0	\$4,041
Underweight	21	1.1	\$5,353
Normal Weight	895	48.5	\$3,294
At Risk	376	20.4	\$5,462**
Overweight	554	30.0	\$4,347
<b>White</b>	1,528	100.0	\$4,963
Underweight	28	1.8	\$6,338
Normal Weight	809	52.9	\$4,169
At Risk	263	17.2	\$6,314*
Overweight	428	28.0	\$5,544
<b>African Am.</b>	1,850	100.0	\$3,609
Underweight	19	1.0	\$7,536
Normal Weight	956	51.7	\$3,245
At Risk	334	18.1	\$3,768
Overweight	541	29.2	\$4,003

Notes: One asterisk (\*) indicates that the difference between the average expenditure and that for the normal weight group is statistically significant at the 90 percent confidence level. Two asterisks (\*\*) indicate that the difference is statistically significant at the 95 percent confidence level. The sum of the racial group numbers does not equal the total number of children because “other” races are not included in the table due to very small numbers.

	<b>Number of Children</b>	<b>Average Hospital Expenditures per Child</b>	<b>Average Physician Expenditures per Child</b>	<b>Average Prescription Drug Expenditures per Child</b>
<b>Total</b>	3,528	\$327	\$2,154	\$401
Underweight	49	\$1,201	\$3,697	\$639
Normal Weight	1,841	\$269	\$1,897	\$340
At Risk	619	\$379	\$2,456	\$426*
Overweight	1,019	\$360	\$2,361	\$483**

Note: One asterisk (\*) indicates that the difference between the average expenditure and that for the normal weight group is statistically significant at the 90 percent confidence level. Two asterisks (\*\*) indicate that the difference is statistically significant at the 95 percent confidence level.

	<b>Average Expenditure</b>	<b>Underweight</b>	<b>Normal Weight</b>	<b>At Risk</b>	<b>Overweight</b>
Number of Children	3,528	49	1,841	619	1,019
<b>Diagnosis Group</b>		<b>Percentage Who Had the Diagnosis</b>			
Infections	\$17	8.2	12.8	12.9	13.7
Neoplasms	\$19	0.0	1.4	1.6	0.9
Diabetes	\$9	0.0	0.4	0.5	1.7**
Mental Disorders	\$2,643	26.5	22.6	22.0	20.1
Circulatory	\$38	0.0	1.4	0.3**	2.3
Asthma	\$13	6.1	4.9	6.6	7.6**
Other Respiratory	\$54	26.5	25.3	27.9	30.3**
Digestive	\$34	14.3	7.2	7.4	7.6
Musculoskeletal	\$62	18.4	17.6	18.4	17.7
Ill-defined Conditions	\$98	42.9*	29.1	31.1	30.5
Injuries	\$130	16.3	26.2	25.8	22.7
Obesity	\$3	0.0	0.2	1.1**	12.0**
Health Check/EPST	\$52	53.1	57.7	54.4	50.6**

Note: One asterisk (\*) indicates that the difference between the percentage and the percentage for the normal weight group is statistically significant at the 90 percent confidence level. Two asterisks (\*\*) indicate that the difference is statistically significant at the 95 percent confidence level.

adolescents had higher average prescription drug expenditures than normal weight adolescents ( $p < .05$ ).

Table 4 shows the average expenditures for selected diagnosis groups across all BMI levels. It also shows the percentage of adolescents in each weight category who had one or more Medicaid paid claims in the diagnosis group. Overweight adolescents had significantly higher percentages who had a claim for diabetes, asthma, and other respiratory conditions, compared to the normal weight group ( $p < .05$ ). As expected, overweight adolescents were much more likely to have a medical claim paid by Medicaid where the primary diagnosis was obesity (ICD-9-CM code 278) ( $p < .05$ ). Overweight adolescents were significantly less likely than normal weight adolescents to have had a well-child care visit during the year ( $p < .05$ ).

The average expenditures for services with a diagnosis of mental disorder were by far the largest of any of the diagnosis categories. Comparing Tables 2 and 4, expenditures for services for mental disorders represent 64 percent of all Medicaid expenditures for this sample of adolescents (\$2,643 out of \$4,113). This compares to approximately 25 percent of Medicaid expenditures for mental disorders for all age groups. The percentage of adolescents with one or more claims for a mental disorder did not differ much by BMI category (Table 4). However, among those adolescents who did have a mental disorder claim, the average expenditure per adolescent was \$9,890 for normal weight, \$14,734 for at risk, and \$14,810 for overweight (data not shown in Table 4).

The most frequent detailed diagnoses for mental disorders (ranked by the number of claims) were oppositional disorder (ICD-9-CM code 313.81), attention deficit with hyperactivity (314.01), conduct disturbance not otherwise specified (312.9), adjustment reaction with mixed disturbance of emotions and conduct (309.4), conduct disorder – childhood onset type (312.81), prolonged post-traumatic stress disorder (309.81), and depressive disorder not elsewhere classified (311).

