

# Overweight Among Young Children in the Philadelphia Health Care Centers

## Incidence and Prevalence

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**Objectives:** To estimate the prevalence and incidence of overweight among low-income, inner-city children aged 3 to 7 years and to determine predictors of changes in body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) percentile.

**Design:** Retrospective cohort study using administrative and medical records.

**Setting:** The Philadelphia Health Care Centers, 1996 through 2003.

**Participants:** Three hundred eighty-six patients who had at least 2 well-child visits between the ages of 3 and 7 years, had at least 1 visit between September 2001 and 2003, and were between the ages of 5 and 7 years at the most recent visit. Mean follow-up time was 2.4 years.

**Main Exposures:** Age, sex, race/ethnicity, and BMI percentile at baseline.

**Main Outcome Measures:** Prevalence and incidence

of overweight and at risk of overweight and change in BMI percentile.

**Results:** Prevalence of overweight at the initial visit was 18%, with 16% at risk of overweight. At the last visit, the prevalence of overweight was 19%, with 15% at risk of overweight. Based on maximum BMI percentile, 29% were overweight at some point and an additional 19% were at risk of overweight at least once. Annualized incidence of overweight among those not overweight at baseline was 5% per year: 2% per year for normal-weight children and 14% per year for children in the at-risk category. The outcomes were not associated with sex, race/ethnicity, or age at first or last visit. Incident overweight was positively associated with BMI percentile at baseline.

**Conclusion:** The early onset and frequent persistence of overweight demonstrated herein underline the need to prevent overweight among very young children.

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**O**BESITY HAS BECOME ONE OF the most important potentially modifiable causes of disability and disease in the United States.<sup>1</sup> Overweight beginning in childhood has increased dramatically in recent decades.<sup>2</sup> Overweight among children, like obesity among adults, is more common among African American and Hispanic individuals and individuals of lower socioeconomic status than other demographic groups.<sup>3-5</sup> These trends have tremendous implications for the health and quality of life of individuals and for health care costs and productivity of communities.<sup>6</sup>

Most of the available data on child overweight come from cross-sectional surveys or are restricted to older children and adolescents.<sup>2,4,5,7</sup> These data do not allow us to distinguish age differences in overweight from secular trends. Although most data suggest that among children, as

among adults, overweight tends to increase with age, some studies have found exceptionally high prevalence of overweight among very young children.<sup>8</sup> The age at incidence and the course of overweight among young children have not been extensively studied.

We studied the prevalence and incidence of overweight in a sample of patients aged 3 to 7 years who were treated in the Philadelphia Health Care Centers (HCCs). The HCCs are available to all Philadelphia, Pa, residents without regard to insurance status. The overwhelming majority of HCC patients have incomes lower than the poverty line, and most patients are drawn from high-poverty neighborhoods within the city. We sought to estimate the prevalence and incidence of overweight in this population and to determine whether they varied by sex, race/ethnicity, or age.

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**Table 1. Sample Characteristics**

Characteristic	No. (%)
Sample size	386 (100)
Sex	
Female	197 (51)
Male	189 (49)
Race/ethnicity	
Black	293 (76)
Hispanic	39 (10)
White	28 (7)
Asian	21 (5)
Other	4 (1)
Unknown	1 (0)
Age at beginning of follow-up, y	
3	191 (49)
4	110 (28)
5-6	85 (22)
Age at end of follow-up, y	
4-5	103 (27)
6	133 (34)
7	150 (39)

## METHODS

A retrospective cohort study was conducted using administrative and medical records. Pediatric patients who had received primary care services from the HCCs between September 2001 and September 2003, were between the ages of 5 and 7 years at their last visit within that period, and had at least 2 well-child visits between the ages of 3 and 7 years were identified from administrative records. Medical record numbers from each of the 8 neighborhood HCCs were randomized, and the first 50 from each HCC were selected for audit. Philadelphia Health Care Center clinical staff experienced in medical record review extracted demographic information, visit dates, and heights and weights at each visit for each of the selected medical records.

