Health-Related Quality of Life of Severely Obese Children and Adolescents

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Obesity is one of the most common chronic disorders in childhood and its prevalence continues to increase rapidly. There is a growing awareness of the long-term health complications of obesity in children and adolescents, yet many pediatricians do not offer treatment to obese children and adolescents in the absence of comorbid conditions. However, the most widespread consequences of childhood obesity may be psychosocial.

Obese children and adolescents are at risk for psychological and social adjustment problems, including lower perceived competencies than normative samples on social, athletic, and appearance domains, as well as overall self-worth.

While aspects of self-esteem may predict psychological adjustment, including depressive symptoms, health-related quality of life (QOL) is a more comprehensive and multidimensional construct, and includes physical, emotional, social, and school functioning. Although pediatricians believe that being overweight in childhood or adolescence affects future QOL, there is little existing information about the health-related QOL of obese children and adolescents. In contrast, numerous studies have been conducted in obese adults and have demonstrated lower health-related QOL than among nonobese adults. However, the health-related QOL differences in adults vary by sex and body mass index (BMI), and are not consistent across all domains tested. Further, while physical functioning and overall health-related QOL scale scores are consistently lower in obese adults, emotional functioning and

Context One in 7 US children and adolescents is obese, yet little is known about their health-related quality of life (QOL).

Objective To examine the health-related QOL of obese children and adolescents compared with children and adolescents who are healthy or those diagnosed as having cancer.

Design, Setting, and Participants Cross-sectional study of 106 children and adolescents (57 males) between the ages of 5 and 18 years (mean [SD], 12.1 [3] years), who had been referred to an academic children's hospital for evaluation of obesity between January and June 2002. Children and adolescents had a mean (SD) body mass index (BMI) of 34.7 (9.3) and BMI z score of 2.6 (0.5).

Main Outcome Measures Child self-report and parent proxy report using a pediatric QOL inventory generic core scale (range, 0-100). The inventory was administered by an interviewer for children aged 5 through 7 years. Scores were compared with previously published scores for healthy children and adolescents and children and adolescents diagnosed as having cancer.

Results Compared with healthy children and adolescents, obese children and adolescents reported significantly (P<.001) lower health-related QOL in all domains (mean [SD] total score, 67 [16.3] for obese children and adolescents; 83 [14.8] for healthy children and adolescents). Obese children and adolescents were more likely to have impaired health-related QOL than healthy children and adolescents (odds ratio [OR], 5.5; 95% confidence interval [CI], 3.4-8.7) and were similar to children and adolescents diagnosed as having cancer (OR, 1.3; 95% CI, 0.8-2.3). Children and adolescents with obstructive sleep apnea reported a significantly lower health-related QOL total score (mean [SD], 53.8 [13.3]) than obese children and adolescents without obstructive sleep apnea (mean [SD], 67.9 [16.2]). For parent proxy report, the child or adolescent's BMI z score was significantly inversely correlated with total score (r = -0.263; P = .01), physical functioning (r = -0.347; P < .001), and psychosocial functioning (r = -0.209; P = .03).

Conclusions Severely obese children and adolescents have lower health-related QOL than children and adolescents who are healthy and similar QOL as those diagnosed as having cancer. Physicians, parents, and teachers need to be informed of the risk for impaired health-related QOL among obese children and adolescents to target interventions that could enhance health outcomes.

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mental health domains have not been found to be uniformly lower than in healthy adults.10

We hypothesized that obese children and adolescents, when compared with healthy children and adolescents, would have worse health-related QOL findings as seen in other pediatric chronic health conditions.7,12-14 We also hypothesized that greater BMI values would correlate with lower overall health-related QOL. Finally, to establish a clinical context for the health-related QOL of obese children and adolescents, we compared health-related QOL of obese children and adolescents with that of children and adolescents diagnosed as having cancer and who were receiving chemotherapy.13 We chose cancer because it is a chronic health condition with known impaired health-related QOL.

