



Contributory Factors Influencing Interdisciplinary Pediatric Weight Management Program Attendance for Racially Minoritized Youth

William A. Anastasiadis^{1,2,4} · Ashley Bazier^{1,2,4} · Elaine Gilbert^{1,2} · Katherine Schwartzkopf^{1,2} · Kari Benson^{1,2} · Anthony J. Perkins³ · Sara K. Naramore¹

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Abstract

Childhood obesity is a complex medical condition associated with biopsychosocial complications that requires a multifaceted treatment approach. Historically weight management treatment has been challenging to access for racially minoritized youth. This study evaluated factors influencing treatment attendance for racially minoritized youth in a pediatric weight management program between 2018 and 2021. Medical information from 228 participants was collected, including demographics, insurance type, use of telehealth visits, measures of health-related quality of life (HRQOL), distance from the weight management program, and medical history. Although participants entering the weight management program came from across the state, racially minoritized participants from the Indianapolis area were more likely to attend the program. Racially minoritized participants farther from the program were comparatively underrepresented. Relative to families from majority backgrounds, racially minoritized families had the highest public health insurance rates. Specific physical and mental health comorbidities may further increase risk. Results have important implications for pediatric weight management programs to improve access and treatment opportunities for racially minoritized and underserved populations.

Keywords Obesity · Pediatrics · Healthcare disparities · Weight management · Racially minoritized youth

Introduction

Childhood obesity is a pervasive disease associated with multiple comorbidities, higher healthcare expenditure, and increasing utilization of healthcare resources. Even in childhood, complications of obesity are present, including type 2 diabetes, nonalcoholic fatty liver disease (NAFLD), sleep apnea, anxiety, and depression (Dietz, 1998; Freedman et al., 1999). In addition to mental and physical health comorbidities, obesity is also associated with poorer psychosocial outcomes for youth, such as decreased quality of

life (Frontini et al., 2016; Gouveia et al., 2014). Recent epidemiological trends show that approximately 36% of youth meet overweight or obesity criteria in the United States (Skinner et al., 2018). Further, obesity rates have increased during the COVID-19 pandemic, likely due to greater social isolation and sedentary behavior (Woolford et al., 2021). Early intervention is crucial for improving prognosis and overall functioning to help prevent complications of obesity throughout development.

Rates of obesity are higher in racially minoritized youth, with the highest rates among Hispanic (25.8%) and non-Hispanic Black (22.0%) youth as compared to non-Hispanic White youth (14.1%) (Hales et al., 2017). Racial and ethnic disparities are observed as early as preschool and are thought to be influenced by genetics, nutrition, physical activity, and social determinants of health (Byrd et al., 2018). Previous research suggests that racial and ethnic disparities also exist in health-related quality of life (HRQOL), with racially minoritized youth reporting poorer quality of life; this is particularly true for Latine youth (Wallander et al., 2019). However, literature in this area is mixed, highlighting the need for continued research on potential disparities in

✉ William A. Anastasiadis
william.anastasiadis@indstate.edu

¹ Department of Pediatrics, Riley Hospital for Children, Indianapolis, IN, USA

² Department of Child and Adolescent Psychiatry, Riley Hospital for Children, Indianapolis, IN, USA

³ Department of Biostatistics and Health Data Science, Indiana University School of Medicine, Indianapolis, IN, USA

⁴ Department of Psychology, Indiana State University, Terre Haute, IN, USA

HRQOL and how this may impact treatment access. Differences in prevalence rates and quality of life are also affected by inequalities in the availability and accessibility of equitable care for racially minoritized and historically underserved youth (Riley, 2012).

The history of structural racism within healthcare has contributed to contemporary racial and ethnic disparities in treatment access. Racial and ethnic disparities exist in quality of care, access to services, and mortality rates across the lifespan (Flores, 2010; Nelson, 2002). Youth of racially minoritized backgrounds are more likely to experience challenges in receiving consistent care in addition to specialty physical and mental healthcare (Flores, 2010; Smitherman et al., 2021). Specifically, racially minoritized youth are less likely to have a regular primary care provider and be referred for specialty care (Flores, 2010), which may serve as a significant barrier to early intervention for racially minoritized populations. For those who receive a referral to a weight management program, additional barriers are often associated with decreased attendance for sessions following baseline assessment (Kwitowski et al., 2017). Specific barriers to specialty care include: living farther from the clinic, limited access to transportation, financial and food insecurity, and public health insurance (Kwitowski et al., 2017; Singh et al., 2017). In addition, Shaffer et al. (2016) demonstrated that a variety of factors are associated with a greater likelihood of initial attendance following referral to a pediatric weight management program, including female sex, higher body mass index (BMI), private health insurance associated with higher socioeconomic status (SES), and advanced family education.

Historically, systemic racism and discrimination have perpetuated treatment access. Higher unemployment rates and disparities in educational attainment are seen among racially minoritized individuals (Singh et al., 2017). Racially minoritized families are also more likely to be uninsured and to live in low-income neighborhoods (Flores, 2010; Singh et al., 2017). The experience of racism has been recognized as a social determinant of health that contributes to inequities and disparities specific to pediatric obesity (Browne et al., 2021; Trent et al., 2019). Thus, contemporary racial disparities may impact every stage of treatment throughout development from early detection and prevention to attendance in treatment for racially minoritized youth. While other studies have addressed barriers to specialty treatment for racially minoritized youth, there is a dearth of literature on access to pediatric weight management programs for historically underserved populations.

Given the higher prevalence rates of obesity in racially minoritized youth and barriers to accessing equitable care, further investigation of variables perpetuating such health disparities is warranted. This study evaluated healthcare disparities in initial attendance at a Midwestern, metropolitan,

interdisciplinary weight management program. The clinical and demographic characteristics of participants in the weight management program were collected at enrollment and retrospectively analyzed. It was hypothesized that racially minoritized participants would be less represented in this program as compared to local census data. The current study evaluated differences in HRQOL, use of public insurance, distance from the program, and medical complexity to assess barriers to weight management treatment for racially minoritized youth.

