



Physical and psychosocial determinants of quality of life in children with obesity

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ABSTRACT

Background: Obesity has a negative impact on the physical and psychosocial quality of life of children. As rates of obesity continue to increase, it is important to recognize the widespread effects obesity has on children and their families.

Methods: This clinical investigation evaluated the self-reported quality of life of children with obesity in a weight management program and compared this to a parent/guardian's perspective of the child's quality of life using the Pediatric Quality of Life survey 4.0. The quality of life of children with obesity was compared to children with other chronic diseases and healthy children.

Results: An association was discovered between the guardians' responses to the Pediatric Quality of Life survey and the child's age. Guardians with children younger than 11 years reported higher quality of life scores than guardians of children 11 years and older. Race, comorbidities of obesity, insurance type, household structure, and parental education attainment were not significantly associated with a child's quality of life. Children with obesity had a lower quality of life compared to children who were organ transplant recipients and children with organic gastrointestinal disease.

Conclusions: These results emphasize the need to evaluate and treat the physical and psychosocial components of wellbeing in children with obesity at an early age.

1. Introduction

The prevalence of obesity in the U.S. has markedly increased from 13.7% to 15.4% over the last decade [1]. Children are acquiring chronic diseases, such as type II diabetes and non-alcoholic fatty liver disease, at young ages due to the rising early onset of obesity. The negative long-term impact obesity has on a child's physical and psychological quality of life along with a dearth of treatment options continue to be a focus of concern within the medical community. Additionally, family dynamics for children with obesity can often be impaired [2], thus, the primary aim of this study was to investigate perceived differences in quality of life (QOL) scores between youth and their caregivers who were enrolled in a pediatric weight management program. The study

also analyzed secondary associations across demographics, including biological sex, age, race, insurance type, and parental status, as well as associations between the severity of obesity, and its comorbidities, such as diabetes, dyslipidemia, and non-alcoholic fatty liver disease (NAFLD). The final aim explored the association between self-reported quality of life for children with obesity, healthy children, and children with functional gastrointestinal disorders, organic gastrointestinal diseases, and organ transplantations. A better understanding of the contributing factors to a child's quality of life will enable individualized, comprehensive care to be provided.

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2. Methods

2.1. Subjects

This prospective observational cohort study included 143 children under the age of 18 years who participated in the Weight Management Program at an academic children's hospital from October 2018 to January 2021. Children were classified as having class 1, 2, or 3 obesity based on BMI percentile for age and sex at the initial clinic visit. Class 1 obesity is defined as a BMI 95% to <120% of the 95th percentile. Class 2 obesity is classified as a BMI 120% to <140% of the 95th percentile. Class 3 is classified as a BMI greater than 140% of the 95th percentile. All weights were obtained on a consistent, calibrated standing scale and height was measured using the same scale with a height rod. All subject data were stored in a secure electronic REDCap database which received IRB approval from Indiana University School of Medicine to conduct prospective research investigations.

2.2. Demographics and comorbidities of obesity

Demographics and clinical variables were collected from subjects at the time of study enrollment. Variables included age, sex, race/ethnicity, BMI, comorbidities of obesity, home parental status, and insurance type. The prevalence of various comorbidities, including dyslipidemia, prediabetes, Type 2 diabetes mellitus, and elevated liver enzymes suggestive of nonalcoholic fatty liver disease, was determined. Dyslipidemia was defined as having either a total cholesterol ≥ 200 mg/dL or triglycerides ≥ 150 mg/dL. Prediabetes was defined as participants having an HbA1c of 5.7–6.4%, and Type 2 diabetes mellitus was defined as having an HbA1c of 6.5% or greater. Elevated liver enzymes were defined as having an ALT and AST ≥ 50 U/L [3].

2.3. Pediatric Quality of Life survey

The Pediatric Quality of Life survey (PedsQL) 4.0 is a modular instrument for measuring health-related quality of life in children ages 2–18. It is administered by paper at the first clinic visit to each child and parent/guardian, and it is available in English and Spanish. It consists of 23 items that encompass various aspects of a child's quality of life perception. The four categories assessed by the PedsQL are Physical functioning (8 items), Emotional functioning (5 items), Social functioning (5 items), and School Functioning (5 items). Total scaled scores range from 0 to 100. The psychosocial score is the mean of the emotional, social, and school functioning scaled scores. The total scaled score and the psychosocial score comprise the health-related QOL for a child. Higher scores equate to a more positive perception of health-related quality of life [4].

