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The Impact of a Parent-Only Pediatric Obesity Intervention Program on Quality of Life in Racially Diverse Children

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Abstract

Pediatric obesity has been associated with significant decrements in pediatric quality of life (QOL) comparable with severe pediatric diseases such as cancer. Parenting interventions have yielded health benefits for children with obesity; however, few studies have investigated the impact of parent-focused interventions on QOL in children with overweight and obesity. This study investigated the impact of a 6-week intensive parenting intervention program on the QOL of 5-12 year old, predominantly Black children with overweight and obesity. Parents were randomized into either the parenting intervention (NOURISH+) or a control group, and QOL, as well as variables related to child and parenting health-related behaviors, were measured at both baseline and post-intervention. Linear mixed models revealed that participants in both the control and intervention groups reported significant QOL improvements at post-intervention, however significant differences between control and intervention groups were only observed for the school QOL subscale. Sensitivity analyses identified an influence of race on QOL scores, Black children reported significantly lower QOL compared with White participants, furthermore younger (5 to <9 years) Black children reported the lowest QOL scores at baseline and post-testing compared with same age white children and older (9-12 years) Black and White children. Regression analyses revealed that BMI%ile, moderate physical activity, and parent feeding behaviors were associated with child QOL at baseline; parent feeding behaviors alone were associated with post-intervention QOL scores. These findings highlight the impact of obesity on QOL, particularly in younger, Black children, a group that is often overlooked in research. More research is needed on the impact of parent-focused interventions on QOL scores in children with obesity, particularly in minoritized groups.

Pediatric overweight or obesity currently impacts 1 in 3 children in the United States (Kumar & Kelly, 2017). Between 1971 and 2018, the prevalence of obesity among children aged 6-to-11 years increased five-fold (Fryar et al., 2020). According to the National Health and Nutrition Examination Survey (NHANES), children aged 2-to-5 years showed acute increases in obesity prevalence from the 2013-2014 survey to the 2015-2016 survey; in particular, boys aged 2-to-5 years displayed a 40% increase in obesity rates since 2011 (Skinner et al., 2018). This is concerning as excess adiposity in childhood is associated with an increased risk of chronic diseases previously thought to solely affect adults, such as type 2 diabetes, cardiovascular disease, non-alcoholic fatty liver disease, obstructive sleep apnea, and dyslipidemia (Kansra et al., 2020; Steinbeck et al., 2018). Pediatric obesity is also associated with negative psychological, social, and emotional health (Pulgarón, 2013; Rankin et al., 2016). These negative psychological outcomes are generally considered attributable to weight stigma and internalized weight bias, issues evident in children as young as preschool age (Fan et al., 2021; Janssen et al., 2004; Pont et al., 2017).

Obesity is a complex disease with a multifactorial etiology linked to biological, behavioral, and social factors (Hu, 2008; Kansra et al., 2020). This etiological complexity facilitates the obstinate nature of obesity; approximately 90% of adolescents with this condition continue to have overweight or obesity in young adulthood (Gordon-Larsen et al., 2004). Studies analyzing weight trends have found childhood obesity (<13 years) is moderately predictive of progression to adult obesity, whereas adolescent obesity (>13 years) is highly predictive of adult obesity; thus, childhood might be an especially fruitful time to initiate individual and family health-related behavior changes (Guo et al., 1994). As rates of pediatric obesity have increased, it has become apparent that this condition disproportionately affects Black youth (Browne et al.,

2021; Johnson et al., 2021). The 2015-2016 NHANES survey indicated prevalence estimates of class I obesity in children aged 2-19 were highest amongst Black females (25.1%) relative to White females and males at 13.6% and 14.7%, respectively (Skinner et al., 2018). Moreover, an analysis of 17,100 youth ages 2-to-18 years (studied over 4 years), found that racial/ethnic disparities in overweight prevalence increased by 211% between 2003 and 2007 (Singh et al., 2010). Therefore, Black children are uniquely vulnerable to the overall increasing rates of pediatric obesity seen within the United States. Culturally and racially sensitive obesity prevention efforts are needed to reduce existing overall disparities and halt the disproportionate increase in obesity within vulnerable populations.

Quality of Life

Obesity can have numerous deleterious impacts on an individual's health and overall Quality of Life (QOL). QOL is a multidimensional construct that reflects subjective satisfaction with various aspects of life, including physical, occupational or school, emotional, and social wellness (Fan et al., 2021). QOL has emerged as an important clinical outcome and public health concern, particularly in the area of chronic disease management in children and adults (Freira et al. 2019). Schwimmer and colleagues (2003) provided novel insight into the association between obesity and children's QOL, reporting that children with obesity reported QOL scores commensurate with that of children with cancer actively undergoing chemotherapy (Schwimmer et al., 2003; Varni et al., 2007). This finding catapulted QOL as a key outcome for pediatric obesity (Schwimmer et al., 2003, Varni et al., 2005). In particular, QOL is considered important because it can both provide a multidimensional understanding of an individual's health status, and offer crucial insight into the positive or negative impacts of intervention trials on children with obesity that might not be captured by weight change alone (Finne et al., 2013; Lek et al.,

2021; Williams et al., 2019). The following sections provide an overview of QOL, explore how its specific domains are impacted in children with obesity, and offer a rationale for assessing this construct in pediatric obesity interventions.