Methods

Participants

Pediatric participants ($N = 228$) attended the weight management program at Riley Hospital for Children between 2018 and 2021. Participants were under the age of 18 years and diagnosed with obesity, defined as a BMI greater than the 95th percentile for age and sex. A weight-to-length ratio greater than the 95th percentile for age and sex defined obesity for participants under two years of age.

Procedure and Data Collection

Children were typically referred to the pediatric weight management program at Riley Hospital for Children/Indiana University (IU) Health by their primary care physician, pediatric gastroenterologist, or pediatric psychologist due to concerns related to obesity. Following referral, the child and their parent(s) or guardian(s) were scheduled for an intake with an interdisciplinary team, including a physician, pediatric psychologist, and dietician. At the initial visit, a medical assessment was conducted in coordination with a biopsychosocial interview with the interdisciplinary team. Medical conditions, including mental and physical health diagnoses, were recorded. The parent(s) or guardian(s) and children completed the PedsQL 4.0 survey at the time of initial evaluation, and each total score, physical health score, and psychosocial score was recorded as part of routine clinical care. Variables that were further assessed included insurance type (i.e., commercial, public, or self-pay), type of visit (i.e., in-person or telehealth), and home location. Each participant's anthropometrics were also recorded, including weight, height, and BMI, along with the z -scores for each growth parameter. Parent(s) or guardian(s) were provided a patient history questionnaire to report qualitative demographic information, including self-reported race, birth, social and family history, and other health conditions.

All medical information collected as routine clinical care was stored in a secure electronic database using REDCap software. Identifying protected health information (PHI) was removed to maintain confidentiality. The Institutional Review Board (IRB) at Indiana University School of Medicine approved this study using archival data obtained from all participants and their parent(s) or guardian(s) as part of standard clinical care.

Pediatric Quality of Life Inventory 4.0 (PedsQL)

The 23-item Pediatric Quality of Life Inventory 4.0 (Varni et al., 2001) was administered at enrollment to participants and their parent(s) or guardian(s). The PedsQL is a validated assessment of HRQOL in healthy children and those with medical conditions. The PedsQL assesses for physical, emotional, social, and school functioning. Scores range from 0–100 on each scale, with higher scores indicating a higher level of functioning in each domain. For this study, overall functioning was evaluated by each participant's PedsQL physical health summary score (i.e., same as the aforementioned physical functioning score), psychosocial health summary score (i.e., a combination of the emotional, social, and school functioning scales), and total summary score (i.e., sum of all answered items). Families with a child between the age of 2 and 4 were only provided with an informant-based PedsQL. Participants between the ages of 5 and 18 were provided with a self-report and an informant-based PedsQL. As applicable, each family was provided with only one informant-based and self-report PedsQL survey contingent upon participant age.

Data Analysis

Fisher's Exact Tests compared demographic, clinical, and geographic characteristics by race. Participants were classified according to race, including White, Black, Hispanic/Latine, and 'other,' which included Asian, American Indian, and Alaskan Native racial identities; for the current study, archival data on ethnicity were combined into race since ethnicity data only delineated between those participants of Hispanic/Latine origin. If a categorical variable differed across the four racial comparison groups, pairwise comparisons were conducted and adjusted using the step-down Bonferroni method. One-way analysis of variance (ANOVA) was calculated to test if age, anthropometrics, and quality of life scores differed by race. Pairwise comparisons were conducted for variables that differed significantly across races using Tukey–Kramer adjustment. Independent samples *t*-tests were further conducted to compare PedsQL 4.0 data across physical and mental health conditions. Linear regressions were performed to assess

associations of HRQOL and BMI data with demographic, physical, and mental health conditions.

Chi-square analyses compared the racial profile of the program participants to the most recent 2020–2021 Indiana and Indianapolis census data (United States Census Bureau, 2021). Post-hoc comparisons across races were analyzed according to a step-down Bonferroni correction method. Geographic locations were classified as Indianapolis-only, counties surrounding Indianapolis, and locations outside Indianapolis and surrounding counties. However, because there was no significant difference in race between participants in the Indianapolis surrounding counties and participants residing outside Indianapolis and surrounding counties, this group was combined for the subsequent chi-square analysis and compared to the state of Indiana census data. In contrast, participants from Indianapolis-only were analyzed independently and compared with the Indianapolis census data for the chi-square analysis. A *p*-value less than 0.05 was used to define statistical significance, and analyses were performed using SAS v9.4 and Microsoft Excel v16.56.

Results

Demographics

There were 228 ($M_{age} = 11.1$ years, $SD = 3.8$) participants enrolled in the interdisciplinary weight management program between 2018 and 2021. The sample consisted of 101 (44.3%) female participants. The participant cohort consisted of 124 (54.5%) White, 58 (25.4%) Black, 40 (17.5%) Hispanic/Latine, and 6 (2.6%) in the 'other' race category (see Table 1).

Insurance Type

Health insurance types differed by race ($p < 0.001$), as shown in Table 1. The health insurance type of White participants differed significantly from the insurance type of Black ($p = 0.035$) and Hispanic/Latine ($p = 0.001$) participants. White participants were more likely to have commercial health insurance, whereas racially minoritized groups were more likely to have public health insurance. There were no significant differences in insurance type between Black, Hispanic/Latine, and participants categorized as 'other.'

