

Normative Values for Adolescent Quality of Life in Plastic Surgery: A Longitudinal, Cohort Study

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Background: Adolescence is a challenging time, and an increasing number of young people are seeking plastic surgery. With the rise of health-related quality of life studies in plastic surgery, it is critical to understand the natural variation and changes in health-related quality of life for this population.

Methods: In this longitudinal, cohort study validated surveys were administered to cisgender participants aged 12–21 years: Short-Form 36v2, Rosenberg Self-Esteem Scale, Breast-Related Symptoms Questionnaire, and Eating-Attitudes Test-26. Surveys were administered at baseline and up to 9 years follow-up. At the time of enrollment, participants were in a current state of good health with no considerable past or current medical, surgical, or psychological history.

Results: A total of 149 female and 75 male participants were included, with a median (interquartile range) baseline age of 16.0 (4.4) years and follow-up time of 3.3 (4.1) years. Over the study period, girls who were not overweight or obese experienced significant declines in five SF-36 domains (general health, vitality, social functioning, role-emotional, and mental health) and on the Rosenberg Self-Esteem Scale, Breast-Related Symptoms Questionnaire, and Eating-Attitudes Test-26 ($P < 0.05$). In contrast, boys' and overweight/obese girls' health-related quality of life largely remained stable ($P > 0.05$).

Conclusions: Adolescence is a challenging time, on which plastic surgery-related concerns are superimposed. Our findings suggest that girls may be more at risk for developing psychosocial deficits that worsen over adolescence and young adulthood. This observation is critical for the interpretation and contextualization of health-related quality of life in adolescent plastic surgery patients. (*Plast Reconstr Surg Glob Open* 2022;10:e4311; doi: [10.1097/GOX.0000000000004311](https://doi.org/10.1097/GOX.0000000000004311); Published online 6 May 2022.)

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INTRODUCTION

Patient-reported outcomes (PROs) provide insight into patient perception of operative results and health-related quality of life (HRQoL), which are central to the mission of plastic surgery.¹ Adolescents increasingly seek plastic surgery for a number of important functional and psychosocial issues.² Unfortunately many PROs are validated among adult-aged patients, with limited guidance for adolescent assessment. However, a large number of condition-specific PRO measures exist for pediatric and young adult populations.^{3,4}

Adolescence is a unique developmental stage marked by physical, emotional, and social change and growth.⁵ As such, it can be difficult to produce “stable” normative data, as are produced for adult PROs.¹ Although adolescence is associated with relatively good health, it is a time when risk-taking behaviors and psychopathologies, including mood, anxiety, and eating disorders, first emerge.⁶ Countless studies have explored HRQoL changes in adolescent

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disease populations; however, few have sought to measure changes in a longitudinal cohort of healthy participants.^{7–9} Cross-sectional studies have established that sex differences in psychosocial well-being begin to manifest during adolescence, with girls more likely to develop depressive symptoms than boys.^{10,11} However, findings from the limited longitudinal adolescent series vary.^{7–9}

This longitudinal, cohort study sought to prospectively measure changes in the HRQoL of healthy boys and girls during the window of adolescence and young adulthood. The impact of sex and body mass index category on HRQoL over the course of adolescence was also investigated. It was hypothesized that obesity would negatively impact adolescents' HRQoL. Over the study period, we expected to observe psychosocial declines in female participants, with male participants' HRQoL remaining relatively unchanged. Ultimately, understanding the normal values and trends for these various PROs will inform investigators and surgeons as to what is expected during the course of adolescence to establish a baseline when interpreting the impact of surgical intervention. Knowledge of how HRQoL changes over the course of adolescence will equip plastic surgeons with a better understanding of how to care for this growing surgical population.

METHODS

Participants

This research was shaped through clinical feedback and observations from adolescent and young adult patients, their caregivers, and healthcare providers. This study was part of the Adolescent Breast Research Program, which was approved by the Boston Children's Hospital Committee on Clinical Investigation (Protocol number: X08-10-0492). After obtaining written informed consent from all participants and a parent or guardian, if under 18 years, cisgender patients between the ages of 12 and 21 years were prospectively enrolled from 2008 through 2019. Each patient completed an intake form during every clinical appointment disclosing their (1) assigned sex at birth, and (2) gender identity. Patients whose gender identity matched their assigned sex at birth were included in this study (defined as "cisgender"). Only patients undergoing noncosmetic treatment were recruited during clinic visits at the Department of Plastic and Oral Surgery, which included skin excision, laceration repair, hand injury treatment, minor wound or scar management, and non-cosmetic botulinum toxin injection. Participants were also recruited during routine visits with the Division of Adolescent/Young Adult Medicine at the same institution. Eligible participants were in a current state of good health, with no considerable medical or surgical history. Patients with a current or prior benign breast-related condition were excluded, as these have been found to negatively impact HRQoL.^{12,13} Additionally, patients with a psychiatric disorder were excluded from enrollment.