2.4. Comparison of quality of life across disease states

Additionally, this study compared the PedsQL scores of study participants and children with other chronic conditions. PubMed was used to identify articles with the following inclusion criteria: study used the English PedsQL4.0 Generic version, child and guardian total scores and subset scores were reported, similar study cohort size, and conducted a cross-sectional study. Following inclusion criterion, two articles were selected which evaluated the PedsQL scores in children who received an organ transplant and had either a functional gastrointestinal disorder (FGID) or an organic gastrointestinal (GI) disease [4,5]. The FGIDs included chronic constipation, functional abdominal pain, irritable bowel syndrome, and functional dyspepsia. Organic GI diseases included Crohn's disease, ulcerative colitis, and gastroesophageal reflux disease [5]. We also compared our study findings to PedsQL scores in children with no medical diagnoses [6]. Obesity was not a disease of exclusion in the comparison studies.

2.5. Data analysis

Analysis of variance (ANOVA) was used to determine if there was an association of quality of life (physical, psychosocial and total scores) with subject demographics and comorbidities. Paired t-tests determined if there was a significant difference in child-reported scores and guardian-reported scores. We also assessed the agreement between child and guardian scores using the Intraclass Correlation Coefficient (ICC).

Previous investigations have demonstrated that healthy children and their guardians report PedsQL scores of approximately 80 [6]. In our study, a score of 80 and above was designated as a positive quality of life score. McNemar's test determined if the dichotomous outcomes of scores < 80 and ≥ 80 differed between children and guardians. The Kappa coefficient assessed agreement between the dichotomous scores for the two groups. Additionally, two sample t-tests compared the mean PedsQL scores obtained from the study subjects to mean scores obtained from studies involving various pediatric health problems. A p-value < 0.05 was used to define statistical significance, and all analyses were performed using SAS v9.4.

3. Results

3.1. Clinical characteristics

This study included 143 children with obesity who were enrolled in a weight management program. 55 (38.5%) were female and the mean age of the cohort was 11.8 years (SD = 3.2). The study included 3 (2.6%) Asians, 30 (25.6%) Blacks, 19 (16.2%) Hispanics, and 65 (55.6%) Whites. When assessing severity of obesity, 69 (63.3%) participants had Class 3 obesity. Important social determinants of health in this study included that 78 (55.3%) had Medicaid insurance, and 86 (60.6%) lived in a dual-parent household. Many youth have developed complications of obesity including those 37 (25.9%) who had prediabetes, 32 (22.4%) with dyslipidemia, and 18 (12.6%) with elevated liver enzymes (Table 1).

Table 1
Demographics and clinical characteristics.

| Clinical Characteristic | N (%) |
|-------------------------------------|-------------|
| Biological Sex (N = 143) | |
| Female | 55 (38.5%) |
| Age (N = 143) | |
| < 11 | 40 (28.0%) |
| ≥ 11 | 103 (72%) |
| Race/Ethnicity (N = 117) | |
| Asian | 3 (2.6%) |
| Black | 30 (25.6%) |
| Hispanic | 19 (16.2%) |
| White | 65 (55.6%) |
| Obesity Class (N = 109) | |
| Class 1 | 14 (12.8%) |
| Class 2 | 26 (23.9%) |
| Class 3 | 69 (63.3%) |
| Insurance Type (N = 141) | |
| Commercial | 61 (43.3%) |
| Medicaid | 78 (55.3%) |
| Self-pay | 2 (1.4%) |
| Parental Status (N = 142) | |
| Single-parent | 41 (28.9%) |
| Dual-parent | 86 (60.6%) |
| Dual-shared custody | 11 (7.7%) |
| Other | 4 (2.8%) |
| Diabetes (N = 143) | |
| Normal HbA1c | 101 (70.6%) |
| Prediabetes | 37 (25.9%) |
| Diabetes | 5 (3.5%) |
| Dyslipidemia (N = 143) | |
| Yes | 32 (22.4%) |
| Elevated Liver Enzymes (143) | |
| Yes | 18 (12.6%) |