Visit Type

Across all participants, in-person visits at the time of enrollment were much more frequent ($n = 213$, 93.4%) than telehealth visits ($n = 15$, 6.6%). Racial groups did not have significant differences according to visit type (see Table 1). All telehealth visits occurred after the onset of the COVID-19

Table 1 Racial differences in demographics at enrollment

Demographic	Total ^a		Black ^b		Hispanic/Latine ^c		White ^d		Other ^e		<i>p</i>
	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	
Age in Years		11.1 (3.8)		11.1 (3.6)		11.4 (3.6)		11.1 (3.9)		8.3 (4.9)	.322
Anthropometrics											
BMI <i>z</i> -score		2.7 (0.7)		2.7 (0.4)		2.5 (0.4)		2.7 (0.8)		3.3 (1.4)	.103
Weight <i>z</i> -score		3.0 (0.8)		3.2 (0.7)		2.7 (0.7)		3.0 (0.9)		3.5 (0.7)	.025
Height <i>z</i> -score		1.0 (1.2)		1.1 (1.3)		0.5 (1.3)		1.1 (1.1)		2.3 (0.4)	.015
Female	101 (44.3)		32 (55.2)		15 (37.5)		52 (41.9)		2 (33.3)		.252
Insurance											<.001
Commercial	85 (37.6)		16 (27.6)		6 (15.4)		61 (49.6)		2 (33.3)		
Public	138 (61.1)		42 (72.4)		32 (82.0)		61 (49.6)		3 (50.0)		
Self-pay	3 (1.3)		0 (0.0)		1 (2.6)		1 (0.8)		1 (16.7)		
Visit Type											.095
In-Person	213 (93.4)		56 (96.6)		38 (95.0)		115 (92.7)		4 (66.7)		
Telehealth	15 (6.6)		2 (3.4)		2 (5.0)		9 (7.3)		2 (33.3)		.081
Pre-COVID-19	0 (0)		–		–		–		–		
COVID-19	15 (8.1)		2 (4.1)		2 (6.3)		9 (9.2)		2 (33.3)		

Demographics according to race were analyzed using a one-way ANOVA or Fisher's Exact Test. Post-hoc comparisons by race were analyzed on all significant results according to a step-down Bonferroni correction method or Tukey–Kramer adjustment. Significant pairwise comparisons are shown above in bold font. The insurance status of White participants differed significantly from the insurance status of Black ($p = .035$) and Hispanic/Latine participants ($p = .001$). There was no significant difference in insurance type between Black, Hispanic/Latine, and participants of other races. In addition, the weight *z*-score, $F(3,221) = 3.18$, $p = .025$, and height *z*-score, $F(3,215) = 3.56$, $p = .015$, were found to be significantly different amongst racial groups. Examining pairwise comparisons, the weight *z*-score significantly differed between Black and Hispanic/Latine participants ($p = .040$); the height *z*-score significantly differed between Hispanic/Latine and participants with race marked as 'other' ($p = .038$). Other = Asian, American Indian, and Alaskan Native racial identities; *BMI* body mass index

^a $N = 228$

^b $n = 58$

^c $n = 40$

^d $n = 124$

^e $n = 6$

pandemic and lasted for a brief (i.e., five weeks) duration at the start of the pandemic. For those who used telehealth services, there was no significant difference in geographic location ($p = 0.196$); specifically, for families who used telehealth services, there were 6 participants who resided in Indianapolis, 1 participant who lived in a county directly surrounding Indianapolis, and 8 participants who resided farther than the surrounding counties of Indianapolis.

Anthropometrics

BMI, weight and height *z*-scores were further compared by racial group (see Table 1). There was no significant difference found in BMI by race, $F(3, 213) = 2.08$, $p = 0.103$. However, the weight *z*-score, $F(3, 221) = 3.18$, $p = 0.025$, and height *z*-score, $F(3, 215) = 3.56$, $p = 0.015$, differed by race. The weight *z*-score was significantly higher ($p = 0.040$) in Black ($M = 3.2$, $SD = 0.7$) as compared to Hispanic/Latine ($M = 2.7$, $SD = 0.7$) participants. In addition, the height

z-score was significantly lower ($p = 0.038$) for Hispanic/Latine ($M = 0.5$, $SD = 1.3$) participants as compared to participants with race classified as other ($M = 2.3$, $SD = 0.4$).

Medical History

A comprehensive list of health conditions categorized as 'other' is shown in Supplemental Table 1. Comparing physical and mental health conditions across race revealed that anxiety ($p = 0.005$), autism spectrum disorder (ASD; $p = 0.027$), type 2 diabetes ($p = 0.024$), and NAFLD ($p = 0.008$) differed significantly by race (see Table 2). White participants (21.0%) had a higher proportion of anxiety as compared to Hispanic/Latine participants (2.5%, $p = 0.034$). Hispanic/Latine participants (27.5%) had a higher proportion of NAFLD than White (9.7%, $p = 0.041$) and Black (5.2%, $p = 0.017$) participants. After adjusting for multiple

comparisons according to race, there were no significant pairwise comparisons for ASD or type 2 diabetes.

Pediatric Quality of Life Inventory 4.0 (PedsQL)

Across all participants, scores on the PedsQL 4.0 for parent- ($M_{Total} = 67.6$, $SD = 18.8$) and child- ($M_{Total} = 71.2$, $SD = 16.8$) reports are listed in Table 3. Overall, there were no differences found across race for parent-proxy or child-self-report scores.

PedsQL Ratings Across Physical and Mental Health Conditions

Supplemental independent-sample *t*-tests were conducted to compare the PedsQL ratings across various physical and

mental health conditions. There were significant differences in PedsQL ratings across anxiety, externalizing disorders (i.e., attention-deficit/hyperactivity disorder [ADHD], disruptive behavior disorders [DBDs]), NAFLD, sleep apnea, and health conditions marked as 'other.' Specifically, informants reported decreased psychosocial functioning ($p = 0.001$) for participants diagnosed with anxiety; likewise, participants with anxiety self-reported decreased HRQOL across both physical ($p = 0.001$) and psychosocial functioning ($p < 0.001$). Participants with ASD self-reported lower psychosocial functioning as compared to participants without ASD ($p = 0.018$). Informant report ($p < 0.001$), in addition to self-report ($p = 0.001$), PedsQL data for participants diagnosed with an externalizing disorder revealed lower psychosocial functioning as compared to participants without an externalizing disorder. Informant reports of participants with NAFLD reported decreased overall HRQOL ratings ($p = 0.042$), with trending differences in both physical ($p = 0.052$) and psychosocial ($p = 0.068$) ratings.