Definition and Measurement of Quality of Life

The World Health Organization originally defined QOL as, "an individual's perception of their position in life in the context of the culture in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL Group, 1995, pg 1405). The term QOL was created to measure the various subjective positive and negative aspects of an individual's life (WHOQOL Group, 1998), and is viewed as overlapping with, yet separate from, the construct of health. The World Health Organization originally sought to create a QOL scale to assist clinicians in making judgments about the areas of patients' lives most affected by disease, with the goal of informing treatment decisions and care plans (WHOQOL Group, 1995). The original measure of QOL was a 15-item instrument created in the 1970s by American psychologist, John Flanagan, and was developed with a diverse sample of 3,000 participants from across the United States (Burckhardt & Anderson, 2003). Since that time, a variety of QOL instruments have been adapted to measure QOL in the general population and for specific health conditions (Haraldstad et al., 2019). Generally, QOL instruments include objective and subjective indicators related to health, material well-being, relationships, intellectual and personal development, community and culture, and recreation (Burckhardt & Anderson, 2003). QOL assessments for specific health conditions are tailored to include items specifically targeted to an individual's experience with the disease (Seow et al., 2019). QOL improvement is recognized as a central public health goal within *Healthy People,* a government outline of leading public-health issues within the US (Healthy People, 2020).

Health Related Quality of Life

As an evolution from QOL, the concept of health-related quality of life (HRQOL) was first described in the 1980s to incorporate all aspects of an individual's QOL directly impacted by health status and disease management, as well as the ability to live a fulfilling life (Center for Disease Control, 2020; McHorney, 1999). In the research literature, the terms health, QOL, and HRQOL are often used interchangeably, (Haraldstad et al., 2019). Like QOL instruments, HRQOL measures assess perceived physical and psychological QOL with either generic, or disease-specific questionnaires, which allow for comparison of individuals within and between specific disease states (Harcourt et al. 2019). HRQOL has proved to be a more powerful predictor of mortality and morbidity than singular measures of health, such as weight (Phyo et al., 2020; Idler & Benyamini, 1997), and has become generally accepted as a valid indicator of intervention needs in both clinical and community settings (Center for Disease Control, 2020).

Pediatric Quality of Life Inventory

Within child and adolescent populations, a frequently used instrument to assess general and disease specific QOL is the Pediatric Quality of Life Inventory (PedsQL) 4.0. The PedsQL is a 23-item assessment of pediatric QOL in children and adolescents ages 2-18 years (Varni et al., 2001). This measure assesses both children's self-report of their internal state, and parents' reports of their children's observable behaviors (Desai et al., 2014). The PedsQL core domains include: physical functioning (8 items), emotional functioning (5 items), social functioning (5 items), and school functioning (5 items). Together, these four domains provide a total QOL score ranging from 0-100, a physical health summary (i.e., 8 items from the physical domain), and a psychosocial health summary (i.e., 15 items from the emotional, social, and school subscales) (Hoedjes et al., 2018; Varni et al., 2001). The PedsQL yields reliable and valid scores with child

self-report for ages 5-18, and parent proxy report for ages 2-18 in the general pediatric population, and in children and adolescents with various chronic diseases (Varni et al., 2001).

Child and adolescent QOL can be negatively impacted by a variety of conditions or circumstances, including chronic physical diseases, psychological disorders, and maltreatment within the family (Bastiaansen et al., 2004; Lanier et al., 2015; Varni et al., 2007). In a comparison of pediatric QOL across 2,500 pediatric patients representing 33 chronic diseases, pediatric patients with chronic health conditions had significantly lower scores on QOL subscales assessing physical, emotional, social, and school functioning, relative to those of healthy children (Varni et al., 2007). Thus, children's QOL scores can be used to identify specific domains of life directly impacted by a disease state and, furthermore, provide guidance for treatment, support, and management resources that might directly improve QOL and overall health status.

QOL assessments have also been modified to include specific items pertinent to various disease states which can help in comparing clinically meaningful decreases or improvements in QOL within and across chronic disease states (Fan et al., 2021). Clinically meaningful change in PedsQL 4.0 scale scores has been defined as the smallest difference in a score of a domain of interest that would confer beneficial change from the patient's perspective and mandate a potential change to the patient's management (Jaeschke et al., 1989). Based on the responses of 10,241 families who completed the PedsQL 4.0, Varni et al. (2003) determined that a 4.4-point change in the total score (100 points) for child self-report, and 4.5-point change in the total score for parent proxy-report, represent minimal clinically meaningful differences. Varni and colleages determined the minimal clinically important difference by calculating the standard error of measurement within their sample as the standard error of measurement and minimal clinically

important difference have shown "excellent agreement" in prior research (Wyrich et al., 2002). Numerous studies have used the PedsQL 4.0 as well as other QOL measures to determine disease-specific clinically meaningful change scores; however, to our knowledge extant literature has yet to determine clinically meaningful change scores on the PedsQL 4.0 scale for children with obesity.

Quality of Life in Children with Obesity

Pediatric obesity, like other chronic diseases, is associated with significantly lower QOL (Varni et al., 2007), and greater decrements in QOL are seen with each higher weight class (Wallander et al., 2013). *Z*-scores or percentiles are used to represent Body Mass Index (BMI) in children, and vary with age and sex. The CDC classifies pediatric overweight as a BMI within the 85th to < 95th percentile; pediatric obesity is defined as a BMI $\geq$ 95th percentile for age and sex (Centers for Disease Control and Prevention [CDC], 2022). Severe obesity has historically been defined as a BMI $\geq$120% of the 95th percentile, or a BMI at or above 35 kg/m^2, whichever is lower (CDC, 2022). The American Heart Association indicated that the expression of high BMI values as a percentage above the 95th percentile provides more flexible means to evaluate healthier youth (Kelly et al., 2013). However, there were known limitations of expressing BMI as a percentage above the 95th percentile, such as percentiles not reflecting age-specific dispersion of the BMI distributions in the higher range (CDC, 2022). Thus, the CDC recently provided an extended method for calculating z-scores and percentiles to characterize BMI distributions above the 95th percentile up to the 99.99th percentile (CDC, 2022). Of note, the current study's data collection and analysis occurred before the updates to BMI percentiles for children with severe obesity, therefore any results pertaining to BMI will be presented in the context of the previous BMI standards.