Takeaways

Question: The number of adolescents seeking plastic surgical procedures continues to rise; however, patient-reported outcomes in this young population are poorly understood.

Findings: This longitudinal, cohort study found that young women may be more at risk for developing psychosocial deficits that worsen over the course of adolescence and young adulthood relative to their male peers.

Meaning: Understanding that health-related quality of life may change over adolescence and young adulthood is crucial when assessing patient-reported outcomes in younger patients.

Clinical Presentation and Biometrics

Each participant's height and weight were collected by clinical staff at the baseline evaluation. BMI category was determined using either the Child and Teen BMI percentile calculator¹⁴ or the Adult BMI calculator,¹⁵ both provided by the Centers for Disease Control and Prevention and using the following Centers for Disease Control and Prevention classification: underweight (adult: BMI < 18.5 kg/m²; child/teen: <5th BMI percentile), healthy weight (adult: BMI 18.5–24.9 kg/m²; child/teen: 5–84th BMI percentile), overweight (adult: BMI 25.0–29.9 kg/m²; child/teen: 85–94th BMI percentile), and obese (adult: BMI ≥30 kg/m²; child/teen: ≥95th BMI percentile). Baseline BMI category was used as a covariate in analyses concerning racial/ethnic minority status. During their baseline visit, participants were asked to self-identify their race from the following categories: White, Black, Asian, Native American/Pacific Islander, other, and prefer not to answer. Participants were also asked to identify their ethnicity as either Hispanic or non-Hispanic.

Survey Measures

All participants completed the following self-administered surveys: Short-Form 36v2 (SF-36), Rosenberg Self-Esteem Scale (RSES), and Eating Attitudes Test-26 (EAT-26), at baseline and at the following time points: 6 months, and 1, 3, 5, 7, and 9 years. Participants received a \$5 gift card for every study time point completed. The SF-36 assesses quality of life using the following eight domains: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.¹⁶ A higher SF-36 domain score indicates better HRQoL. The RSES measures self-esteem, in which a higher score is more favorable.^{17,18} The EAT-26 assesses for disordered eating attitudes and behaviors.¹⁹ Scores at or above 20 indicate potential disordered eating thoughts and behaviors and require further clinical evaluation. As we and others have previously demonstrated that breast-related complaints considerably impact women's well-being,^{12,20,21} female participants also completed the Breast-Related Symptoms Questionnaire (BRSQ) at every time point, in which a higher BRSQ score signifies fewer, milder breast-related symptoms and complaints.^{21,22}

Paper surveys were completed in clinic or completed at home and returned via mail.

Data Management and Statistical Methods

The secure database REDCap (Research Electronic Data Capture) was used to collect and store data.²³ Data analysis was conducted using SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, N.Y.). Mann Whitney U and Pearson χ^2 were used to compare demographics between cohorts. Transformed survey scores for the SF-36 domains,²⁴ RSES,¹⁷ EAT-26,¹⁹ and BRSQ²¹ were computed. Independent two-sample *t* tests were used to compare survey score between study groups. For analyses, baseline BMI category was collapsed into two groups (underweight or healthy versus overweight or obese) and race/ethnicity was dichotomized (White, nonHispanic versus all other participants). Patients with missing race/ethnicity data were excluded from all applicable analyses. Repeated measures ANOVAs were used to measure within-subjects baseline to follow-up changes in survey score. A maximum threshold of 20% missing survey response data was used for all analyses, and a *P* value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

Baseline Demographics

A total of 149 female and 75 male participants completed baseline and follow-up surveys (Table 1). Both cohorts were of comparable age at baseline (*P* = 0.08; range: 12–21 years; Table 1). The majority of all participants had a healthy baseline BMI (160 [71.4%]), and were White, non-Hispanic (157 [70.1%]). Of note, a greater proportion of racial/ethnic minorities was overweight or obese compared with White, non-Hispanic participants (52 [55.8%] versus 157 [18.5%]; odds ratio, 5.57; 95% confidence interval, 2.82–11.00; *P* < 0.001). Roughly half of all participants were recruited at appointments for skin

lesion excision (56.7%), with the remaining recruited during sick visits and annual examinations with their primary care physician (17.0%), and office visits: for hand injuries (8.5%), lacerations (6.3%), and other noncosmetic surgical procedures (11.6%).