## Discussion

Children in North Carolina who receive well-child care and other services from public health department clinics were substantially more likely to be overweight than children in a representative national sample.<sup>3</sup> Twenty-eight percent of 6-11 year-olds and 27 percent of 12-18 year-olds seen in North Carolina public health departments in 2004 were overweight (Table 1). The comparable figures from the 2003-2004 national sample are 19 percent and 17 percent, respectively.<sup>3</sup> A statewide assessment of all Arkansas public school students showed that 21 percent of K-12 students were overweight in 2003-04 and 2004-05.<sup>12</sup> The differences between these studies and our study indicate that the children in our sample are a high-risk group.

Studies by Stettler et al.,<sup>13</sup> Gauthier et al.,<sup>14</sup> and Mirza et al.<sup>15</sup> of children in community health centers and inner-city clinics show overweight percentages more similar to ours. Children using public health departments and community health centers are at much higher risk for obesity. Like community health centers, public health departments play an important role in health care delivery because of the populations they serve (predominantly low socioeconomic status, underserved, and a high proportion of minorities). Children age 6 and older in North Carolina qualify for public health department services only if their family income is less than 100 percent of the federal poverty level. These health care providers are an important source of care to children who are overweight and should be a focus of efforts to address childhood obesity.

Anticipatory guidance by primary care providers is an important intervention for obesity. Public health departments can be an important health care resource for addressing childhood overweight in high-risk populations. Public health departments may provide more comprehensive well-child care than other providers. For example, a study of lead screening in North Carolina showed that public health departments screened a higher percentage of Medicaid children for lead poisoning during Health Check visits than did other providers.<sup>16</sup> However, our data suggest that overweight adolescents are not getting higher rates of anticipatory guidance during health department visits. A lower

percentage of the overweight adolescents in our sample had a Health Check/EPST visit, compared to the normal weight adolescents. Efforts should be made to assure that public health departments provide screening and counseling to low-income adolescents who are overweight.

It is well known that overweight and obesity are risk factors and predisposing conditions for diabetes. Our data suggest that there may be an early progression to diabetes in overweight adolescents. Our study also shows a significantly higher percentage of overweight adolescents with medical care claims for asthma and other respiratory conditions, compared to normal weight adolescents. A study by Gennuso, et al. of urban minority children and adolescents showed an association between asthma and obesity, and suggested that asthma is a risk factor for obesity in this predominantly Hispanic population.<sup>17</sup>

The very high average expenditures for the underweight adolescents may to some extent be due to an illness leading to a loss of weight. Also, the number of underweight adolescents in our sample is very small, so the results should be considered with caution. Due to the small sample size for the underweight group, only one difference was statistically significant: the underweight adolescents were more likely to have a claim paid by Medicaid with a diagnosis in the “ill-defined conditions” category, compared to the normal weight adolescents.

Our data show that despite a similar prevalence of overweight in African American and white adolescents, the average Medicaid expenditures for African Americans were much lower. This is consistent with the results of a previous North Carolina study of children ages 0-4,<sup>18</sup> in which African American children had significantly lower Medicaid expenditures than white children, even after statistically controlling for other maternal and infant characteristics that affect health service use. The authors concluded that “factors contributing to the lower use of health care services among African American children might include family transportation problems, shortages in the community of health care providers who accept Medicaid patients, lack of culturally appropriate health services, barriers to service accessibility in medical offices, and racial discrimination among health care providers.”<sup>18</sup>

In this study, treatment of mental disorders comprised a very high percentage of medical care services for adolescents. A recent national study<sup>19</sup> indicated that the annual number of children prescribed anti-psychotic drugs jumped fivefold between 1995 and 2002. We found much higher average medical care expenditures for mental disorders among the at-risk and overweight adolescents who did have a mental disorder claim, though the percentage of at-risk and overweight adolescents who had a mental disorder claim was not significantly higher than the percentage for normal weight adolescents. One study using a sample of children from the National Longitudinal Survey of Youth found that obese Hispanic and white females demonstrated significantly lower levels of self-esteem by early adolescence.<sup>20</sup> Also, obese children with decreasing levels of self-esteem had significantly higher rates of sadness, loneliness, and nervousness and were more likely to engage in high-risk behaviors such as smoking or consuming alcohol.<sup>20</sup>

A limitation of our study is that it does not use a representative sample of low-income adolescents in North Carolina. These data are specific for adolescents seeking health care at public health departments. Also, this is a descriptive study that can show only associations of BMI with medical care expenditures. We cannot demonstrate that differences in medical care expenditures are caused by the adolescents’ weight, as opposed to other factors that are associated with weight.

Overall, and in most demographic and service categories, the at-risk and overweight adolescents had substantially higher average Medicaid expenditures when compared to normal weight adolescents. Some of these differences are statistically significant. Further studies with a larger sample size could help confirm the suggestive findings from our study.

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