METHODS

Subjects

A pediatric QOL inventory (PedsQL 4.0) generic core scale was used as the measure of health-related QOL. Obese children and adolescents between the ages of 5 and 18 years, who were newly referred to pediatric gastroenterology or nutrition clinics at Children’s Hospital and Health Center (San Diego, Calif) for the evaluation of obesity between January and June 2002, were recruited. Exclusion criteria were genetic syndromes associated with obesity, cerebral palsy, spina bifida, hypothyroidism, and living in a group home or institutionalized facility. Written parental informed consent and child assent were obtained prior to participation in the study. University of California (San Diego) and Children’s Hospital institutional review boards approved the research protocol.

Comparison Groups

Published pediatric QOL inventory reference data were used for comparison.7,13 The primary comparison was with healthy children and adolescents aged 5 to 18 years, who were recruited from private practice pediatrician offices and community health clinics.7 These children and adolescents had scores similar to more than 8000 healthy children and adolescents in a study in progress (unpublished data, 2003) and are therefore thought to be representative of healthy children and adolescents in California.

As a secondary comparison, children and adolescents diagnosed as having cancer and who were receiving chemotherapy (including induction and maintenance) were recruited at 2 large children’s hospitals and were considered representative of pediatric cancer patients receiving chemotherapy at those hospitals. These cancer patients were used because they reported the lowest scores of any chronic illness group assessed with a pediatric QOL inventory.15 Demographic characteristics for the healthy children and adolescents and those diagnosed as having cancer are presented in Table 1.

Procedures

Anthropometrics. Height was measured to the nearest 1 mm using a wall-mounted stadiometer and weight was measured to the nearest 0.1 kg using a balance scale. Body mass index was calculated as the weight in kilograms divided by the height in meters squared. Obesity was defined as a BMI in the 95th percentile or higher for age and sex.15-16 The BMI z scores were calculated to compare subjects across age and sex.

Comorbid Conditions. A medical history, physical examination, and laboratory evaluation were performed based on expert committee recommendations.17 The obesity-related comorbid conditions assessed were diabetes mellitus, obstructive sleep apnea (OSA), tibia vara, polycystic ovary syndrome, nonalcoholic fatty liver disease, fasting hyperinsulinemia (fasting serum insulin >20
with obesity. Subjects were deter-

The 23-item pediatric QOL inven-
tory generic core scales encompass
physical functioning (8 items), emo-
tional functioning (5 items), social func-
tioning (5 items), and school functioning (5 items). A 5-point response scale was used (0 = never a problem; 4 = almost always a problem). Items are re-
verse-scored and linearly transformed to
a zero to 100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, 4 = 0), so that higher scores indi-
cate better health-related QOL. A total
core scale score (derived by the mean of all
23 items) and a psychosocial health sum-
mary score (composed of the mean of
items in the emotional, social, and school
functioning subscales) are calculated to
provide a summary of the child or ado-
lescent's health-related QOL. The total
core scale score for both child self-report
and parent proxy report has been demon-
strated to approach or exceed a Cron-
bach α reliability coefficient of .90, which
is recommended for individual patient
analysis24,25 and that makes the total scale
core score as a summary score for the
primary analysis of health-related QOL
outcome in clinical trials and other
group comparisons. If there are signif-
icant differences between groups for the
total scale score, secondary analysis may
be done using the physical health scale
and the psychosocial health summary
differences. The individual emotional,
social, and school functioning subscales
are recommended to examine specific do-
main of functioning for descriptive
analyses because they have the lowest
reliability coefficients of all the QOL in-
ventory scores, although in general they
exceed the minimum of .70 recom-
dended for group analysis. These rec-
ommendations are meant to base the pri-
mary analysis on the most reliable scale
scores, while also controlling for the
number of statistical tests conducted to
reduce type I error.