Table 2 Racial differences in physical and mental health conditions at enrollment

Condition	Total ^a		Black ^b		Hispanic/Latine ^c		White ^d		Other ^e		<i>p</i>
	<i>N</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Dyslipidemia	62	27.2	10	17.2	12	30.0	39	31.4	1	16.7	.201
Pre-Diabetes	53	23.2	18	31.0	12	30.0	22	17.7	1	16.7	.138
Sleep Apnea	48	21.1	18	31.0	4	10.0	25	20.2	1	16.7	.080
Externalizing Disorder	38	16.7	8	13.8	3	7.5	26	21.0	1	16.7	.200
Other Health Conditions	33	14.5	7	12.1	2	5.0	23	18.6	1	16.7	.147
Anxiety	31	13.6	4	6.9	1	2.5	26	21.0	0	0.0	.005
Depression	27	11.8	7	12.1	2	5.0	18	14.5	0	0.0	.415
NAFLD	27	11.8	3	5.2	11	27.5	12	9.7	1	16.7	.008
Hypertension	23	10.1	5	8.6	6	15.0	12	9.7	0	0.0	.672
Autism Spectrum Disorder	18	7.9	4	6.9	0	0.0	12	9.7	2	33.3	.027
Type 2 Diabetes	7	3.1	4	6.9	1	2.5	1	0.8	1	16.7	.024
NASH	5	2.2	0	0.0	2	5.0	3	2.4	0	0.0	.389
PCOS	3	1.3	1	1.7	0	0.0	2	1.6	0	0.0	1.000
Genetic Disease	3	1.3	0	0.0	0	0.0	3	2.4	0	0.0	.773
Type 1 Diabetes	1	0.4	0	0.0	1	2.5	0	0.0	0	0.0	.202

The prevalence of each condition was determined according to race and compared using a Fisher's Exact Test. Post-hoc comparisons across races were analyzed according to a step-down Bonferroni correction method. Significant pairwise comparisons are shown above in bold font. White participants were more likely to have anxiety than Hispanic/Latine participants ($p = .034$). Hispanic/Latine participants were more likely to have NAFLD than White ($p = .041$) and Black ($p = .017$) participants. When adjusting for multiple comparisons, there were no significant pairwise comparisons for ASD and type 2 diabetes. Other = Asian, American Indian, and Alaskan Native racial identities; Externalizing Disorder = attention-deficit/hyperactivity disorder (ADHD) or disruptive behavior disorders; NAFLD nonalcoholic fatty liver disease, NASH nonalcoholic steatohepatitis, PCOS polycystic ovary syndrome. Other Health Conditions = infrequent comorbid physical and mental health conditions (see Supplemental Table 1); Genetic Disease = genetic disease associated with obesity

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^e $n = 6$

Table 3 Parent and child scores on the PedsQL 4.0 survey at enrollment compared by race

PedsQL 4.0 Scales	Total ^a		Black ^b		Hispanic/Latine ^c		White ^d		Other ^e		<i>F</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Parent-report											
Physical score	66.5	24.0	67.5	22.5	70.1	18.4	63.8	25.9	92.7	12.6	1.64
Psychosocial score	68.0	18.4	71.2	18.0	69.6	12.3	65.5	19.8	78.2	19.8	1.06
Total Score	67.6	18.8	70.1	17.8	69.8	12.9	65.0	20.4	84.2	13.7	1.47
Child Self-Report											
Physical Score	73.1	20.6	72.6	18.8	72.6	16.0	72.6	22.6	91.7	14.4	0.83
Psychosocial Score	70.1	17.1	70.3	18.0	70.7	15.9	69.6	17.1	77.8	19.5	0.22
Total Score	71.2	16.8	71.1	16.7	71.3	15.0	70.7	17.4	82.6	15.2	0.48

The mean total PedsQL scores and the mean scores for the physical and psychosocial scales were determined according to race and compared using a one-way ANOVA. There were no significant differences found across racial groups in PedsQL scores. PedsQL = Pediatric Quality of Life Inventory; Other = Asian, American Indian, and Alaskan Native racial identities

^a*N* = 228

^b*n* = 58

^c*n* = 40

^d*n* = 124

^e*n* = 6

Participants diagnosed with sleep apnea self-reported lower overall HRQOL across physical ($p = 0.001$) and psychosocial ($p = 0.038$) functioning. Finally, informant report ($p = 0.018$), in addition to self-report ($p = 0.042$), PedsQL data for participants diagnosed with other health conditions revealed decreased physical functioning.

Factors Associated with HRQOL and BMI

Supplemental linear regressions were conducted across a variety of demographic, physical, and mental health conditions to predict health-related quality of life and BMI (see Table 4). Increased age was associated with a lower BMI *z*-score ($p < 0.001$). Likewise, living in a surrounding county was associated with a lower BMI *z*-score relative to participant families who resided farther away ($p = 0.007$). In contrast, participants diagnosed with a genetic disease related to obesity ($p = 0.012$), hypertension ($p = 0.003$), and sleep apnea ($p = 0.013$) were associated with a higher BMI *z*-score. Participants diagnosed with anxiety were associated with lower PedsQL self-report ratings ($p = 0.027$); similarly, participants diagnosed with NAFLD had significantly lower PedsQL informant scores ($p = 0.008$).

Distance from Program

Participants in the weight management program were represented across the state of Indiana. Table 5 shows the comparison of participants' race by residence. 109 (47.8%)

participants resided in Indianapolis, 45 (19.7%) lived in counties directly surrounding Indianapolis, and 74 (32.5%) participants resided farther than the surrounding counties of Indianapolis. There were significant ($p < 0.001$) racial differences between the three geographic regions. Participants in counties directly surrounding Indianapolis ($p = 0.002$) and participants outside Indianapolis and surrounding counties ($p = 0.002$) differed in racial profile as compared to participants residing in Indianapolis; those not living in Indianapolis were more likely to be White, with prevalence rates of 70% and above in the current sample. There was no significant difference in race ($p = 0.586$) between participants in the Indianapolis surrounding counties and participants residing outside Indianapolis and surrounding counties.