Age and body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) at each visit were calculated and compared with sex-specific and age-specific reference BMI tables to classify each patient as overweight ( $\geq 95$ th percentile), at risk of overweight (85th to  $< 95$ th percentile), normal weight (5th to  $< 85$ th percentile), or underweight ( $< 5$ th percentile) at each visit.<sup>9</sup>

Weight variables were assessed by sex, age at first and last visit, and race/ethnicity. Cumulative incidence of overweight among children not initially overweight was calculated as the number overweight at the end of follow-up divided by the number not overweight at the beginning of follow-up. Annualized incidence rates were calculated for children who were not overweight at baseline, using person-time at risk (from the baseline visit to the first visit at which the child was overweight or the last visit recorded), with confidence intervals calculated using the normal approximation with correction for continuity.<sup>10</sup> Bivariate associations of sex, race/ethnicity, and age at baseline with baseline overweight and overweight at the end of follow-up were evaluated with  $\chi^2$  tests and Fisher exact tests; multivariate associations were assessed using logistic regression. Proportional hazards regression was used to evaluate the same variables plus BMI percentile at baseline as predictors of incident overweight among those not overweight at baseline.

This study was approved by the Philadelphia Department of Public Health institutional review board. Parental consent requirements were waived because data were collected retrospectively.

Of the 400 medical records selected for audit based on the administrative data, 14 (3.5%) were found on medical record review to be ineligible, either because the patients were too young or too old or because there were fewer than 2 visits with heights and weights recorded. The 386 eligible patients who contributed data to the analysis included 197 girls and 189 boys (**Table 1**). Seventy-six percent of the sample were African American; the remainder were Hispanic (10%), non-Hispanic white (7%), Asian (5%), or other (1%). One patient did not have race/ethnicity recorded. The median age at the beginning of follow-up was 4.0 years (range, 3.0-6.6 years). Median follow-up time was 2.2 years (range, 142 days-4.9 years), including a median of 3 clinic visits (range, 2-9 visits).

The prevalence of overweight at the initial visit was 18% (95% confidence interval [CI], 15% to 22%), and 16% (95% CI, 12% to 20%) were at risk of overweight (**Table 2**). Six percent were underweight (95% CI, 3% to 8%). At the last visit, the prevalence of overweight was 19% (95% CI, 15% to 23%); at risk of overweight, 15% (95% CI, 11% to 19%); and underweight, 3% (95% CI, 2% to 5%). Looking at each patient's maximum BMI percentile during follow-up, 29% (95% CI, 25% to 34%) were overweight at some point, and an additional 19% (95% CI, 15% to 23%) were at risk of overweight at least once. Only 1 child was underweight throughout follow-up.

Of 315 children who were not overweight at the beginning of follow-up, 30 were overweight at the end of follow-up, for a cumulative incidence of overweight of 10% (95% CI, 6% to 13%). Among those initially at risk of overweight, the cumulative incidence was 26% (95% CI, 15% to 37%). Of those initially normal weight, the cumulative incidence of overweight was 6% (95% CI, 3% to 9%), and an additional 10% (95% CI, 6% to 14%) were at risk of overweight at the end of follow-up (**Table 3**). The annualized incidence of overweight was 5% per year: 2% per year for normal-weight children and 14% per year for children in the at-risk category. At the same time, 18% (95% CI, 10% to 30%) of those who were initially overweight and 40% (95% CI, 28% to 54%) of those initially at risk of overweight were normal weight at the end of follow-up.

None of the outcomes was significantly associated in either bivariate or multivariate analyses with sex, race/ethnicity, or age at first or last visit (data not shown). Incident overweight was positively associated with BMI percentile at baseline, with a hazard ratio of 1.53 (95% CI, 1.25 to 1.86) for each additional 10-percentile increment in BMI at baseline.

The mean change in BMI percentile between the first and last visit was 3.71 (95% CI, 1.18 to 6.25); on an annualized basis, the mean change was 1.36 (95% CI, 0.01 to 2.72). While overall the sample became slightly heavier (compared with age norms) over time, there was great variability in weight change. There was a strong negative correlation between initial BMI percentile and change in BMI percentile ( $r = -0.52$ ;  $P < .001$ ). Mean change in BMI percentile per year varied significantly by weight cat-

**Table 2. Weight Status at Beginning and End of Follow-up and Maximum BMI**

	Weight Status, No. (%)			
	Overweight	At Risk	Normal Weight	Underweight
First visit	71 (18)	62 (16)	231 (60)	22 (6)
Last visit	74 (19)	58 (15)	241 (62)	13 (3)
Maximum BMI percentile during follow-up	113 (29)	74 (19)	198 (51)	1 (0)

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared).