Although BMI is often used as a clinical standard for measuring adiposity, it is known to overestimate fatness in children who are short or who have relatively high muscle mass (Kumar and Kelly, 2017). BMI has also received criticism for less accurately reflecting body fatness in children from minoritized racial and ethnic groups compared with white children (Freedman et al., 2012). Therefore, other measures of health status, such as QOL, can serve as complementary metrics to provide a more complete picture of health status in diverse children with obesity. Despite the potential limitations with BMI, there are relatively consistent associations between BMI and QOL in children, as is reviewed in the following paragraph.

Specifically, in a literature review of QOL in children and adolescents with overweight and obesity, 31 of the 34 studies found a significant association between obesity and lower reported QOL, and these associations were stronger in clinical versus community populations (Buttitta et al., 2014). Children with severe obesity reported mean QOL scores similar to those of children with end-stage renal disease on hemodialysis, cerebral palsy with diplegia, mood disorders, and newly diagnosed cancer (Ingerski et al., 2010; Schwimmer et al., 2003; Varni et al., 2007). However, the specific QOL domains impacted varied across disease groups. For example, Varni and colleagues (2007) assessed 2,500 pediatric patients representing 33 chronic disease states and found that children in the obesity and diabetes cohorts reported the highest school scores of all disease groups. Nonetheless, in a comparison of mean school scores within the obesity group, children with both obesity and severe obesity had significantly lower scores relative to children with overweight (Varni et al., 2007). Overall, children with obesity generally report significantly lower QOL compared to children with other disease states; however, specific domain decrements may differ.

Impact of Pediatric Obesity on Quality of Life Across Domains

Domain specific decrements in QOL indicate specific areas of life that are particularly impacted by a given disease state (WHOQOL Group, 1995; Varni & Limbers, 2009). Although children with obesity have manifested significantly lower QOL relative to children with BMIs in the normal range, the clinical meaningfulness of decrements in specific domains has varied across studies. For example, Varni et al. (2001) concluded that children with obesity demonstrated significant impairment in each of the four domains. Nonetheless, these results were potentially confounded by the fact that a majority (65.1%) of the sample had at least one obesity-related comorbidity. Similarly, Schwimmer et al. (2003) conducted a cross-sectional study of 106 treatment-seeking outpatient children and adolescents with obesity and reported that children and adolescents with obesity manifested significantly lower HRQOL, compared with their peers with healthy weights across all domains, with even greater diminishment of HRQOL evident in children and adolescents with comorbid obesity and sleep apnea.

Although multiple studies have identified links between pediatric obesity and lower total QOL, not all domains of QOL appeared to be equally affected among children and adolescents with obesity (Swallen et al., 2005; Williams et al., 2005). For example, in a nationally representative, community sample of adolescents (n = 4743) those with obesity endorsed poorer physical scores, but did not significantly differ on emotional, social, or school subscales, from children with BMIs in the normal range (Swallen et al., 2005). This study concluded that BMI was negatively linked to HRQOL only among younger adolescents (aged 12-14 years) (Swallen et al., 2005). Likewise, another study with a large community-based sample (n = 1456) reported that children with overweight and obesity did not have significantly lower scores in the emotional or school subscales, but did have lower physical and social scores, compared with children with weights in the “normal” range (Williams et al., 2005).

Moreover, there are differences in domain specific impairment across studies. These mixed results might be related to sample source (i.e., community vs clinical populations), severity of obesity, age, and comorbidities. Nonetheless, across studies, the physical and social domains were most consistently significantly impacted (Tsiros et al., 2009), suggesting that children with obesity might be particularly at risk for deficits in QOL related to physical and social aspects of life. It is important to consider the unique impact of obesity on each QOL domain to enhance understanding of the potential influence of this disease on multiple aspects of functioning, and to inform intervention and treatment strategies.

Impact of Pediatric Obesity on Quality of Life - Physical Subscale

Typically, physical QOL scores have displayed an inverse relationship with children's and adolescents' BMI (Schwimmer et al., 2003; Zeller and Modi, 2006). This is likely related to decreased rates of physical activity; for example, Gu et al. (2019) found physical activity levels were positively associated with HRQOL in a sample of 321 children (9-to-12 years old) with obesity. Furthermore, children with obesity often display reduced capacity to perform common locomotor tasks (such as walking and climbing stairs, O'Malley et al., 2021). Despite the inverse relationship noted between BMI and physical scores, numerous studies have demonstrated the positive impact exercise-based interventions can have on physical and total QOL in children with obesity. For example, Williams et al. (2019) assessed the impact of an 8-month after-school exercise program (compared to an alternative that did not involve exercise) in a sample of adolescents (87% Black, children age 9.7 +- 0.9 years), with obesity (73%) and found exercise program participation was associated with improvements in QOL, depressive symptoms, and self-worth. Similarly, Goldfield et al. (2012) randomized 30 obese adolescents (12-17 years old) to twice weekly exercise sessions of stationary cycling or interactive video game cycling for 10-

weeks and found that engagement in aerobic exercise, but not change in body composition, was positively associated with improvements in psychosocial functioning. Therefore, although children with obesity report lower physical QOL, compared with normal weight peers, this concern has the potential to be ameliorated through interventions focused on increasing activity levels.

Impact of Pediatric Obesity on Quality of Life - Emotional Subscale

Results regarding the emotional subscale scores of QOL in children with obesity vary across studies. Some cross-sectional studies have not identified significant differences between the emotional scores of children with healthy weight compared to those with obesity (Tsiros et al., 2009; Williams et al., 2005). Other studies, such as a cross-sectional analysis of preschool-aged children in Russia, found emotional scores to be the area with the largest differences between children with and without obesity (Lir et al., 2021). Studies have drawn connections among weight stigma, low self-esteem, decreased social support, and emotional distress in children with obesity (Pont et al., 2017; Rankin et al., 2016). These findings have led several researchers to suggest that weight gain might be exacerbated by reliance on maladaptive coping strategies, such as emotional eating, night eating, and excessive screen time (D'avila et al., 2019; Incledon et al., 2011).