Baseline Comparisons

Compared with boys, girls scored significantly lower at baseline in the SF-36 vitality and mental health domains and on the RSES, and scored higher on the EAT-26 (*P* < 0.05, all; Table 2). Scores for the remaining six SF-36 domains (physical functioning, role-physical, bodily pain, general health, social functioning, and role-emotional) did not vary between cohorts (*P* > 0.05, all). Boys' baseline HRQoL survey scores did not vary by BMI category (*P* > 0.05, all). However, girls who were overweight or obese had significantly lower scores in four SF-36 domains (physical functioning, role-physical, social functioning, and mental health) and on the BRSQ, and higher EAT-26 scores compared with their nonoverweight/obese female counterparts (*P* < 0.05, all).

After controlling for differences in BMI category, boys who identified as a racial/ethnic minority had a lower SF-36 social functioning domain score compared with White, non-Hispanic boys, with this difference approaching significance (*P* = 0.05). Minority girls scored lower in the role-emotional SF-36 domain and on the RSES (*P* < 0.05, both), with all other scores remaining comparable to their White, non-Hispanic peers (*P* > 0.05, all).

Follow-up Comparisons

Male participants were followed for a median of 3.1 years (interquartile range, 3.7; range, 6 months–8.9 years), whereas female participants were followed for a median of 3.5 years (interquartile range, 4.2; range, 6 months–9.5 years; *P* = 0.19). The majority of participants completed 6-month, 1-year, and 3-year follow-up surveys (Table 1). At most recent follow-up, girls had significantly lower scores than boys in five SF-36 domains (physical functioning,

Table 1. Cohort Demographics

	Female (N = 149)	Male (N = 75)	P
Median (IQR, range) baseline age, y	16.1 (5.1, 12.1–21.8)	15.5 (3.6, 12.0–21.8)	0.08
Baseline BMI category, N (%)			
Underweight	2 (1.3)	3 (4.0)	0.42
Healthy	107 (71.8)	48 (64.0)	
Overweight	22 (14.8)	12 (16.0)	
Obese	18 (12.1)	12 (16.0)	
Race/ethnicity, N (%)			
White, non-Hispanic	101 (67.8)	56 (74.7)	0.67
Black	19 (12.8)	11 (14.7)	
Hispanic	9 (6.0)	3 (4.0)	
Other	8 (5.4)	2 (2.7)	
Unknown	12 (8.1)	3 (4.0)	
Median (IQR, range) follow-up time, y	3.5 (4.2, 0.5–9.5)	3.1 (3.7, 0.5–8.9)	0.14
Survey response rate, N (%)*			
Baseline	149/149 (100)	75/75 (100)	—
6 mo	92/149 (61.7)	45/75 (60.0)	—
1 y	107/145 (73.8)	52/75 (69.3)	—
3 y	84/135 (62.2)	35/69 (50.7)	—
5 y	53/112 (47.3)	20/61 (32.8)	—
7 y	28/91 (30.8)	11/50 (22.0)	—
9 y	7/24 (29.2)	0/15 (0)	—

*Each denominator represents the number of participants who reached a particular study time point and were eligible to complete surveys for that study interval.

Table 2. Baseline Survey Score Comparisons by Cohort

	Female, Mean ± SD Baseline Score	Male, Mean ± SD Baseline Score	P
SF-36* domains			
Physical functioning	91.9 ± 19.3	90.9 ± 23.4	0.73
Role—physical	90.2 ± 16.7	91.6 ± 13.7	0.54
Bodily pain	76.9 ± 16.1	73.6 ± 18.5	0.20
General health	80.7 ± 16.8	84.9 ± 14.0	0.07
Vitality	52.1 ± 14.0	59.3 ± 12.5	<0.001
Social functioning	86.0 ± 19.2	90.0 ± 18.5	0.13
Role—emotional	88.2 ± 16.0	92.5 ± 19.3	0.07
Mental health	76.5 ± 16.5	81.1 ± 14.3	0.04
RSES†	34.0 ± 5.4	35.8 ± 4.9	0.02
EAT-26‡	5.6 ± 5.9	3.7 ± 3.6	0.004

Values in bold are statistically significant at $p < 0.05$.