3.2. Impact of demographics and clinical characteristics on QOL

The age of a child can provide information about the guardian’s understanding of their child’s reported QOL (Table 2). The guardian’s reported quality of life of his/her child differed significantly by the child’s age. There were 40 (28%) subjects younger than 11 years old. The guardians of children younger than 11 years old had a total mean PedsQL score of 72.4, and the guardians of children 11 years and older reported a significantly lower mean score of 63.1 (p = 0.005). However, there was no significant difference between child self-reported total

scores based on age, with total mean scores of 73.8 and 68.1, respectively (p = 0.061). When assessing the PedsQL subsections, children younger than 11 years reported a significantly higher mean physical score of 79.1 compared to children 11 years and older who reported a mean physical score of 70.2 (p = 0.012). Moreover, there were no significant differences in reported quality of life by sex, race, insurance status, obesity class, or any of the comorbidities of obesity evaluated.

Table 2
Guardian and child PedsQL scores according to demographics and clinical characteristics.

| | Guardian | | | Child | | |
|---|-------------|--------------|--------------|--------------|--------------|-------------|
| | Physical | Psychosocial | Total | Physical | Psychosocial | Total |
| Sex (N = 143) | | | | | | |
| Female (n = 55) | 64.3 (23.6) | 67.0 (19.4) | 66.1 (19.3) | 73.7 (20.2) | 69.3 (17.4) | 70.8 (16.7) |
| Male (n = 88) | 65.7 (21.7) | 65.3 (17.4) | 65.5 (17.2) | 72.1 (18.8) | 67.3 (17.2) | 69.0 (16.1) |
| P-value | 0.724 | 0.585 | 0.84 | 0.63 | 0.496 | 0.513 |
| Age (N = 143) | | | | | | |
| < 11 (n = 40) | 72.2 (23.1) | 72.6 (16.4) | 72.4 (17.7) | 79.1 (15.3) | 70.8 (15.8) | 73.8 (14.2) |
| 11+ (n = 103) | 62.5 (21.6) | 63.4 (18.1) | 63.1 (17.5) | 70.2 (20.1) | 67.0 (17.7) | 68.1 (16.9) |
| P-value | 0.02 | 0.006 | 0.005 | 0.012 | 0.228 | 0.061 |
| Race/Ethnicity (N = 117) | | | | | | |
| Asian (n = 3) | 92.7 (12.6) | 78.2 (19.8) | 84.2 (13.7) | 91.7 (14.4) | 77.8 (19.5) | 82.6 (15.2) |
| Black (n = 30) | 68.0 (20.3) | 71.2 (18.2) | 70.2 (17.1) | 72.7 (17.6) | 72.3 (16.6) | 72.4 (15.2) |
| Hispanic (n = 19) | 66.0 (18.5) | 67.2 (12.4) | 66.8 (12.7) | 71.0 (14.8) | 68.9 (15.5) | 69.5 (14.1) |
| White (n = 65) | 62.6 (24.4) | 63.7 (19.6) | 63.3 (19.7) | 70.7 (22.3) | 66.5 (18.1) | 68.0 (17.9) |
| P-value | 0.121 | 0.199 | 0.109 | 0.357 | 0.368 | 0.355 |
| Obesity Class (N = 109) | | | | | | |
| Class 1 (n = 14) | 61.6 (15.1) | 66.5 (14.7) | 64.9 (13.1) | 74.8 (15.9) | 72.9 (15.9) | 73.5 (13.7) |
| Class 2 (n = 26) | 65.7 (22.6) | 64.4 (19.7) | 65.0 (19.2) | 71.9 (19.1) | 65.9 (22.1) | 68.0 (19.8) |
| Class 3 (n = 69) | 63.8 (22.8) | 65.1 (19.5) | 64.6 (19.0) | 72.9 (19.4) | 68.0 (16.2) | 69.7 (15.6) |
| P-value | 0.85 | 0.95 | 0.995 | 0.899 | 0.5 | 0.601 |
| Insurance Type (N = 141) | | | | | | |
| Commercial (n = 61) | 68.4 (20.0) | 66.2 (17.6) | 67.1 (17.1) | 73.7 (18.5) | 67.5 (17.5) | 69.7 (16.2) |
| Medicaid (n = 78) | 62.6 (23.4) | 65.8 (18.2) | 64.7 (18.2) | 71.1 (19.9) | 68.2 (17.1) | 69.2 (16.5) |
| Self-pay (n = 2) | 70.3 (42.0) | 69.2 (43.6) | 69.6 (43.0) | 98.4 (2.2) | 89.2 (15.3) | 92.4 (10.8) |
| P-value | 0.297 | 0.962 | 0.709 | 0.119 | 0.22 | 0.143 |
| Parental Status (N = 142) | | | | | | |
| Single-parent (n = 41) | 65.8 (25.4) | 66.7 (19.1) | 66.4 (19.7) | 70.2 (23.5) | 67.7 (19.5) | 68.5 (19.3) |
| Dual-parent (n = 86) | 64.7 (20.5) | 65.3 (17.6) | 65.1 (16.9) | 73.3 (17.3) | 68.7 (15.8) | 70.3 (14.5) |
| Dual – shared custody (n = 11) | 70.2 (29.3) | 71.8 (20.2) | 71.2 (22.0) | 79.5 (17.9) | 71.2 (20.2) | 74.1 (18.6) |
| Other (n = 4) | 62.5 (10.5) | 61.7 (11.1) | 62.0 (9.6) | 72.7 (17.0) | 55.8 (9.1) | 61.7 (10.8) |
| P-value | 0.882 | 0.674 | 0.719 | 0.547 | 0.477 | 0.557 |
| Diabetes (N = 143) | | | | | | |
| Normal HbA1c (n = 101) | 64.8 (21.6) | 66.4 (17.0) | 65.8 (16.8) | 73.0 (17.8) | 68.7 (15.5) | 70.2 (14.5) |
| Prediabetes (n = 37) | 65.1 (25.0) | 63.5 (21.4) | 64.1 (21.7) | 72.2 (22.2) | 67.3 (20.7) | 69.1 (20.0) |
| Diabetes (n = 5) | 73.8 (21.0) | 74.6 (11.1) | 74.9 (10.2) | 71.3 (27.7) | 59.3 (23.2) | 63.5 (23.9) |
| P-value | 0.686 | 0.396 | 0.451 | 0.964 | 0.475 | 0.649 |
| Dyslipidemia (N = 143) | | | | | | |
| No (n = 111) | 64.9 (21.5) | 65.8 (17.7) | 65.5 (17.3) | 71.6 (19.7) | 67.4 (17.3) | 68.9 (16.4) |
| Yes (n = 32) | 66.1 (25.5) | 66.5 (19.7) | 66.3 (20.4) | 76.6 (17.3) | 70.1 (16.9) | 72.4 (15.9) |
| P-value | 0.805 | 0.846 | 0.828 | 0.194 | 0.434 | 0.287 |
| Elevated Liver Enzymes (N = 143) | | | | | | |
| No (n = 125) | 66.0 (22.7) | 66.6 (18.1) | 66.4 (18.0) | 72.6 (19.6) | 68.3 (17.4) | 69.8 (16.6) |
| Yes (n = 18) | 59.7 (19.9) | 61.5 (18.3) | 61.0 (17.6) | 73.8 (17.1) | 66.3 (16.1) | 68.9 (15.1) |
| P-value | 0.269 | 0.265 | 0.24 | 0.802 | 0.646 | 0.831 |