It is possible that the observed differences in emotional QOL are especially pronounced in children seeking clinical weight loss treatment. In a review of the psychological effects of obesity in children, Flodmark (2005) concluded that children with obesity in community samples have higher overall QOL than those in clinical samples. This author further posits that children with obesity might be best supported by focusing on social support rather than weight, as emphasizing weight might exacerbate negative attitudes towards the self. This conclusion was

somewhat supported by a more recent evaluation of a year-long lifestyle intervention program with a 1-year follow-up, which reported that children with severe obesity manifested improvements in psychosocial functioning unrelated to the degree of weight loss, and despite partial weight regain, suggesting weight loss is not necessary for improvement in emotional scores (Hoedjes et al., 2018). Similar to findings related to improvements in social scores regardless of weight, these results suggest pediatric obesity interventions would benefit from the inclusion of resources to address potentially diminished emotional scores in this population.

Impact of Pediatric Obesity on Quality of Life - Social Subscale

Compared to the other QOL domains, social scores are consistently lower in children with obesity, relative to their peers with healthy weight (Tsiros et al., 2009; Varni et al., 2001; Williams et al., 2005). This finding is likely related to weight stigmatization experienced by children and adolescents in the form of self-stigma, weight-based bullying by peers, and stigmatizing messaging from parents, teachers, and healthcare professionals (Janssen et al., 2004; Pont et al., 2017). Weight stigma is defined as a "societal devaluation of a person because he or she has overweight or obesity" and typically includes implicit or explicit associations between excess adiposity and laziness, and decrements in motivation and willpower (Pont et al., 2017, p. 2). Weight-based stigmatization is maintained and propagated in society through the belief that shame will motivate individuals to lose weight and achieve optimal health; however, this very stigmatization is likely a direct cause of decreased social subscale scores (Pont et al. 2017; Puhl & Suh, 2015). Zeller and Modi (2006) found the strongest predictors of HRQOL for youth with obesity were depressive symptoms and low levels of perceived social support from classmates. The authors noted that youth with obesity who felt supported by their school-based peer group had better overall HRQOL and social scores. Many interventions targeting youth with obesity

primarily focus on lifestyle changes to achieve weight loss, and neglect to incorporate curriculum or resources around social support, weight stigma, and internalized weight bias, which is concerning given the associations of these constructs with QOL in youth.

Impact of Pediatric Obesity on Quality of Life - School Subscale

Results regarding the link between pediatric obesity and school QOL are mixed (Griffith et al., 2010). For example, in a nationally representative community sample, Swallen et al. (2005) found pediatric obesity was associated with significantly lower physical QOL, but was not significantly associated with lower emotional, social, or school QOL, compared to children with normal BMIs. Likewise, another study with a large (n = 1456) community-based sample reported that children with overweight and did not have significantly lower scores in the emotional or school functioning domains, but did have lower physical and social functioning scores, compared to normal weight children (Williams et al., 2005). In contrast, other studies have reported significantly lower school QOL scores in children with obesity compared to normal weight peers; researchers have attributed this QOL deficit to lower self-esteem, depression, and perceived social support in children with obesity (Schwimmer et al., 2003; Zeller and Modi, 2006). Overall, there findings regarding obesity in children and school QOL are inconsistent, and thus, worthy of additional research attention.

Demographic Variables Associated with Quality of Life in Children with Obesity

Racial/ethnic Minorities and Quality of Life

In many QOL analyses, race is either controlled for, or generally found to have a non-significant effect across various groups (Desai et al., 2014; Schwimmer et al., 2003). For example, a cross-sectional analysis of a community sample of 5th graders with overweight and obesity found consistent decreases in QOL associated with increases in BMI category across

Latinx, Black, and White children (Wallander et al., 2013). Similarly, Fallon and colleagues (2005) found an inverse association between overweight BMI status and QOL in both White and Black overweight adolescents (n = 110) compared with their non-overweight counterparts (n = 34); however, this study also reported that Black adolescents manifested slightly less impairment compared with their White counterparts. There has been speculation regarding whether ethnic and cultural weight and appearance ideals mediate obesity's impact on QOL (Modi et al., 2008). Some researchers have posited that Black youth prefer a heavier ideal body size (Neff et al., 1997; Story et al., 1995). In contrast, more recent research indicates that ethnicity and cultural preference might not be as protective as once thought. Black women, for example, are susceptible to body image concerns despite acceptance of a curvier body type (Kelch-Oliver & Ancis, 2011; Roberts et al., 2006). In sum, the inverse relation between BMI and QOL in children appears across all racial/ethnic groups. Moreover, as Latinx and Black youth experience the highest rates of overweight and obesity within the U.S., racially minoritized children with obesity seem particularly at-risk for low QOL.

Age and Quality of Life

Children and adolescents with obesity are around five times more likely to have obesity in adulthood compared with their lean counterparts (Simmonds et al., 2015). Around 55% of children with obesity, and 80% of adolescents with obesity, continue to have obesity in adulthood (Simmonds et al., 2015). Thus, interventions targeting obese youth are recommended to reduce risk for obesity in adulthood and the development of weight-related comorbidities (Kumar & Kelly, 2017, Kansra et al., 2021). Less is known, however, about the impact of age on QOL in children and adolescents with obesity. A review of 34 articles addressing QOL in children and adolescents with obesity yielded mixed results regarding the impact of age as a

moderator of the link between BMI and QOL in overweight and obese youth (Buttitta et al., 2013). For example, one longitudinal study of children 4-to-17 years found that as children progress to adolescence, HRQOL decrements become more significant (Killedar et al., 2020). This study found that at the age of four, obesity was only associated with a minor decrement in HRQOL. However, the inverse association between HRQOL and obesity strengthened with age, and was related to clinically meaningful decrements in HRQOL by age nine (Killedar et al., 2020). Killedar and colleagues (2020) further concluded that obesity among children younger than age nine might not affect HRQOL, but early intervention could nonetheless prevent impairment later in life. Moreover, Steele and colleagues (2012) evaluated a family-based behavioral group intervention for pediatric obesity and found that both children and adolescents experienced clinically significant improvements in QOL at one-year follow-up, despite non-significant changes in zBMI within the adolescent group. Therefore, participation in pediatric obesity intervention programs could potentially improve QOL in children and adolescents with obesity, regardless of changes in weight status. In sum, QOL appears inversely related to BMI in both children and adolescents; however, this association might strengthen with age. Interventions targeting pre-adolescent children provide a unique opportunity to facilitate immediate improvements in QOL, and simultaneously prevent the future decrement of QOL associated with age in pediatric obesity.