Racial Representation of Program Compared to Recent Census Data

The proportion of each racial group in the weight management program was compared to US census data from 2020 to 2021 (United States Census Bureau, 2021). The racial proportion of participants from Indianapolis-only was significantly different than the racial proportion of the Indianapolis area as determined by recent census results, $\chi^2(3, n = 109) = 40.43, p < 0.001$ (see Fig. 1). The percentage of Hispanic/Latine and Black participants in the weight management program was significantly greater than the Hispanic/Latine ($p = 0.004$) and Black ($p = 0.004$) individuals, according to the most recent Indianapolis census

Table 4 Linear regressions of demographics, mental and physical health conditions predicting PedsQL ratings and BMI z-scores

Variable	Total PedsQL Parent-Report			Total PedsQL Child-Report			BMI z-score		
	β (SE)	F (df)	p	β (SE)	F (df)	p	β (SE)	F (df)	p
Age	-0.81 (0.52)	2.44 (1, 92)	.122	-0.40 (0.52)	0.60 (1, 94)	.441	-0.06 (0.01)	27.22 (1, 190)	<.001
Female	7.18 (3.85)	3.47 (1, 92)	.066	1.01 (3.44)	0.09 (1, 94)	.771	-0.13 (0.08)	2.24 (1, 190)	.136
Race	-	1.10 (3, 92)	.353	-	0.13 (3, 94)	.944	-	1.24 (3,190)	.298
Black	3.44 (5.25)	0.44 (1, 92)	.514	1.16 (4.38)	0.07 (1, 94)	.792	-0.05 (0.11)	0.16 (1, 190)	.689
Hispanic/Latine	5.00 (6.17)	0.66 (1, 92)	.420	-1.70 (5.57)	0.10 (1, 94)	.761	-0.15 (0.12)	1.42 (1, 190)	.238
Other	20.20 (12.68)	2.53 (1, 192)	.115	3.98 (10.81)	0.14 (1, 94)	.714	0.47 (0.32)	2.19 (1,190)	.141
White	REF	-	-	REF	-	-	REF	-	-
Insurance	-	0.49 (2, 92)	.615	-	0.86 (2, 94)	.428	-	0.01 (2, 190)	.986
Commercial	8.75 (14.55)	0.36 (1, 92)	.549	-13.60 (12.64)	1.17 (1, 94)	.285	-0.04 (0.44)	0.01 (1, 190)	.919
Public	5.51 (15.06)	0.14 (1, 92)	.715	-15.98 (12.97)	1.51 (1, 94)	.221	-0.03 (0.45)	0.01 (1,190)	.939
Self-pay	REF	-	-	REF	-	-	REF	-	-
Distance	-	0.18 (2, 92)	.834	-	0.68 (2, 94)	.509	-	3.73 (2, 190)	.026
Surrounding	2.87 (5.32)	0.29 (1, 92)	.591	4.62 (5.05)	0.85 (1, 94)	.362	-0.33 (0.12)	7.45 (1,190)	.007
Indianapolis	-0.005 (5.26)	0.00 (1,92)	.999	4.88 (4.56)	1.15 (1, 94)	.288	-0.12 (0.10)	1.32 (1,190)	.251
Outside	REF	-	-	REF	-	-	REF	-	-
Condition									
Anxiety	-6.16 (6.13)	1.01 (1, 92)	.317	-11.51 (5.11)	5.07 (1, 94)	.027	-0.03 (0.14)	0.04 (1, 190)	0.845
ASD	1.65 (7.30)	0.05 (1, 92)	.822	-5.84 (6.02)	0.94 (1, 94)	.335	0.25 (0.16)	2.29 (1, 190)	0.132
Externalizing	-9.55 (5.44)	3.08 (1, 92)	.083	-4.88 (4.49)	1.18 (1, 94)	.280	-0.02 (0.12)	0.02 (1, 190)	0.897
Depression	0.35 (6.89)	0.00 (1,92)	.959	2.04 (5.33)	0.15 (1, 94)	.703	-0.01 (0.14)	0.00 (1, 190)	0.960
Type 1 Diabetes	16.08 (20.84)	0.60 (1, 92)	.443	-23.08 (17.94)	1.65 (1, 94)	.202	0.65 (0.61)	1.13 (1, 190)	0.289
Type 2 Diabetes	10.78 (10.28)	1.1 (1, 92)	.297	-0.53 (8.01)	0.00 (1, 94)	.948	0.32 (0.24)	1.81 (1, 190)	0.180
Dyslipidemia	1.27 (4.28)	0.09 (1, 92)	.767	3.88 (3.76)	1.07 (1, 94)	.304	-0.17 (0.09)	3.09 (1, 190)	0.080
Genetic Disease	N/A	-	-	N/A	-	-	0.88 (0.35)	6.50 (1, 190)	.012
Hypertension	12.23 (6.53)	3.51 (1, 92)	.064	3.82 (5.90)	0.42 (1, 94)	.519	0.42 (0.14)	9.14 (1, 190)	.003
NAFLD	-14.41 (5.31)	7.37 (1, 92)	.008	-3.03 (4.75)	0.41 (1, 94)	.524	-0.17 (0.14)	1.61 (1, 190)	0.206
NASH	0.99 (11.47)	0.01 (1, 92)	.932	7.43 (9.99)	0.55 (1, 94)	.459	-0.19 (0.28)	0.49 (1, 190)	0.485
PCOS	N/A	-	-	-30.15 (16.18)	3.47 (1, 94)	.066	0.35 (0.34)	1.03 (1, 190)	0.311
Prediabetes	0.37 (4.51)	0.01 (1, 92)	.935	-1.64 (3.74)	0.19 (1, 94)	.662	0.09 (0.10)	0.87 (1, 190)	0.353
Sleep Apnea	-6.79 (4.75)	2.05 (1, 92)	.156	-7.93 (4.02)	3.90 (1, 94)	.051	0.27 (0.11)	6.31 (1, 190)	.013
Other health conditions	-7.35 (5.67)	1.68 (1, 92)	.198	-3.44 (4.78)	0.52 (1, 94)	.473	-0.03 (0.12)	0.08 (1, 190)	0.776

$N=228$. Supplemental linear regressions were conducted across a variety of demographic, physical, and mental health conditions to predict health-related quality of life and BMI. Significant predictions are shown above in bold font. *PedsQL* Pediatric Quality of Life Inventory; Surrounding = counties surrounding Indianapolis; Outside = counties outside Indianapolis and surrounding counties; *ASD* = autism spectrum disorder; Externalizing = externalizing disorder (e.g., attention-deficit/hyperactivity disorder, disruptive behavior disorders); *NAFLD* nonalcoholic fatty liver disease, *NASH* nonalcoholic steatohepatitis; *PCOS* polycystic ovary syndrome; Other Health Conditions = infrequent comorbid physical and mental health conditions (see Supplemental Table 1); Genetic Disease = genetic disease associated with obesity; *REF* reference category for the linear regression grouping; *N/A* data not available

data. Conversely, the percentage of White participants in the weight management program was significantly less than the White racial representation according to the most recent Indiana census data ($p = 0.004$).