Data Analysis
We compared QOL scores using inde-
pendent sample t tests.26,27 To deter-
mine the magnitude of the differences
between healthy and obese children and
adolescents, effect sizes were calcu-
lated by taking the difference between
the scale means for the obese and
healthy samples divided by the SDs of the
healthy sample. Effect sizes were
designated as small (0.20), medium
(0.50), and large (0.80).28 Impaired
health-related QOL was defined as a
score that was more than 1 SD below
the healthy sample mean. Odds ratios
(ORs) were calculated to determine the
likelihood of obese children and ado-
lescents having impaired health-
related QOL for both total scale and
subscale scores compared with healthy
children and adolescents and those di-
agnosed as having cancer.

We explored the independent and
group contributions of demographic
variables to health-related QOL scores.
Differences in health-related QOL
scores for sex and ethnicity were ex-
plored using a t test and a 1-way analy-
sis of variance. A Bonferroni correc-
tion was used to account for multiple
comparisons, resulting in an adjusted
significance level of .007. All t tests
reported met this adjusted level of sig-
nificance. Pearson correlations were
conducted for age and SES. We also
conducted a stepwise multiple regres-
sion analysis, with the child self-
report total score as the dependent vari-
able and age, sex, SES, and ethnicity as
independent variables.

The influence of the degree of obe-
sity was explored by analyzing Pearson
correlations between BMI z scores and
QOL inventory scores. Scores for obese
children and adolescents with and with-
out obesity-related comorbid condi-
tions were also compared using the t test.
Statistical analyses were conducted us-
ing SPSS statistical software.29 Re-
ponses were pooled across languages
and ages as previously validated for both
self-report and proxy report.7

RESULTS
Clinical Characteristics
Inclusion criteria were met by 108 of
115 children and adolescents evalu-
ated for obesity. Of these 108, 2 chil-
dren or adolescents and 3 parents de-
clined to participate. Table 1 presents
the clinical characteristics of the 106 chil-
dren and adolescents who completed a
**Table 2. Generic Quality of Life Core Scales for Obese and Healthy Children and Adolescents**

<table>
<thead>
<tr>
<th>No. of Items</th>
<th>No. of Individuals</th>
<th>Mean (SD)</th>
<th>No. of Individuals</th>
<th>Mean (SD)</th>
<th>Difference</th>
<th>Effect Size</th>
<th>df</th>
<th>t Test(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child self-report total score</td>
<td>23</td>
<td>106</td>
<td>67.0 (16.3)</td>
<td>401</td>
<td>83.0 (14.8)</td>
<td>16.0</td>
<td>1.08</td>
<td>505</td>
</tr>
<tr>
<td>Physical health score</td>
<td>8</td>
<td>106</td>
<td>71.0 (18.8)</td>
<td>400</td>
<td>84.4 (17.3)</td>
<td>13.4</td>
<td>0.78</td>
<td>504</td>
</tr>
<tr>
<td>Psychosocial health score</td>
<td>15</td>
<td>106</td>
<td>64.9 (17.7)</td>
<td>399</td>
<td>82.4 (15.5)</td>
<td>17.5</td>
<td>1.13</td>
<td>503</td>
</tr>
<tr>
<td>Emotional functioning</td>
<td>5</td>
<td>106</td>
<td>63.2 (20.1)</td>
<td>400</td>
<td>80.9 (19.6)</td>
<td>17.7</td>
<td>0.90</td>
<td>504</td>
</tr>
<tr>
<td>Social functioning</td>
<td>5</td>
<td>105</td>
<td>67.5 (25.0)</td>
<td>399</td>
<td>87.4 (17.2)</td>
<td>19.9</td>
<td>1.16</td>
<td>502</td>
</tr>
<tr>
<td>School functioning</td>
<td>5</td>
<td>106</td>
<td>64.1 (20.4)</td>
<td>386</td>
<td>78.6 (20.5)</td>
<td>14.5</td>
<td>0.71</td>
<td>490</td>
</tr>
<tr>
<td>Parent proxy report total score</td>
<td>23</td>
<td>105</td>
<td>63.3 (19.2)</td>
<td>388</td>
<td>87.6 (12.1)</td>
<td>24.3</td>
<td>2.01</td>
<td>491</td>
</tr>
<tr>
<td>Physical health score</td>
<td>8</td>
<td>105</td>
<td>63.6 (24.0)</td>
<td>389</td>
<td>89.1 (16.0)</td>
<td>25.5</td>
<td>1.60</td>
<td>492</td>
</tr>
<tr>
<td>Psychosocial health score</td>
<td>15</td>
<td>105</td>
<td>63.1 (18.6)</td>
<td>388</td>
<td>86.7 (12.9)</td>
<td>23.6</td>
<td>1.83</td>
<td>491</td>
</tr>
<tr>
<td>Emotional functioning</td>
<td>5</td>
<td>105</td>
<td>60.9 (21.7)</td>
<td>388</td>
<td>82.2 (18.4)</td>
<td>21.3</td>
<td>1.16</td>
<td>491</td>
</tr>
<tr>
<td>Social functioning</td>
<td>5</td>
<td>105</td>
<td>67.2 (26.1)</td>
<td>388</td>
<td>92.5 (13.1)</td>
<td>25.3</td>
<td>1.93</td>
<td>491</td>
</tr>
<tr>
<td>School functioning</td>
<td>5</td>
<td>105</td>
<td>61.4 (21.5)</td>
<td>377</td>
<td>85.5 (17.0)</td>
<td>24.1</td>
<td>1.42</td>
<td>480</td>
</tr>
</tbody>
</table>