Pediatric Obesity Interventions and Quality of Life Outcomes

Myriad studies suggest that pediatric obesity is inversely related to QOL (Ingerski et al., 2010; Schwimmer et al., 2003; Varni et al., 2007); nevertheless, a variety of pediatric obesity intervention trials also indicate that impaired QOL can be attenuated within this population (Griffiths et al., 2010; Poeta et al., 2013; Willie et al., 2008). Yet, quality of life outcomes and

factors associated with improved QOL within pediatric obesity interventions are mixed. For example, multiple interventions have yielded improvements in QOL despite non-significant weight loss or in the presence of weight regain (Griffiths et al., 2010; Hoedjes et al., 2018; Vallis, 2016; Willie et al., 2008). Further, some studies have identified positive QOL outcomes within sedentary control groups, indicating a potential intervention effect related to structured time with adults, peer socialization, and/or healthy lifestyle changes that do not result in weight loss (Finne et al., 2013; Lek et al., 2021; Williams et al., 2019). Therefore, specific factors associated with improved QOL across interventions vary.

For example, one intervention targeting children and adolescents with severe obesity (99.9th age-and-sex-specific percentile BMI or 99th age-and-sex specific percentile with one obesity-specific comorbidity according to a Dutch nationwide growth study) identified significant improvements in both overall and weight-related HRQOL at 1-year follow up, despite partial weight regain (Hoedjes et al., 2018). Moreover, greater weight loss was positively associated with improvements in the physical subscale scores (Hoedjes et al., 2018). Similarly, a family-based lifestyle intervention found significant improvement in QOL across both child and adolescent groups despite non-significant changes in BMI within the adolescent group (Steele et al., 2012). This improvement in QOL was thought to be related to the intervention's focus on increasing physical activity and social support from family and friends, along with reviewing strategies for dealing with weight-related stigma (Steele et al., 2012). Likewise, results of a 2-year longitudinal study of 267 diverse youth aged 8 to 18 years (63% Black) with depression and obesity (25.5% obese, 72.7% severely obese) indicated that even youth with severe obesity manifested QOL improvements after visiting a weight treatment clinic over two years, despite only modest changes in BMI and no change in overall weight category (Pratt et al., 2013). Thus,

regardless of minor weight changes, improvements in QOL are reported following participation in programs that include psychosocial support targeting self-esteem and weight stigma in addition to nutrition, exercise, and health education (Diao et al., 2020; Hoedjes et al., 2018; Steele et al., 2012).

A meta-analysis by Ligthart and colleagues (2015) assessed the effects of 11 multidisciplinary intervention programs (including behavioral therapy, nutrition advice, and/or physical activity) targeting children with overweight and obesity on QOL. This meta-analysis concluded multidisciplinary weight reduction interventions can improve QOL, as indicated by positive trends for QOL in the intervention groups, yet results were inconsistent across studies and improvements were occasionally evident in both intervention and control groups. Moreover, QOL and change in weight status were not significantly related. Based on these results, the authors concluded that QOL is not directly related to weight change. (Ligthart et al., 2015). Similarly, results of multiple pediatric obesity intervention studies assessing QOL suggested that children participating in these programs likely benefitted from their psychosocial components (such as content addressing self-esteem, body image, weight-related stigma), in addition to the diet and activity-focused content (Diao et al., 2020; Fan et al., 2021). However, more research is needed to assess the optimal ways in which interventions could address these topics.

Psychosocial Intervention Factors and Quality of Life in Children with Obesity

As mentioned above, children and adolescents with obesity often manifest decrements in social scores. In a review of several studies investigating QOL in children and adolescents with obesity, Buttittia and colleagues (2017) concluded QOL was negatively correlated with bullying, body pain, and screen time, and positively correlated with self-image and physical activity. A cross-sectional study of 8- to 11-year-old children recruited from the community (n = 600)

representing all BMI classes (35% with overweight, obesity, or severe obesity), found that perceived weight stigma mediated the link between HRQOL and BMI and that body (Guardabassi et al., 2018). This finding highlights the significance of weight stigma in the association between BMI and HRQOL. Moreover, Diao and colleagues (Diao et al., 2020) conducted a randomized controlled trial of 948 Chinese children (BMI not reported) selected from four schools to participate in either an obesity-related intervention, or a control group. These investigators attributed the intervention group's psychological QOL improvements to the positive body image and appearance acceptance aspects of the intervention's curriculum (Diao et al., 2020). However, these assumptions were based on inference, and it is possible that other, unmeasured factors might have contributed to improved psychological scores (Diao et al., 2020). Furthermore, a systematic review of psychological and behavioral issues in obesity treatment in adults by Vallis (2016) concluded that interventions incorporating cognitive-behavioral strategies with a focus on self-acceptance and self-esteem appeared to improve depressive symptoms, independent of weight loss. These findings suggest that in order to improve the multifaceted domains of children's QOL, pediatric obesity interventions would benefit from incorporating topics such as children's and parents' perceptions of weight, weight stigma, and self-esteem.