3.3. Health-related quality of life

This study evaluated the differences in PedsQL scores reported by guardians and children across all test subsections. Guardians reported a lower total mean score of 65.7 when compared to the subject mean score of 69.7 ($p < 0.001$). Additionally, guardians reported a significantly lower mean physical functioning score of 65.2 when compared to the subject mean score of 72.7 ($p < 0.001$). However, there was no significant difference in mean psychosocial functioning PedsQL scores between guardians and children with scores of 65.9 and 68.0, respectively ($p = 0.051$) (Table 3).

Table 3 demonstrates dichotomous outcomes when using a score of ≥ 80 or < 80 , as this is the average score seen in healthy children. There was a significant difference in the 28 (19.6%) guardians who reported a total mean score of ≥ 80 and the 38 (26.6%) children who reported a total mean score of ≥ 80 ($p = 0.018$). For the physical health domain, 41 (28.7%) guardians reported a mean score of ≥ 80 as compared to a significantly higher 51 (35.7%) children who reported a mean score of ≥ 80 ($p = 0.049$) [4]. Moreover, there was no significant difference in guardian and subject psychosocial mean scores ($p = 0.297$).

There was a moderate to strong agreement between parent/guardian and child psychosocial scores and total scores. The psychosocial and total scores had an ICC of 0.74 where as the physical score had an ICC of 0.64.