*Adapted from published data.*

†Designated as small (0.20), medium (0.50), and large (0.80).

‡All values are significant at the \(P<.001\) level.

QOL inventory and who are included in the analysis. The mean (SD) BMI was 34.7 (9.3). A majority (65.1%) of the sample had 1 or more obesity-related comorbid conditions: diabetes mellitus (3.8%), OSA (6.6%), tibia vara (1.9%), polycystic ovary syndrome (2.8%), non-alcoholic fatty liver disease (28.3%), hyperinsulinemia (51.9%), and dyslipidemia (36.8%). Asthma was present in 9 children and adolescents (8.5%), which is similar to national prevalence data. Anxiety or depression was preexisting or subsequently diagnosed in 14 children and adolescents (13.2%), which is somewhat higher than the national childhood prevalence. During the month prior to evaluation, obese children and adolescents missed more days from school (mean [SD] of 4.2 [7.7] days and median [range] of 1.0 [0-30] days) than healthy children and adolescents (mean [SD] of 0.7 [1.7] days and median [range] of 0 [0-17] days; \(P<.001\)).

**Health-Related QOL**

Obese children and adolescents reported significantly \((P<.001)\) lower health-related QOL in all domains compared with healthy children and adolescents (Table 2). For example, the mean (SD) total score was 67.0 (16.3) for obese children and adolescents and 83.0 (14.8) for healthy children and adolescents. The parent proxy report scores were not only significantly \((P<.001)\) lower than the reference population, they were also lower than the self-report scores for most domains. For total score, the parents of obese children and adolescents reported a mean (SD) of 63.3 (19.2) compared with 87.6 (12.1) for parent proxy reports for healthy children and adolescents.

In the obese cohort, the prevalence of impaired health-related QOL (child vs parent report) was determined for total score (49% vs 65%), psychosocial health (50% vs 65%), physical functioning (41% vs 55%), emotional functioning (46% vs 59%), social functioning (51% vs 57%), and school functioning (39% vs 60%). Obese children and adolescents were more likely to have impaired health-related QOL than healthy children and adolescents (ie, total score: OR, 5.5 [95% confidence interval (CI), 3.4-8.7]) and were similar to children and adolescents diagnosed as having cancer (total score: OR, 1.3 [95% CI, 0.8-2.3]; Table 3).

**Influence of Demographic Variables, Clinical Variables, and Comorbid Conditions**

Within the obese group, there were no significant differences in QOL scores by sex or ethnicity. Age or SES were not significantly correlated with QOL scores. Stepwise multiple regression analysis using demographic variables also indicated no significant contributions to QOL scores. Using standard sample size and power tables with an \(\alpha = .05\) and power of .80, we determined that we would need a minimum of 2474 subjects to detect significant differences in QOL scores on the basis of sex, 400 subjects for ethnicity, 194 subjects for age, and 3134 subjects for SES.