Parent-focused Interventions and Quality of Life

Parent-focused interventions have gained popularity as effective pediatric obesity treatment program formats (Golan & Crow, 2004; Cardel et al., 2020). Throughout childhood and adolescence, parents serve as key role models for eating and exercise behaviors (Cooke et al., 2004) and are typically responsible for the provision of specific foods or lifestyle habits (Wardle et al., 2005). Parent-only interventions are positively associated with child outcomes in pediatric obesity treatment (Ewald et al., 2014;Golan & Crow, 2004; Golan et al., 1998), have

the secondary benefit of potentially impacting parents' weight status (Whitaker et al., 1997), and are generally more cost-effective than family-based approaches as they require fewer staff and resources (Janicke et al., 2008). Previous research has not examined the impact of parent-focused interventions on QOL in children with obesity. Only one study by Steele and colleagues (2012) assessed potential changes in pediatric QOL within family based-programs, comparing an inpatient family-based behavioral group intervention to an outpatient brief family intervention in a sample of treatment-seeking children and adolescents with obesity. Steele and colleagues (2012) found significant decreases in BMI across both groups, but only the inpatient family-based program yielded clinically significant improvements in QOL at one year follow up; the authors noted that one potential reason for this result could be the shorter duration of the outpatient program. Also, the outpatient program was more focused on energy balance, with less attention given to other "ancillary" QOL issues. Steele et al.'s (2012) study provides insight into the impact of inpatient vs outpatient family-based interventions on QOL in children with obesity, but more research is needed to test the overall efficacy of family-based programs in improving QOL in children with obesity compared to a non-family-based program.

Gaps in the literature

There is currently a dearth of studies assessing the long-term impact of parent-focused lifestyle interventions on QOL in children, particularly racially diverse children with obesity from low SES households recruited from the community. As previously stated, pediatric obesity is inversely linked with QOL across all racial groups. Given that prevalence estimates of obesity in Black children are higher than those of White children (Heerman et al., 2016), and obesity is associated with lower QOL in children, it is possible that QOL is lower in Black children relative to White children (Schwimmer et al., 2003; Varni et al., 2007). However, this relation has not

been the focus of empirical study. Interventions targeting both obesity and QOL in Black children from the community setting are not only needed but also auspiciously timed to manifest continued improvements in individual and family-level health-related behavior changes (Brotman et al., 2012; Guo et al., 1994).

Children with obesity in clinical studies report significantly lower QOL than community samples of children with obesity (Buttitta et al., 2014; Flodmark, 2005). Reflecting this, many QOL assessments of children with obesity have been conducted within the inpatient clinical setting (Schwimmer et al., 2003; Varni et al., 2009) or have included both community and clinical participants (Steele et al., 2012), making it difficult to assess the effects of pediatric obesity on children within the community sample specifically (Buttitta et al., 2014; Tsiros et al, 2009). Among the few community-based studies assessing QOL in children with obesity, many are cross-sectional analyses of larger datasets; therefore, it was not possible to assess the causal effect of obesity treatments on QOL in children (Lir et al., 2021; Tsiros et al., 2009; Wallander et al., 2013; Williams et al., 2005). Thus, there remains a need for additional research in community settings to enhance understanding of the effectiveness of pediatric obesity interventions on pediatric QOL.

Lastly, parent-focused interventions have proved effective for pediatric weight loss (Golan & Crow, 2004), but few studies have assessed the impact of a parent-focused program on children's QOL. Furthermore, parent-focused interventions provide a unique opportunity to address both physical and psychosocial topics related to children's QOL, (Buttittia et al., 2017; Diao et al., 2020; Guardabassi et al., 2018), without making the child more sensitive or potentially ashamed of their weight as a "problem" requiring external help (O'Dea, 2005; Tylka et al., 2014). Thus, data supporting the effectiveness of parent-focused interventions for

improving pediatric QOL could provide support for a novel intervention method for improving QOL in children with obesity without negatively impacting the child's perception of self or fostering disordered eating.

NOURISH+ Theoretical background

The current study's parent-focused intervention was designed based on the results of the pilot trial with the original NOURISH program (Mazzeo et al., 2012). The NOURISH intervention was grounded in Social Cognitive Theory (SCT, Bandura, 1986), which emphasizes the interaction among environmental, personal, and behavioral factors, and is widely used in health behavior interventions (Austin, 2000; Steiner-Adair et al, 2002). SCT continued to provide the theoretical basis for NOURISH+. Based on feedback from the NOURISH pilot, behavioral aspects were more strongly emphasized in NOURISH+. For example, parents developed a small number of individualized goals during the first session, and progress on these goals was tracked in each subsequent meeting. Other key behavioral strategies such as self-monitoring, contingency management, and stimulus control were integrated throughout all sessions. The NOURISH+ intervention was also informed by Stages of Change Theory (Prochaska et al., 1992). This approach was integrated into the intervention through regular self-assessment of barriers to change as well as facilitated discussions of the process (pros and cons) of deciding to engage in healthy lifestyle changes.

Summary and Purpose of Study

The main objective of this study was to examine the impact of a 6-week intensive parenting intervention, NOURISH+ (Nourishing Our Understanding of Role modeling to Improve Support and Health +), on QOL in a diverse (72% Black) sample of children with overweight and obesity (BMI $\geq$ 85th percentile). NOURISH+ participants were randomly

assigned to either NOURISH+, or a control group. This 6-week intervention included traditional healthy lifestyle topics of nutrition and exercise, as well as psychosocial and parenting topics including role modeling, parenting styles, body image, social media, and weight-related teasing. The control group attended a "Family Wellness Night" with pediatric obesity resources available. Materials presented at this function did not directly overlap with NOURISH+ content.

We hypothesized that children of parents participating in NOURISH+ would manifest significantly higher greater pediatric QOL change from baseline to post-intervention, compared with children of parents enrolled in the control group. A secondary objective of this study was to examine factors associated with QOL at baseline and post-intervention.