3.4. Quality of life compared to other chronic diseases

PedsQL scores of children with obesity were compared to previous investigations of healthy children, organ transplant recipients, children with FGID, and children with an organic GI disease. In a study conducted by Varni et al., 1622 guardians of healthy children had a mean PedsQL score of 80.9. Similarly, there were 960 healthy children who had a mean score of 79.6 [6]. When comparing the guardian-reported PedsQL scores for healthy children and the guardian reports for children with obesity, there was a significantly higher PedsQL score found in the guardians of healthy children ($p < 0.001$). Children who were healthy also self-reported a significantly higher PedsQL score than children with obesity ($p < 0.001$) (Table 4).

Next, Weissberg-Benchell et al., evaluated 247 guardian reports of children with organ transplants, and the mean score was 74.9. The corresponding 199 children had a mean score of 79.6 [4]. The guardians of and children who received an organ transplant reported a significantly higher PedsQL score than children and their guardians with obesity ($p = 0.001$) (Table 4).

Moreover, Varni et al., analyzed the PedsQL reports of 356 guardians of children with FGID to find a mean score of 70.5. Similarly, there were 281 children with FGID and the total mean score was 70.2 [5]. When comparing these results to the guardian self-reports in our cohort, the guardians of children with FGID reported a higher quality of life than the guardians of children with obesity ($p = 0.010$). There was no statistically significant difference in self-report scores between children with FGID and children with obesity (Table 4).

Table 3
Mean guardian and child PedsQL scores for physical and psychosocial domains.

| | Guardian Score | Child Score | P-value |
|------------------------------------|----------------|-------------|------------------|
| Continuous Score, Mean (SD) | | | |
| Physical | 65.2 (22.4) | 72.7 (19.3) | <0.001 |
| Psychosocial | 65.9 (18.1) | 68.0 (17.2) | 0.051 |
| Total | 65.7 (18.0) | 69.7 (16.3) | <0.001 |
| Dichotomous Outcome, N (%) | | | |
| Physical 80+ | 41 (28.7) | 51 (35.7) | 0.049 |
| Psychosocial 80+ | 35 (24.5) | 40 (28.0) | 0.297 |
| Total 80+ | 28 (19.6) | 38 (26.6) | 0.018 |

Table 4

PedsQL scores for guardians and children who have obesity, who are healthy, organ transplantation, functional gastrointestinal disorder, and organic gastrointestinal disease.

| | Children with Obesity Mean (SD) N = 143 | Healthy Children Mean (SD; p-value) N = 1622 | Transplant Recipients Mean (SD; p-value) N = 247 | Children with FGIDs Mean (SD; p-value) N = 356 | Children with Organic GI Disease Mean (SD; p-value) N = 301 |
|------------------------|---|--|--|--|---|
| Guardian Report | | | | | |
| Physical | 65.2 (22.4) | 81.4 (23.2; <0.001) | 79.1 (23.3; <0.001) | 72.1 (22.8; 0.002) | 77.9 (21.1; <0.001) |
| Psychosocial | 65.9 (18.1) | 80.6 (16.5; <0.001) | 72.7 (19.5; 0.001) | 69.7 (19.9; 0.051) | 74.4 (17.6; <0.001) |
| Total | 65.7 (18.0) | 80.9 (16.7; <0.001) | 74.9 (19.4; <0.001) | 70.5 (19.1; 0.01) | 75.6 (17.5; <0.001) |
| Child report | | | | | |
| | Mean (SD) N = 143 | Mean (SD; p-value) N = 960 | Mean (SD; p-value) N = 199 | Mean (SD; p-value) N = 281 | Mean (SD; p-value) N = 298 |
| Physical | 72.7 (19.3) | 80.2 (19.3; <0.001) | 81.1 (19.7; <0.001) | 73.1 (20.3; 0.849) | 80.5 (16.6; <0.001) |
| Psychosocial | 68.0 (17.2) | 79.4 (15.7; <0.001) | 73.7 (17.2; 0.003) | 68.6 (17.8; 0.757) | 76.6 (15.7; <0.001) |
| Total | 69.7 (16.3) | 79.6 (15.3; <0.001) | 76.1 (17.3; 0.001) | 70.2 (17.0; 0.759) | 78.0 (14.6; <0.001) |

Additionally, we compared the outcomes for our study cohort with those with organic GI diseases. 301 guardians of children with an organic GI disease had a PedsQL mean score of 75.6. There were 298 children with an organic GI disease who had a mean PedsQL score of 78.0 [5]. Both the guardians of and children with an organic GI disease reported higher mean PedsQL scores than guardians of and children with obesity ($p < 0.001$) (Table 4).