*Short-form 36v2.

†Rosenberg Self-Esteem Scale.

‡Eating-Attitudes Test-26.

general health, vitality, social functioning, and mental health) and on the RSES, and higher EAT-26 scores ($P < 0.05$, all; Table 3). Both cohorts scored comparably on the remaining three SF-36 domains (role-physical, bodily pain, and role-emotional; $P > 0.05$, all).

Stratified by baseline BMI category, within-subject analyses were conducted for both cohorts using participants' most recent follow-up survey data. The male cohort's survey scores largely remained stable during the study period ($P > 0.05$, all), with nonoverweight/obese boys experiencing a significant increase in their SF-36 bodily pain score ($P = 0.02$). Over the study period, nonoverweight/obese girls had significant score declines in five SF-36 domains (general health, vitality, social functioning, role-emotional, and mental health) and on the RSES and BRSQ, and had a score increase on the EAT-26 ($P < 0.05$, all; Fig. 1). Overweight and obese female participants; however, experienced a significant score increase in their SF-36 role-physical score ($P = 0.02$), but had a decline on the BRSQ ($P = 0.007$).

DISCUSSION

PROs continue to play an increasingly important role in the assessment of plastic surgical outcomes. This

Table 3. Most Recent Follow-up Survey Score Comparisons by Cohort

	Female, Mean ± SD Follow-up Score	Male, Mean ± SD Follow-up Score	P
SF-36* domains			
Physical functioning	91.3 ± 20.4	96.5 ± 14.1	0.03
Role—physical	93.5 ± 15.1	94.9 ± 13.7	0.52
Bodily pain	81.2 ± 11.0	78.7 ± 15.3	0.41
General health	75.0 ± 18.1	83.2 ± 16.8	0.001
Vitality	49.4 ± 15.8	55.7 ± 15.4	0.005
Social functioning	83.7 ± 20.8	91.2 ± 18.4	0.007
Role—emotional	83.6 ± 21.2	89.0 ± 20.7	0.07
Mental health	71.4 ± 18.8	80.4 ± 26.9	0.001
RSES†	32.6 ± 5.8	34.9 ± 5.3	0.004
EAT-26‡	7.6 ± 9.0	3.4 ± 4.8	<0.001

Values in bold are statistically significant at $p < 0.05$.

*Short-Form 36v2.

†Rosenberg Self-Esteem Scale.

‡Eating-Attitudes Test-26.

is complicated by the fact that adolescence is a uniquely dynamic time, characterized by considerable physical, psychological, and social development.^{4,25} This is in stark contrast to normative values for adult PROs that often remain stable for decades.²⁶ The onset of eating, anxiety, mood, behavioral, and attention deficit disorders typically occurs during adolescence.^{4,5} It is estimated that one-fifth of all American children will at some point during adolescence meet the diagnostic criteria for a mental health disorder.²⁷ Despite this, few studies have longitudinally examined natural changes in HRQoL over the course of adolescence in an otherwise healthy population.⁷⁻⁹ This study aimed to address this gap, by prospectively quantifying quality of life changes in cohorts of healthy male and female adolescents and young adults.

HRQoL Sex Differences

At baseline, our female cohort exhibited poorer vitality, mental health, and self-esteem compared with the male cohort. Additionally, girls indicated having more disordered eating attitudes and behaviors. This performance gap widened over the course of the study. Although boys' HRQoL remained stable for the duration of the study, nonoverweight/obese girls, in particular, experienced marked declines in their general health, vitality, social functioning, emotional well-being, mental health, and self-esteem. Their breast-related somatic complaints and disordered eating attitudes and behaviors also increased over the course of the study. At follow-up, boys outperformed the female cohort in the majority of all assessed physical and psychosocial domains and measures.

It has been well-established in the literature that sex differences in mental health first emerge during adolescence.^{9-11,25,28,29} Numerous studies have found that adolescent girls are more likely to have depression, with this sex discrepancy persisting over most of the lifespan.^{7,8,10,11,25,28,29} Interestingly and in conflict with our findings, one of the largest studies concerning lifetime depression found that although adolescent girls had greater depressive symptoms than boys, these symptoms lessened as both sexes progressed through adolescence and young adulthood, before steeply increasing during their 30s.⁹ It must be noted, however, that the great majority of participants in this multi-decade, longitudinal study were adolescents and young adults before the advent of social media.