Methods

Participants

Eligible participants for the NOURISH+ study were recruited from the Greater Richmond Metro area. To qualify, parents/caregivers were required to be at least 18 years old and have a child between the ages of 5 and 11 years with a BMI > 85th%ile who primarily resided in the caregiver's home. Participants were also required to speak English, be able to follow basic instructions, and perform simple exercises. Caregivers were ineligible if they: 1) were non-ambulatory, 2) were pregnant, 3) had a medical condition that might be negatively impacted by exercise, or 4) had a psychiatric diagnosis that would impair their ability to respond to assessments or participate in a group. Parents whose children had a medical or developmental condition that precluded weight loss using conventional diet and exercise methods were also ineligible. Through the recruitment and screening process, 578 families and 672 children (59.1% and 60.5% respectively, of those who inquired about the study) were invited to participate with 369 caregivers and 411 children attending baseline. Of the caregivers and children who attended

baseline, 340 caregivers and 365 children (92.1% of families attending baseline) were deemed eligible for NOURISH+. Once eligible families completed baseline assessments, they were randomly assigned to either the intervention group (NOURISH+) or the control group so that groups sizes were similar. In total, 268 caregivers and 284 children completed post-testing, yielding a retention rate of 78.8% for caregivers and 77.8% for children.

Before any data collection, detailed consent/permission and assent were obtained from each parent and child, respectively. The study was approved by Virginia Commonwealth University's Institutional Review Board (ClinicalTrials.gov identifier: NCT00628030).

Procedure

NOURISH+ Intervention Format

Families were assigned to either the NOURISH+ group (the intervention group) or the control group using a random number generator, applied as 1:1 in each cohort. There were six NOURISH+ sessions that were 1.5 hours each. Approximately 10-15 parents were in each NOURISH+ cohort. Homework was assigned between sessions so that the skills learned could be practiced (Prochaska et al., 1992). Sessions began with a review of the previous week's homework. Intervention content and homework focused on the parents' relationships with everyone in the family, not just the "identified patient" or overweight child, as is recommended by Golan et al. (Golan & Crow, 2004; Golan et al., 1998). Three weeks after the program's completion, parents in the intervention group were contacted via phone to participate in a brief, personalized booster session. Session group leaders included doctoral students in psychology, supervised by Dr. Mazzeo, a licensed, clinical psychologist with experience in group facilitation. Doctoral students had training in group facilitation and master's level counseling skills with additional training in the NOURISH+ manual.

Parents randomly assigned to the control group were invited to an in-person "Family Wellness Night" where we offered publicly available information regarding pediatric overweight. Material presented in this program did not overlap with that presented in NOURISH+. In addition, the control group was mailed publicly available brochures on pediatric overweight five times during the intervention period (i.e., during the six-week NOURISH+ program) and once more three weeks after the program's completion. This number of mailings was selected to match the number of additional in-person sessions in which the intervention group participated and was designed to mitigate attention effects.

NOURISH+ Session Content

The specific content of the group sessions was informed by the integration of SCT, behavioral theory, and the results of previous studies, including the NOURISH pilot and research with the TEENS program (Evans et al., 2009; Mazzeo et al., 2008; Stern, Mazzeo, Gerke et al., 2006; Stern, Mazzeo, Porter et al., 2006). Briefly, the following topics were covered over six sessions: 1) orientation to NOURISH+ goals, 2) the importance of parents as role models of eating and exercise behaviors, 3) improving nutrition, 4) increasing physical activity and decreasing sedentary behavior, 5) parenting styles and health behaviors, 6) family meals, 7) promoting hunger and satiety awareness, 8) media literacy, and 9) coping with teasing and promoting a healthy body image. In addition to these six group sessions, parents in NOURISH+ participated in two individual nutrition sessions during which they could discuss their family's specific dietary challenges. NOURISH+ parents also attended a cooking class focused on preparing easy, practical meals using healthy foods (including substitutions for popular but potentially unhealthy foods).

The NOURISH+ intervention also included an emphasis on increasing physical activity for the whole family. This was achieved via guided goal setting and self-monitoring; pedometers were provided to track activity. During the first session, appropriate goal-setting strategies were reviewed (i.e., defining measurable and realistic behavioral targets). Participants were instructed in the procedures for obtaining and documenting total steps/day using an activity log. NOURISH+ participants were also encouraged to track their total daily steps during the active intervention phase of the study with a pedometer. During each session, individuals determined their pedometer goals for the week. Group leaders encouraged participants to increase their total step count by approximately 10-20% per week. Utilization of the group setting to establish weekly physical activity goals allowed for the opportunity to problem solve potential activity barriers. The use of pedometers in this way represented a more intense effort to enhance weekly accountability regarding exercise participation than was used in the NOURISH pilot.

Several approaches were employed to maintain intervention integrity (treatment fidelity). First, the precise sequence of intervention content and procedures were standardized and detailed in the study Operations Manual. Further, procedural consistency was assured via: 1) initial training (as described above) and ongoing supervision of the group leaders, 2) adherence to protocols specified in the Operations Manual, 3) a check-list describing major intervention criteria, 4) an evaluation summary completed by the interventionists at the end of each session, and 5) weekly research team meetings to discuss any changes needed in the procedure (Cook and Campbell, 1979; Hulley et al., 2001).

Measures

All measures were completed at baseline, post-intervention, and 4-month and 10-month follow-up. This paper only analyzed data from baseline and post-intervention.

Child Measures

Child Demographics.

During recruitment, parents provided demographic information for children including child's sex (male or female), date of birth, racial identity, and ethnic identity. Race options included American Indian/Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, Black or African American, White, or Other/More than one race with a specification option. Ethnicity was assessed as Hispanic/Latino or not Hispanic/Latino. Demographic questions can be found in Appendix A.

Anthropometric Measures.

Anthropometric data were collected by trained research assistants at the research clinic. Height was measured to the nearest ¼ inch using a stadiometer. Weight was measured to the nearest ¼ lb using a balance beam scale. These data were used to calculate children's BMI, which was plotted on the CDC Growth Charts (National Center for Health Statistics, 2000) to obtain BMI%ile for age and gender.