4. Discussion

This study emphasizes the biopsychosocial factors that impact the quality of life in children with obesity, demonstrates the perceptual differences in quality of life between children and their caregivers, and reveals the differences in quality of life between those with obesity and other chronic medical conditions. When assessing child and caregiver differences in quality of life, there was a statistically significant difference within the physical domain. Specifically, children who have obesity felt their physical quality of life was better in comparison to caregiver beliefs. Perceptual differences between a caregiver and a child regarding physical quality of life are known to exist. For example, adolescents can have a narrower view of quality of life and during this stage of development can find psychosocial functioning more important than physical functioning [7]. Physical functioning is also strongly assessed via behavioral observations, which parents are likely to provide further details than adolescents, who may often underestimate their own difficulties [8].

This finding also aligns with the age differences in QOL that were discovered between children and caregivers. Guardians of children who were younger than 11 years old scored the quality of life much higher than guardians of children who were 11 or older. One possibility for this difference is that as children age with obesity, they are more likely to have adverse health complications that their caregivers would perceive as negatively impacting their child's quality of life. In a randomized trial

conducted by Lee et al., it was demonstrated that guardians of children with obesity often experience weight stigma by association which impacts the guardian-child relationship [9]. This stigma would theoretically become more prevalent as children age, negatively impacting guardians' perceptions of their children's health. Additional reasons that could account for the discrepancy in scores between the younger children and the older children could include the following: negative social interactions, increased engagement in recreational screen time, less engagement in physical activity, inconsistent sleep schedule, and greater autonomy and decision making. Additionally with older adolescents these behaviors become more observable by caregivers and may impact caregiver responses.

Other than age, there was no significant association with QOL and the demographic factors and clinical characteristics shown in Table 2. This is interesting as quality of life can often be influenced by social determinants of health such as socioeconomic status, race/ethnicity, sex, and household structure. One possible reason for this lack of significant associations is the small sample size of the demographic subgroups. For example, Asian guardians rated the physical quality of life above 90, but there were only 3 Asian respondents. With a larger sample size, we may find significant associations with other demographic factors, such as race and insurance type (Table 2).

When comparing our results to the study by Varni et al., on healthy children and caregiver PedsQL scores, both child and caregiver scores in this study were significantly lower than scores reported in a healthy population [6]. This evidence is consistent with the current literature in that obesity is often associated with numerous physical and psychological comorbidities, such as Type 2 diabetes, nonalcoholic fatty liver disease, hypertension, dyslipidemia, obstructive sleep apnea, and increased rates of anxiety and depression, which will inherently impact overall quality of life [10]. These comorbidities may be asymptomatic but can further worsen a child's quality of life as they lead to increased medical visits, medication taken routinely, and physical impairments such as decreased endurance and flexibility. Children with obesity and its complications should be provided multidisciplinary care which addresses quality of life and empowers them to improve their physical and mental health.

Similar results were discovered when our study results were compared to children who had received an organ transplant [4]. Children receiving a transplant and their caregivers believed they had a better quality of life as compared to children diagnosed with obesity. A possible explanation for this finding relates to the urgent need for organ transplants in children at a young age. Reasons for transplantation in children are often due to congenital diseases in solid organs and thus are treated when children are very young. If treated in infancy or childhood, these children can be cured of their disease and live with limited detriments to their quality of life. Post-transplant care is often standardized and involves multi-disciplinary teams who assist in addressing medical, physical, and psychosocial needs, whereas the treatment for obesity can differ between healthcare organizations based on available resources [11]. Additionally, a diagnosis of obesity is more commonly associated with social bias and stigma in comparison to other medical conditions, which can impact QOL in all domains [12].