There were trending albeit nonsignificant differences in the racial proportion of participants from those outside Indianapolis compared to recent census results from the state of Indiana, $\chi^2(3, n = 119) = 7.72, p = .052$ (see Fig. 2). Thus, the study cohort outside Indianapolis was representative of the state of Indiana.

Discussion

Identifying contributory factors that influence initial treatment attendance in racially minoritized youth can facilitate improvements in prevention, intervention, and equity of care. Thus, the current study focused on variables impacting attendance at a Midwest-based pediatric weight management program. More White participants were represented in the study cohort than racially minoritized participants. Contrary to predictions, racially minoritized youth in Indianapolis

Table 5 Racial differences of participants based on home location throughout Indiana

Race***	Indianapolis ^a		Indianapolis Surrounding Counties ^b		Outside Indianapolis and Surrounding Counties ^b	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Black	50	45.9	2	4.4	6	8.1
Hispanic/Latine	24	22.0	4	8.9	12	16.2
White	33	30.3	37	82.2	54	73.0
Other	2	1.8	2	4.4	2	2.7
Total	109	47.8	45	19.7	74	32.5

N = 228. The prevalence of each geographical location was determined according to race and compared using a Fisher's Exact Test. According to a post-hoc step-down Bonferroni correction method, geographic locations with a common superscript (i.e., identical letters) are not significantly different. Other = Asian, American Indian, and Alaskan Native racial identities

****p* < .001

were more represented within the weight management program as compared to recent census data; this is consistent with prior literature suggesting that racially minoritized youth are at increased risk for obesity (Hales et al., 2017). Consistent with predictions, factors associated with initial treatment attendance, particularly for racially minoritized youth, include physical and mental health comorbidities, insurance type, HRQOL, and geographic location.

Clinical Characteristics by Race

Medical History

The current study investigated a variety of physical and mental health comorbidities across races. Consistent with prior research, in our study participants who identified as White reported greater rates of anxiety. Of note, racially minoritized youth are more likely to display somatic expressions of anxiety (e.g., abdominal pain, fatigue) and may underreport internalizing symptoms (Escovar et al., 2018). Plausible explanations for underreporting internalizing symptoms for racially minoritized youth are varied and may include distrust of medical providers, lack of representational diversity at medical institutions, and misdiagnosis (Armstrong et al., 2007; Asnaani et al., 2010). Hence, it is critical for healthcare providers to be aware of cultural differences in the expression of internalizing symptoms among racially minoritized youth.

Conditions that co-occur with obesity may further increase morbidity, and disproportionately impact racially minoritized patient populations. For example, consistent with prior literature (Schwimmer et al., 2005), current results found higher prevalence rates of NAFLD in Hispanic/Latine youth. Our study adds to the literature by demonstrating a lower HRQOL for youth diagnosed with NAFLD, as reported by caregivers. Thus, our data suggests that

Hispanic/Latine patient populations may be disproportionately at risk for a worse prognosis due to the high prevalence of comorbid NAFLD and obesity. Broadly, higher rates of comorbid medical conditions for racially minoritized youth with obesity may be associated with an increased number of families seeking care. This study indicates that race, physical, and mental health conditions may influence treatment attendance, highlighting the importance of preventative care for youth with obesity. Regular screening and monitoring for comorbid health conditions in children with obesity may facilitate appropriate diagnosis and treatment.

The American Academy of Pediatrics and US Preventative Services Task Force guidelines denote that the standard of care for pediatric obesity should include regular screening for all children (Cook et al., 2018; Grossman et al., 2017). In many cases, a child may receive a referral to weight management programs from their primary care provider. However, racially minoritized youth are less likely to have a primary care provider, and among those who have established care, racially minoritized youth are less likely to be referred to specialty care (Flores, 2010); additional barriers may compound this disparity for racially minoritized youth, such as living farther from the clinic, limited access to transportation, financial and food insecurity, and public health insurance (Kwitowski et al., 2017; Singh et al., 2017). Indeed, our study suggests that youth with comorbid physical health conditions (e.g., genetic disease, hypertension, sleep apnea) are at increased risk for a more severe clinical presentation, which may lead to various sequelae such as decreased HRQOL or increased BMI.

Insurance Type

When analyzed across racial groups, there was a significant difference between insurance type and race, in which racially minoritized families were more likely to have publicly