Although not investigated in our study, it must be acknowledged that social media and online gaming have remained prominent fixtures in American adolescent and young adult culture during the entire study period, and may potentially explain some of the observed findings.³⁰⁻³⁵ Prolonged engagement with social media and smartphone screen time is associated with poorer academic performance, decrements in body image and self-esteem, depressive traits, and eating disorders in young women.³⁶⁻⁴¹ Although social media has been found to negatively affect young boys' self-esteem, some studies suggest that boys may not be harmed to the same degree as their female peers.³⁶⁻⁴¹ In fact, moderate online gaming among adolescent boys has been associated with improvements in general quality of life, social functioning, and mental

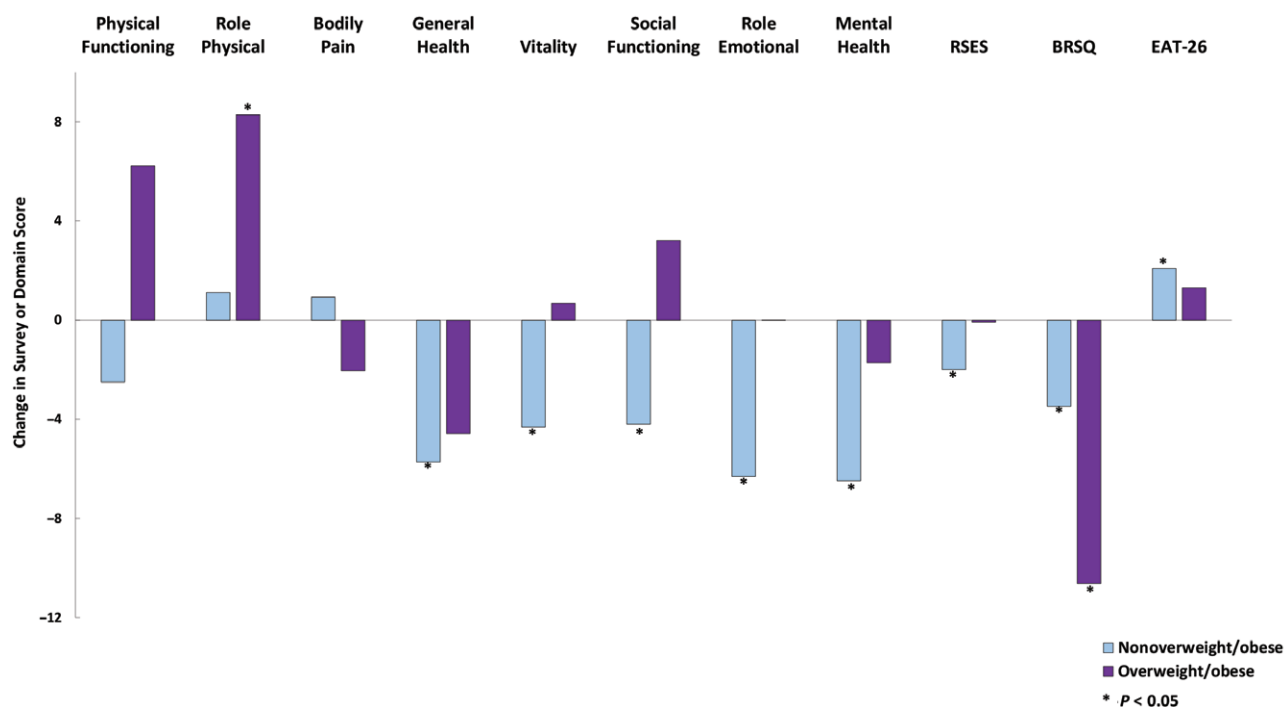


Fig. 1. Female cohort: baseline to follow-up change in survey/domain score. Note: positive change indicates score increase from baseline to follow-up; negative change indicates score decrease. A higher score is more favorable for all surveys/domains, except the EAT-26.

health.^{42–48} The divergent effects of social media on mental health may also partially explain the persistent and widening psychosocial discrepancies found between our cohorts over the duration of the study; however, further investigation is needed.

Impact of BMI Category and Race on HRQoL

At baseline, both overweight/obese and minority participants suffered from greater quality of life deficits. This finding is consistent with the current literature, which demonstrates that obesity and minority status are associated with increased bullying, greater economic stressors, and poorer mental health and physical functioning.^{49–53} Despite these baseline deficits, the HRQoL of overweight and obese participants, in particular, remained relatively stable throughout the study period. In fact, overweight and obese girls enjoyed improvements in their recreational and occupational physical well-being (role—physical SF-36 domain).