**Table 3. Weight Status at End of Follow-up by Weight Status at Baseline**

Weight Status at Beginning of Follow-up	Weight Status at End of Follow-up, No. (%)				
	Overweight	At Risk	Normal Weight	Underweight	Total
Overweight	44 (62)	13 (18)	13 (18)	1 (1)	71 (100*)
At risk	16 (26)	20 (32)	25 (40)	1 (2)	62 (100)
Normal weight	13 (6)	24 (10)	186 (81)	8 (3)	231 (100)
Underweight	1 (5)	1 (5)	17 (77)	3 (14)	22 (100*)
<b>Total</b>	<b>74 (19)</b>	<b>58 (15)</b>	<b>241 (62)</b>	<b>13 (3)</b>	<b>386 (100*)</b>

\*Totals do not sum to 100% because of rounding.

egory at baseline. Mean BMI percentile change among children initially overweight was  $-7.8$  per year (95% CI,  $-11.6$  to  $-4.0$ ); among children initially at risk of overweight, it was  $-9.2$  per year (95% CI,  $-14.2$  to  $-4.2$ ); and among children initially normal weight, it was  $8.2$  per year (95% CI,  $4.9$  to  $11.4$ ).

### COMMENT

Our results show that overweight was common among low-income children as young as 3 years of age in the HCCs; that incidence of overweight beginning between ages 3 and 7 years was common, especially among children initially higher than the 85th percentile of BMI; and that average weights increased slightly over time relative to age-specific norms. Although there was substantial intraindividual variation in weight over time, a majority of those who were overweight when first assessed at ages 3 to 5 years remained overweight at the end of 2 or more years' follow-up. More than one fourth of the children in the at-risk category progressed to overweight during the same period, but most of the children who were normal weight at first assessment remained within the normal weight range. The overall tendency in this group was toward increasing weight relative to age norms. Among those not overweight at baseline, BMI percentile at baseline was the only significant predictor of incident overweight; odds of becoming overweight increased 53% with each increment of 10 in BMI percentile (eg, the difference between the 50th percentile and the 60th).

The small number of children in racial/ethnic groups other than African American limited our ability to assess differences associated with race/ethnicity, but the absence of either racial/ethnic or sex differences suggests that in this low-income, inner-city public health care cen-

ter population, social and economic conditions may be more important than the biological correlates of race and sex in influencing overweight among young children.

The inverse correlation between initial BMI percentile and mean change in BMI percentile during follow-up is most likely a reflection of the principle of "regression to the mean": when subjects are characterized based on a single measurement of a characteristic that has substantial intra-individual variability, those at the extremes will tend to move toward the average in subsequent measurements.<sup>11</sup> A similar pattern was seen in a study that tracked weight-for-height percentiles for children followed up from infancy through age 4 years.<sup>12</sup> The overall data show that the prevalence of overweight did not increase between ages 3 and 7 years in the HCC patient population, despite considerable change in individual weight status.

The limitations of the study include possible mismeasurement because the data were extracted from clinical practice records, not collected as research data. The population of the HCCs disproportionately includes uninsured and underinsured families and may not be representative of other low-income populations. Because all HCC visits within the follow-up period were included, some children may have been dehydrated as a result of illness and therefore had misleadingly low weights at some visits. Restriction of the sample to children with at least 2 well-child visits excludes families who are not adherent to recommendations for well-child care, as well as those who use the HCCs only briefly, a group that includes both unstable and transient families and those who use the HCCs only during a brief gap in health insurance.

The incidence of overweight during follow-up in this study corresponds to the well-known period of "adiposity rebound" between ages 3 and 6 years.<sup>13</sup> Rapid weight gain in this period has been shown to correspond to substantial increased risk of overweight at age 17 years.<sup>14</sup> Our

observation that very early overweight frequently persists over follow-up of several years is consistent with that of the Study of Early Child Care and Youth Development, which found overweight at age 3 years strongly correlated with overweight at age 12 years.<sup>15</sup> This persistence, together with the high prevalence of overweight among the youngest children in this population, suggests the urgent need for increased focus on the prevention of overweight among very young children, including those younger than 3 years. Health care professionals are appropriately cautious in advising parents regarding overweight in young children because of the role of adequate lipid levels in the development of the central nervous system<sup>16</sup> and children's need for adequate intake of calcium, protein, and other nutrients. In addition, research suggests that parental control of food choices may produce the opposite of the intended results, increasing child preferences for restricted foods and reducing willingness to eat more nutritious foods.<sup>17</sup> Recent recommendations strongly support efforts to achieve healthy weight in young children by promoting breastfeeding; increasing consumption of nutrient-dense foods while decreasing consumption of highly processed and saturated fat-laden foods, juices, and sweetened beverages; and avoiding rapid weight gain.<sup>18</sup> Additional research and guidance are still urgently needed to equip health care professionals to provide appropriate advice and effective interventions, especially for very young children.

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