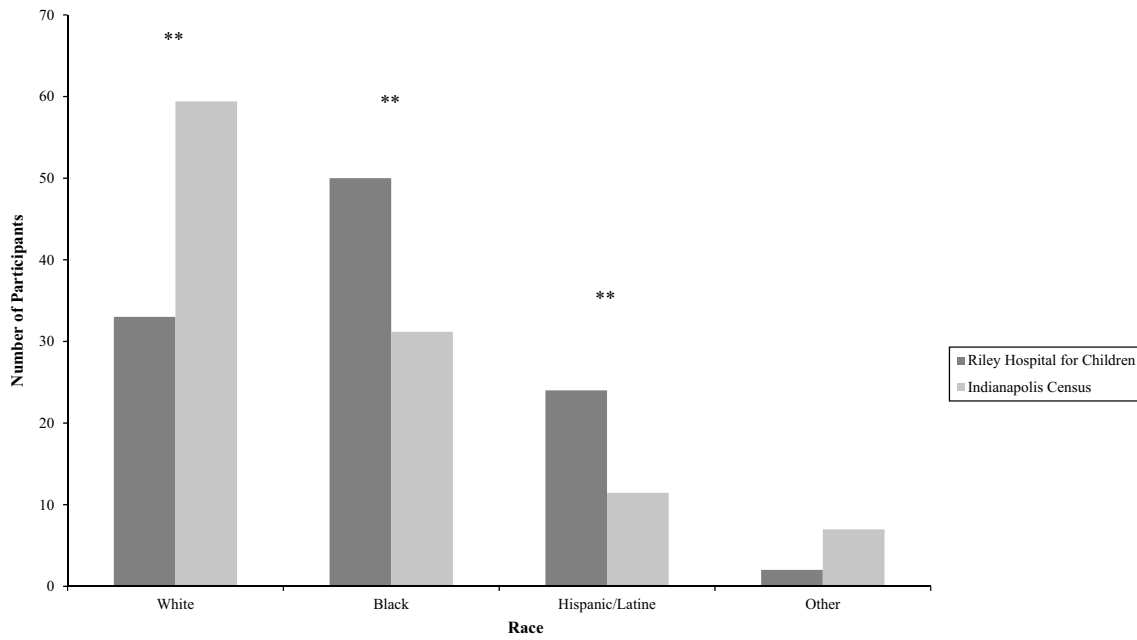


Fig. 1 Racial composition of Indianapolis Participants at Riley Hospital for Children compared to the 2020–2021 Indianapolis Census Data. Chi-square cross-sectional analysis revealed significant differences between the racial profile of Indianapolis participants in the

study cohort compared to recent census records in the city of Indianapolis, $\chi^2(3, n = 109) = 40.43, p < .001$. Post-hoc comparisons across races were analyzed according to a step-down Bonferroni correction method. $**p < .01$

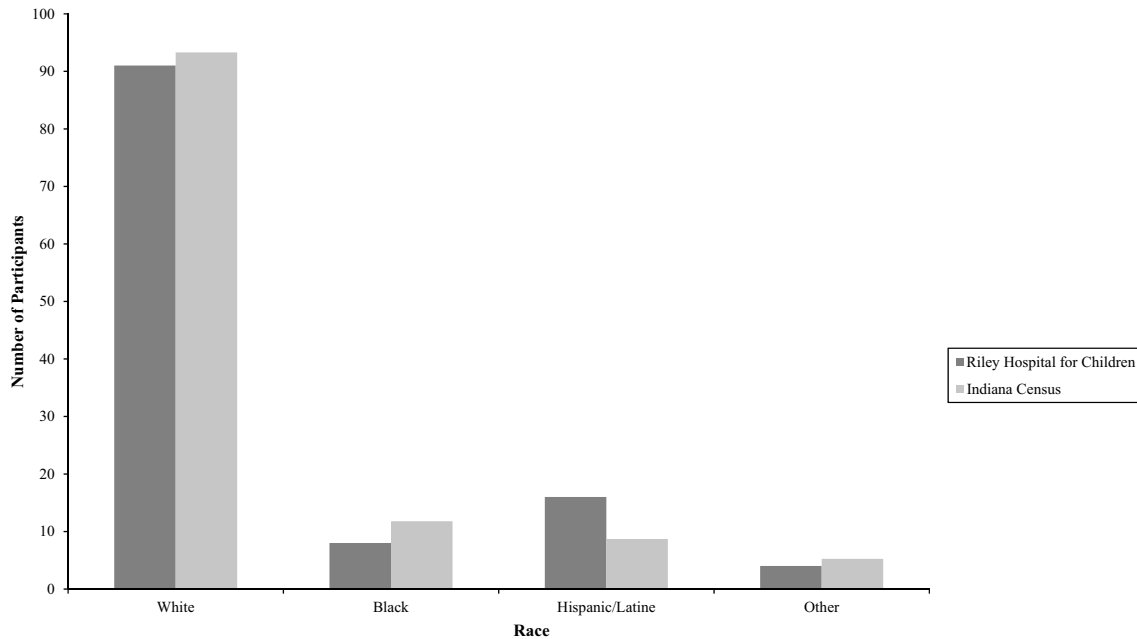


Fig. 2 Racial composition of Participants at Riley Hospital for Children Outside Indianapolis compared to the 2020–2021 Indiana Census Data. Chi-square cross-sectional analysis revealed trending signif-

icance between the racial profile of participants outside Indianapolis as compared to recent census records across the state of Indiana, $\chi^2(3, n = 119) = 7.72, p = .052$

funded insurance than participants who identified as White. Previous research has recognized private health insurance status as one of the strongest predictors of treatment

attendance following a referral to weight management (Shaffer et al., 2016). Insurance type may be considered a barrier to specialty care for racially minoritized families as it

may represent a difference in socioeconomic status between racial groups (Tershakovec & Kuppler, 2003). The relationship between insurance status and treatment attendance may also represent differences in the affordability of specialty treatment, which is often intensive and long-term. However, unlike other specialized weight management programs, the program at Riley Hospital for Children allowed accessibility independent of insurance type. Because this study revealed a relative discrepancy in insurance types between majority and racially minoritized youth, it is recommended that medical centers consider accepting youth with publicly funded insurance to improve access to specialty care such as obesity treatment. Current data suggest that when insurance status does not preclude accessibility, racially minoritized youth will be more likely to equitably access weight management services.