Counter to our original hypothesis that obesity would be associated with decrements in HRQoL was our observation that nonoverweight/obese girls were the only study group to suffer marked declines across a variety of physical and psychosocial domains and measures. This may potentially indicate that some demographic groups are more resilient or susceptible to the stresses of adolescence.⁵⁴ Additional research is needed. Additionally, as BMI was assessed at baseline only, we cannot exclude the possibility that part of these observed decrements in HRQoL are related to weight-gain in the nonoverweight/obese group. Given that it is more likely in our society for weight-gain rather than weight-loss to occur during adolescence,⁵⁵

part of this drop in HRQoL may be weight-change related. More research regarding this observation is needed, however, to draw meaningful conclusions.

Disordered Eating Considerations among Girls

Nonoverweight/obese girls experienced an increase in disordered eating attitudes and behaviors during the study period. However, it must be acknowledged that at follow-up only six (6%) of these participants met the threshold for having a clinically concerning EAT-26 score. Much of the literature concerning eating disturbance in teenagers focuses on those with obesity or diagnosed psychopathology.^{56,57} Our data suggest that eating attitudes and behaviors are not static and may worsen, invisibly, over adolescence. Focus on healthy eating attitudes and behaviors should be extended to all adolescent and young adult patients during office visits regardless of BMI category or formal diagnosis of an eating disorder.

Breast-related Considerations among Girls

Despite excluding participants on the basis of past and present breast diagnoses, our female cohort demonstrated increased breast-related somatic complaints over the study period. As we recruited participants as young as 12 years old, it is possible that some went on to develop breast conditions. This observation was relatively unsurprising in our overweight and obese female subgroup. Overweight/obese girls are more likely to develop breast hypertrophy, with related musculoskeletal pain and clinical impairment worsening over time.^{12,58} Although follow-up BMI was not measured, the increase of breast-related symptoms may suggest potential weight-gain during the

study period, and may in part account for some of the physical functioning decrements observed within our nonoverweight/obese participants. Additionally, previous studies have found that women with depressive symptoms are more likely to endorse somatic complaints and dissatisfaction with their bodies,^{58–60} and may potentially explain the increase in breast-related complaints among our non-overweight/obese female participants in the presence of worsened mental health and self-esteem.

Study limitations must be acknowledged. The HRQoL surveys used in this study have been validated across a myriad of populations, including young adult and adolescent populations. However, it must be noted that participants as young as 12 years were enrolled in our study and the EAT-26 has only been validated to date in children as young as 13 years, and the BRSQ has not yet been validated for younger adolescents. As such, the minimal clinical important difference for our HRQoL measures could not be reported as further research is needed to derive them for this population. Additionally, future studies of this growing cohort are needed to assess HRQoL changes over a longer follow-up period and through adulthood, and to perform age-matched analyses in a uniform cohort. Follow-up BMI data were unavailable for participants, and so baseline BMI was used for all analyses.

Due to limited sample sizes, study analyses were restricted to cisgender individuals. Additional research is needed to explore trends in HRQoL among transgender, gender diverse, and nonbinary populations. We recognize that there are special considerations for these communities that may impact their eating thoughts and behaviors, mental health, social functioning, self-esteem, and physical well-being.

Indicators of economic status were not collected as part of this study. Additional research is needed to explore the impact of economic status on adolescent HRQoL. As race/ethnicity and BMI category were highly inter-correlated, analyses investigating HRQoL changes would require stratification by both variables to parse the impact of race/ethnicity on HRQoL changes. Although both the male and female cohorts were adequately powered, such subanalyses could not be performed due to limitations in sample size. Lastly, results may not be generalizable as participants were recruited from a single, large tertiary care facility.

CONCLUSIONS

Our findings suggest that girls, and racial/ethnic minorities or overweight/obese adolescents and young adults of both sexes may suffer from poorer HRQoL. These are important considerations when assessing PROs in adolescents as it informs surgeons and investigators of baseline HRQoL and expected changes over time. Awareness of these findings can better inform surgeons when interpreting the application of adult PRO measures in adolescents. Importantly, these findings provide insight that may aid in the future design of adolescent-specific PROs and provide surgeons with a better understanding of the unique emotional and social challenges experienced by their adolescent and young adult patients.

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