The BMI \(z\) scores showed small but significant inverse correlations with child self-report for physical \((r = -0.233; \ P = .02)\) and social functioning \((r = -0.228; \ P = .02)\). For parent proxy report, the BMI \(z\) score for children and adolescents was significantly inversely correlated with total score \((r = -0.246; \ P = .01)\), physical functioning \((r = -0.263; \ P < .01)\), social functioning \((r = -0.347; \ P < .001)\), and psychosocial functioning \((r = -0.209; \ P = .03)\).

Of all 7 obesity-related comorbid conditions assessed, only children and adolescents with OSA reported significantly lower health-related QOL (mean [SD] scores: total, 53.8 [13.3]; physical functioning, 54.7 [17.6]) compared with obese children and adolescents without OSA (total, 67.9 [16.2]; physical functioning, 71.9 [18.1]). There was no significant difference in mean (SD) total score between obese children and ado-
voices with (57.7 [19.0]) and without asthma (67.9 [15.9]; \( P = .07 \)). Eliminating children and adolescents with asthma from the obese sample did not change the overall results. There was also no significant difference in mean (SD) total score for obese children and adolescents with depression or anxiety (62.1 [15.1]) vs those obese children and adolescents without a psychiatric diagnosis (67.7 [16.4]; \( P = .27 \)). Finally, there was not a significant difference in mean (SD) total score for obese children and adolescents with (65.6 [16.0]) and without an obesity-related comorbid condition (69.7 [16.9]; \( P = .23 \)).

**COMMENT**

These data demonstrate a significant relationship between severe obesity and impaired health-related QOL in children and adolescents aged 5 to 18 years. The obese children and adolescents reported significant impairment not only in total scale score, but also in all domains—physical, psychosocial, emotional, social, and school functioning—in comparison with healthy children and adolescents. The likelihood of an obese child or adolescent having impaired health-related QOL was 5.5 times greater than a healthy child or adolescent and similar to a child or adolescent diagnosed as having cancer. Children and adolescents diagnosed as having cancer and who were receiving chemotherapy were previously found to have the lowest QOL scores when compared with healthy children and adolescents and children and adolescents with juvenile rheumatoid arthritis, type 1 diabetes mellitus, and congenital heart disease.\(^7,12-14,32,33\) Children and adolescents diagnosed as having cancer experience severe adverse effects due to treatment\(^34\) and consequently often have difficulties keeping up with their peers and maintaining normal activities.\(^35\) Young cancer patients also may experience teasing and withdrawal from peers at school.\(^36\) Although obese children and adolescents may also experience physical limitations and teasing from peers, they are often not exposed to the intense medical interventions (and subsequent adverse effects) that are common in pediatric cancer. Thus, the similar health-related QOL of the obese sample was an unexpected and important finding.

Our sample’s demographics are notably different from the samples in much of the obesity literature, specifically in the greater number of young children and adolescents, boys, and Hispanics. Our inclusion of a large number of Hispanic American boys is important, as epidemiological studies report a high prevalence of obesity for this population in the United States.\(^37,38\) For example, the prevalence of obesity in Mexican American boys aged 6 to 11 years increased from 17.5% for 1988-1994 to 27.3% for 1999-2000.\(^37\) In the only study previously addressing health-related QOL of obese children and adolescents, children being admitted to German rehabilitation facilities were evaluated by comparing obese children and adolescents with those with asthma and atopic dermatitis.\(^39\) The authors concluded that obese girls and adolescents older than 13 years had lower health-related QOL. No data were reported regarding the degree of obesity or the prevalence of comorbid conditions. Among adults, obesity-related impairment of health-related QOL is greatest among white non-Hispanics, women, those with higher BMIs, and those seeking the most intensive treatments.\(^40\) In our study, health-related QOL did not vary by age, sex, race, and socioeconomic status did not contribute to the scores.