Health-Related Quality of Life

While no statistically significant differences were found across race for HRQOL in patients with obesity, there were differences in a variety of comorbid physical health conditions in which racially minoritized youth were disproportionately impacted (e.g., pre-diabetes, type 2 diabetes, NAFLD). In general, HRQOL was comparable to a previous study by Pratt et al. (2013), with similar scores in informant and child-self-report measures in a pediatric weight management program (i.e., child-self $M_{total} = 73.0$, parent-proxy $M_{total} = 66.2$). Likewise, the PedsQL scores of the participants in the current study were also comparable to participants with functional gastrointestinal disorders (i.e., child-self $M_{total} = 70.2$, parent-proxy $M_{total} = 70.5$) (Varni et al., 2015). The mean HRQOL scores of the participants were also lower than what Huang et al. (2009) demonstrated in a study of children with chronic diseases. Thus, it is important to note that HRQOL for children with obesity may be impacted by additional psychosocial stressors that include increased negative self-worth, bullying and decreased coping (Griffiths et al., 2010; Talen & Mann, 2009; Waasdorp et al., 2018). Children with obesity are more likely to experience reduced social functioning, potentially exacerbated by peer victimization, adjustment problems, and minority status (Griffiths et al., 2010; Waasdorp et al., 2018). In addition, data in the current study further revealed that participants diagnosed with comorbid mental health diagnoses, such as anxiety, are at increased risk for a lower HRQOL. Overall, this suggests that participants with obesity experience difficulties with quality of life related to chronic medical conditions; this also highlights the continued need for interdisciplinary care to help address concerns from a biopsychosocial perspective.

Geographic Location at Enrollment

Compared to the most recent Indianapolis census data, there was a significant difference in racial representation between the participant sample and the Indianapolis general census population. This comparison showed more Hispanic/Latine and Black participants in addition to fewer White participants than what was anticipated from the Indianapolis city census data from 2020 to 2021 (United States Census Bureau, 2021). In contrast, there were no significant differences between racial groups compared to what was anticipated from the most recent statewide census data. Given that racially minoritized participants living outside of Indianapolis were similar in representation to White participants who have a lower risk for obesity, data suggests that racially minoritized participants living a greater distance from the program are underrepresented in the weight management program.

Explanations for the relative underrepresentation of racially minoritized participants outside Indianapolis within this study are varied. Riley Hospital for Children is considered the only pediatric weight management program in Indiana. Hence, consistent with previous research, barriers to specialty treatment may include living farther from the clinic and lack of transportation, further limiting access to specialty care (Kwitowski et al., 2017; Singh et al., 2017). In addition, healthcare providers are less likely to diagnose racially minoritized youth with obesity, which can negatively impact collaboration with community partners and influence referral rates to specialty care for underserved youth (Davis et al., 2009). Because racially minoritized youth within this participant cohort were well-represented in the local Indianapolis region, there should be increased efforts to promote interdisciplinary statewide collaboration, advocacy, and education among providers to improve rates of attendance from all regions of the state to increase referral rates for racially minoritized youth in more distant areas of Indiana.

Limitations

The current study is not without limitations. For example, there was a lack of availability of certain participant information, such as the mode of transportation to the initial appointment and more specific data on aspects of the participant demographics (e.g., culture, familial values/experiences, intersectionality, acculturation), which led to a gap in understanding the complex relationship between factors influencing initial treatment attendance. In addition, the small number of participants from Asian, American Indian, and Alaskan Native backgrounds led to limited statistical power for the interpretation of results within these

racial groups. When conducting comparative analyses of the census data, the study cohort data were from 2018 through 2021, which may be outdated compared to the more recent census data between 2020 and 2021. Geographically the study was conducted at a Midwest-based metropolitan pediatric academic medical center; thus, the study may have limited generalizability to other geographic locations, such as other parts of the US and other specialty-based treatment programs. Another limitation may include the mean age of our cohort of 11 years. The cohort comprises mostly school-age youth and may have limited generalizability to other developmental stages, such as early childhood and adulthood. Finally, this study only evaluated treatment at the initial session, with lack of archival data available on the pediatric weight management referral source, attendance to future appointments, and participants who did not attend the initial meeting following referral. Therefore, this study cannot determine factors influencing follow-up attendance or referral rates.

Future Directions

The limitations call attention to future directions in clinical care and research in addition to important quality improvement initiatives. Because the current study cohort is based upon referrals to the weight management program, the lack of representation from racially minoritized youth outside the local area reflects a need to improve awareness and advocacy of this program throughout the state to increase referrals from other geographic locations. This study also emphasizes the lack of pediatric weight management services available, which may limit specialty care to certain populations, particularly in rural areas. Future research may also focus on gathering additional qualitative information from families to help understand family perspectives of barriers impacting treatment attendance and engagement; likewise, future research may focus on follow-up visits and how data gathered in the initial visit predicts treatment adherence with specialty care. Finally, because many participants are referred by primary care providers in the community, future research should investigate referral practices for these providers and how this impacts referral rates to specialty pediatric weight management programs.

To improve the delivery of clinical care, increased utilization of telehealth services and acceptance of a variety of insurance types may improve treatment attendance for racially minoritized youth and youth from underserved areas. Overall, developing diversity, equity, and inclusion guidelines for specialty pediatric weight management programs can improve cultural sensitivity in obesity treatment.

Conclusion

This study identified factors associated with treatment attendance in a pediatric weight management program. Racially minoritized youth presented with increased rates of public health insurance and medical comorbidities compared to White participants. Participants with additional health comorbidities associated with obesity had decreased HRQOL compared to a less severe clinical presentation. Contrary to predictions, racially minoritized youth in the local metropolitan area were more represented in our weight management program than in recent census data, suggesting that our program reaches a subset of historically underserved participants when they reside in the same city. However, racially minoritized youth were underrepresented as distance increased from the program. To improve the rates of childhood obesity, efforts should focus on increasing access to and enhancing medical treatment for racially minoritized youth through specialty program expansion and further dissemination of intervention.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10880-022-09899-0>.

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Data Availability Data that support the results of this study can be deposited as necessary in a public repository.

Code Availability Not applicable.

Declarations

Conflict of interest William A. Anastasiadis, Ashley Bazier, Elaine Gilbert, Katherine Schwartzkopf, Kari Benson, Anthony J. Perkins, Sara K. Naramore declare no potential conflicts of interest concerning the research and/or authorship of this research project.

Ethical Approval The Institutional Review Board (IRB) at Indiana University School of Medicine approved this study using archival data obtained from all participants and their caregiver(s) as part of standard clinical care. This retrospective chart review study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Not applicable.

Consent for Publication Not applicable.

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