We compared the PedsQL results of our study cohort with children who have a functional gastrointestinal disorder [5]. Guardians of children with an FGID perceived their children had a higher physical and total quality of life compared to guardians of children with obesity. This could be due to guardians of children with obesity seeing their children experience decreased social inclusion and increased negative stigma when compared to guardians of children with FGIDs. Interestingly, children with an FGID did not report statistically significant differences in PedsQL scores compared to children with obesity. This suggests that children with FGIDs and children with obesity have similar perceptions of their own QOL. Children with obesity and children with FGIDs have high rates of mental health conditions that may go undiagnosed and untreated [13]. Additionally, both groups have chronic conditions with

relapsing symptoms and require multimodal treatment options that may lead to a lower perceived QOL.

We also compared the PedsQL results with children who have an organic GI disease [5]. Guardians and their children with an organic GI disease perceived better physical, psychosocial, and total quality of life when compared to guardians and children with obesity. A possible explanation for this finding is organic GI diseases often have treatment regimens that significantly reduce the disease morbidity and allow children to participate in activities of daily living without concerns. Whereas current obesity treatment is not consistent across medical institutions, widely available to patients, or as well-studied in children. Additionally, organic GI diseases do not carry the same negative stigma that is associated with obesity [14]. It is known that experiences with weight stigma are associated with negative social functioning, poor psychological outcomes, and increased body dissatisfaction [15].

4.1. Limitations

There are several limitations to this study. Firstly, systematically minoritized groups were underrepresented in this study. Additionally, approximately 72% of the study cohort were those age 11 years and above. Due to the limited number of racially minoritized youth and children younger than 11 years, there may be differences related to racial disparities and early developmental stages yet to be revealed. In the future, larger studies are needed with a greater representation of all racial and ethnic groups. 78 (55.3%) of our study population had Medicaid insurance, which can be used as a marker of low socioeconomic status (SES). Low SES could be a confounding variable for the decreased QOL scores in our study population, as Gross et al., outlined that poverty can have a negative impact on parenting practices and the parent-child relationship which could impact QOL scores [16].

In our analysis of QOL in children with functional and organic GI disease, the comparison studies did not exclude children with obesity in either the control or study cohorts. Obesity could have been a confounding factor in those who were healthy and those with a GI disease. The same is true for the study by Varni et al., in that parents self-reported their children's chronic condition which may not have included obesity. Moreover, obesity may not have been included as a diagnosis in the medical record for those children who were seen in clinics or hospitals. Unfortunately, often obesity is not recognized as a chronic disease and needs to be identified as a confounding condition, if not excluded from a study.

Our study only included QOL assessments of transplant recipients and those with FGIDs and organic GI diseases due to word limit constraints and given that comparison of PedsQL scores across different chronic conditions was not the primary aim of this study. Future studies could more completely analyze how perceived quality of life differs across chronic conditions. When comparing the results of our study to children with organic GI diseases, we were not able to distinguish individual chronic conditions (i.e., ulcerative colitis, Crohn's disease, and gastroesophageal reflux disease) as these were combined under the classification of organic GI diseases. Future efforts should study individual FGIDs and organic GI diseases for more specific associations.

5. Conclusion and future directions

This study highlights that quality of life can be negatively impacted by various physical and psychosocial conditions, and that quality of life can differ between medical conditions. Thus, it is important that medical treatment reflects this complexity by providing high quality multidisciplinary treatment that targets bias, stigma and healthcare disparities. This conclusion aligns with the American Academy of Pediatrics (AAP) 2023 guidelines for obesity treatment. The guidelines stress the importance of not waiting to treat obesity. Early and aggressive treatment with maximized patient contact hours and a multidisciplinary team decrease the risk of developing future eating disorders, and improves self-esteem,

self-concept, nutrition, physical activity, behavior, and overall quality of life [3]. Our study assessed QOL at the time of enrollment into the weight management program. Future studies should assess the age of diagnosis of obesity and the impact that living with obesity longer has on youth. This would provide a better understanding of the relationship between QOL and living with obesity.

Moreover, future studies should gather BMI data on the parents as parents with obesity may feel differently about the quality of life of their children than parents without obesity. In conjunction, it would be beneficial to administer quality of life assessments which directly evaluate the impact of weight on QOL. These surveys may provide new information within this population. Specific measures could include Impact of Weight on Quality of Life for Adolescents (IWQOL-A), the Impact of Weight on Quality of Life in Kids (IWQOL-Kids), or Health-Related Quality of Life. Additionally, this study can be expanded to include children with other chronic conditions such as asthma, cystic fibrosis, autism spectrum disorder, and diabetes to further understand the relative impact obesity has on quality of life and to evaluate this study's results with a greater pediatric population.