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Studies of obese adults most consistently show decreased physical functioning.\(^41\) The obese children and adolescents in our study were 5 times more likely than healthy children and adolescents to have impaired physical functioning. Furthermore, Doll et al\(^41\) reported that physical functioning decreased with increasing weight among British adults. We also observed that the BMI z score among obese children and adolescents was inversely correlated with physical functioning. This supports the idea that the diminished ability to move with increasing weight leads to a decrease in caloric expenditure with the potential consequence of a further mismatch in energy balance leading to additional weight gain.

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Obesity is one of the most stigmatizing and least socially acceptable conditions in childhood. In keeping with previous studies, the children and adolescents in our study were most likely to demonstrate impairment in psychosocial health when compared with healthy children and adolescents—5.9 times for child self-report and 13.6 times for the parent proxy report. Furthermore, obese children and adolescents were 4 times more likely than healthy children and adolescents to report impaired school function. This is consistent with a study in Thailand, which reported that overweight children and adolescents in grades 7 through 9 were twice as likely to have low grades in math and language as healthy children and adolescents. Obese children and adolescents in our study also missed a mean of 4.2 days of school in the month prior to evaluation. The reasons for absenteeism were not investigated, but increased school absenteeism has been documented in children and adolescents with other chronic diseases including diabetes and asthma. Missed school days may subsequently lead to decreased school performance. The long-term consequences of school absenteeism are not known, but for females, being overweight as an adolescent may be associated with the completion of fewer years of school.

The most common comorbidities present in the obese sample, dyslipidemia and hyperinsulinemia, are silent precursors to cardiovascular disease and diabetes. Few of the children and adolescents had an obesity-related comorbid condition that was readily apparent (eg, tibia vara or OSA). For the most part, neither obesity-related comorbid conditions nor psychiatric disorders were responsible for differences in health-related QOL. In contrast, in a large study of adults in England, comorbid disease was a strong influence on weight- and health-related QOL. In obese children and adolescents, only OSA was associated with significantly greater impairment in QOL total score, which is consistent with a report of frequent QOL concerns in adults with severe OSA. The limitations of our study are due to the process of subject ascertainment and the degree of obesity encountered. The cohort studied was markedly obese with a mean BMI z score of 2.6 (a BMI of approximately 38 in an adult). Whether the findings reported would be seen in children and adolescents with lesser degrees of obesity is unknown. Furthermore, these children and adolescents were selected on the basis of having been referred for evaluation and management of obesity. In adults, seeking treatment for obesity is associated with lower self-reported health-related QOL. In pediatrics, the concept of seeking treatment is more complicated because the impetus may come from the primary care physician, parent, or child or adolescent. A population-based study in children and adolescents would add to the understanding of the effect of weight status on health-related QOL.

In conclusion, even in the absence of comorbid disease, severely obese children and adolescents reported impaired health-related QOL. It is critical for physicians, parents, and teachers to be aware of the risk for impaired QOL in these children and adolescents. We propose that studies of targeted interventions to treat obesity in children and adolescents should include an assessment of health-related QOL before, during, and after the intervention. Such clinical trials would provide the opportunity to evaluate the comprehensive effects of an intervention, not just on weight status, but also on the health-related QOL of the children and adolescents.

Author Contributions: Study concept and design: Schwimmer, Varni. Acquisition of data: Schwimmer, Varni. Analysis and interpretation of data: Schwimmer, Burwinkle, Varni. Drafting of the manuscript: Schwimmer, Burwinkle, Varni. Critical revision of the manuscript for important intellectual content: Schwimmer, Burwinkle, Varni. Statistical expertise: Burwinkle, Varni. Obtained funding: Schwimmer. Administrative, technical, or material support: Burwinkle, Varni. Study supervision: Varni.

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No man ever became wise by chance.
—Lucius Annaeus Seneca (the Younger) (c 4 BC–AD 65)