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Author contribution

The concept of the article was developed by Sara Naramore. Statistical analysis was conducted by Anthony Perkins. Beau Mansker wrote the first draft of the submission. Beau Mansker, Katherine Schwartzkopf, Jose Velez II, Anthony Perkins, and Sara Naramore reviewed, edited, and approved of the final manuscript.

Ethical review

This study is an original research investigation. All referenced articles were appropriately cited in the manuscript. This manuscript has not been submitted to any other journals while awaiting review by *Obesity Pillars*. There are no prior publications with similar information.

Declaration of competing interest

There are no conflicts of interest for any of the authors. This research did not receive grant funding in the public, commercial, or not-for-profit sectors.

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References

- [1] Chang TH, Chen YC, Chen WY, Chen CY, Hsu WY, Chou Y, et al. Weight gain associated with COVID-19 lockdown in children and adolescents: a systematic review and meta-analysis. *Nutrients* 2021;13(10).
- [2] Pratt KJ, Skelton JA. Family functioning and childhood obesity treatment: a family systems theory-informed approach. *Acad Pediatr* 2018;18(6):620–7.
- [3] Hampl SE, Hassink SG, Skinner AC, Armstrong SC, Barlow SE, Bolling CF, et al. Executive summary: clinical practice guideline for the evaluation and treatment of children and adolescents with obesity. *Pediatrics* 2023;151(2).
- [4] Weissberg-Benchell J, Zielinski TE, Rodgers S, Greenley RN, Askenazi D, Goldstein SL, et al. Pediatric health-related quality of life: feasibility, reliability and validity of the PedsQL transplant module. *Am J Transplant* 2010;10(7):1677–85.
- [5] Varni JW, Bendo CB, Nurko S, Shulman RJ, Self MM, Franciosi JP, et al. Health-related quality of life in pediatric patients with functional and organic gastrointestinal diseases. *J Pediatr* 2015;166(1):85–90. e2.
- [6] Varni JW, Seid M, Kurtin PS. PedsQL 4.0: reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. *Med Care* 2001;39(8):800–12.
- [7] Helseth S, Misvaer N. Adolescents' perceptions of quality of life: what it is and what matters. *J Clin Nurs* 2010;19(9–10):1454–61.
- [8] Buttitta M, Iliescu C, Rousseau A, Guerrien A. Quality of life in overweight and obese children and adolescents: a literature review. *Qual Life Res* 2014;23(4):1117–39.
- [9] Lee KM, Arriola-Sanchez L, Lumeng JC, Gearhardt A, Tomiyama AJ. Weight stigma by association among parents of children with obesity: a randomized trial. *Acad Pediatr* 2022;22(5):754–60.
- [10] Pulgaron ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clin Therapeut* 2013;35(1):A18–32.
- [11] Duvant P, Fillat M, Garaix F, Roquelaure B, Ovaert C, Fouilloux V, et al. Quality of life of transplanted children and their parents: a cross-sectional study. *Orphanet J Rare Dis* 2021;16:1–14.
- [12] MacInnis CG, Alberga AS, Nutter S, Ellard JH, Russell-Mayhew S. Regarding obesity as a disease is associated with lower weight bias among physicians: a cross-sectional survey study. *Stigma and Health* 2020;5(1):114.
- [13] Fond G, Loundou A, Hamdani N, Boukouaci W, Dargel A, Oliveira J, et al. Anxiety and depression comorbidities in irritable bowel syndrome (IBS): a systematic review and meta-analysis. *Eur Arch Psychiatr Clin Neurosci* 2014;264(8):651–60.
- [14] Puhl RM, Phelan SM, Nadglowski J, Kyle TK. Overcoming weight bias in the management of patients with diabetes and obesity. *Clin Diabetes* 2016;34(1):44–50.
- [15] Vartanian LR, Pinkus RT, Smyth JM. Experiences of weight stigma in everyday life: implications for health motivation. *Stigma and Health* 2018;3(2):85.
- [16] Gross RS, Messito MJ, Klass P, Canfield CF, Yin HS, Morris PA, et al. Integrating health care strategies to prevent poverty-related disparities in development and growth: addressing core outcomes of early childhood. *Acad Pediatr* 2021;21(8S):S161–8.