Pediatric Health-Related Quality of Life (PedsQL4.0).

The PedsQL (Varni et al., 1999; Varni et al., 2001) is a 23-item assessment designed to assess perceptions of how health affects daily life in four domains: physical, emotional, social, and school functioning. In accordance with the protocol outlined in the PedsQL 4.0 manual, two child self-report versions of the PedsQL were used: one developed for children aged 5-7 and another for children aged 8-12. Items from the PedsQL 4.0 were read aloud to children by trained research assistants to ensure all children understood the items regardless of reading level. Participants were asked to respond to statements such as "It is hard for me to run" and "Other kids do not want to be my friend" on a 5-point Likert scale from *Never* (0) to *Almost always* (4)

(Varni, 1998). Items for each of the domains were reverse-scored and transformed to a 0–100 scale, so that higher scores indicate better health-related quality of life (Varni et al., 2001). The total QOL score was computed as the sum of the four subscale scores divided by the total number of items. Previous studies determined the PedsQL has a Cronbach's alpha of .88 and is able to accurately differentiate between healthy children and those with acute or chronic health conditions and correlate with indicators of illness burden (Varni et al., 1999; Varni et al., 2001). QOL change scores were calculated as total score at post-intervention minus total score at the baseline assessment for Total QOL and each subscale (physical, emotional, social, and school subscales). The PedsQL 4.0 (Young Child Ages 5-7) and (Child Ages 8-12) can be found in Appendix B and C, respectively.

Sugar Sweetened Beverage (SSB) Intake.

At each assessment, children provided information regarding SSB intake. SSB consumption was assessed by a series of six yes/no questions regarding if the child consumes soda, sweet tea, juice, energy drinks, sweet coffee, and sports drinks, followed by a frequency question for each "yes" response. For example, one of the six SSB questions asked, "Do you drink sports drinks, like Gatorade or Vitamin Water?" with a subsequent question of "How many do you drink each week?" Participants were instructed to indicate monthly consumption if they consumed SSBs less than once per week. The SSB variable represented average number of SSB consumed per day. These questions were adapted from a longitudinal family eating behavior assessment by Neumark-Sztainer and colleagues (2008). SSB intake items can be found in Appendix D.

7-day Physical Activity Recall (PAR).

Physical activity was assessed by a trained research assistant using the 7-day PAR (Sallis et al., 1993). The PAR is semi-structured interview designed to estimate an individual's time spent in sleep, moderate, and vigorous activities during the previous seven days (Sallis et al., 1993). The PAR was used within the current study to assess moderate and vigorous physical activity levels of the child participants. For the PAR, the interviewer asked the respondents the number of hours they spent in sleep, moderate, and vigorous activities during the previous week. Moderate physical activity was calculated as the total sum of hours of moderate physical activity over the 7-day window. Vigorous physical activity was calculated as the total sum of hours performing hard and very hard activity over the 7-day window. Both moderate and vigorous physical activity were included as levels of both moderate and vigorous activity differ in children with obesity compared with normal weight children and have each been shown to be a contributing factor in maintenance of childhood obesity (Dorsey et al., 2011; Trost et al., 2001). Previous research of the PAR compared mean PAR scores across 21 interviewers and revealed high levels of agreement across the interviewers with a reliability of .86 as well as high levels of intra-interviewer agreement over a two-week period with a test-retest reliability of .99 (Gross et al., 1990). The PAR can be found in Appendix E.

Parent Measure

Child Feeding Questionnaire (CFQ).

Parental approaches to and attitudes about feeding their enrolled child were measured by the CFQ (Birch et al., 2001). The CFQ is a 31-item self-report measure with seven factors: four factors measuring parental perspectives around child's obesity proneness and three factors measuring parental control practices and attitudes towards child feeding (Birch et al., 2001). Only four of the seven factors were used within the current study's analysis─perceived

responsibility, restriction, pressure to eat, and monitoring—as these factors have been most extensively studied by the existing literature (Carnell et al., 2014; Webber et al., 2010). Restriction assessed the degree to which parents restrict the child's food with the example item of, "I intentionally keep some foods out of my child's reach" (Birch et al., 2001). Pressure to eat assessed the extent to which parents pressure their child to eat more food, typically at mealtimes. An example item of pressure to eat is "My child should always eat all the food on her plate." Monitoring assessed the degree to which parents oversee the child's eating with an example item of "How much do you keep track of the high fat foods that your child eats?" Perceived responsibility assessed parents' beliefs around their responsibility for child feeding with an example item of "when your child is at home, how often are you responsible for feeding her?" All items were measured with a 5-point Likert-type scale, ranging from 1 (*disagree*) to 5 (*agree*). Birch et al. (2001) found significant correlations between child's weight status and parents' scores on two of the four factors used within the current study: restriction and pressure to eat. Within this correlation analysis, pressure to eat was negatively related to child's weight status and restriction was positively related to child's weight status (Birch et al., 2001). Overall, the CFQ has yielded reliable and valid scores in samples of parents with school-aged children with internal consistency ranging from .70-.92. Of note, the original validation of the CFQ was performed on a sample consisting of 85% White adults with children ages 7-11 years (Birch et al., 2001). However, the CFQ has demonstrated reliability and validity (Cronbach's alpha = .70-.92) with Black parents of children aged 5-11 years with overweight and obesity (Lydecker et al., 2017). The full CFQ can be found in Appendix F.

Data Analyses

Prior to conducting analyses, data were cleaned in SPSS (Version 28.0). Data were analyzed for assumptions of normality with descriptive statistics (standardized residuals within ± three standard deviations) and graphical techniques (visual inspection of Q-Q plots). One outlier within post-intervention SSB variable was winsorized. In families with two or more children enrolled as participants, one child was randomly selected for the current analysis. Demographic (sex, age group, race) and QOL baseline biases in study completion were evaluated by comparing participants who were measured at baseline but failed to complete post-intervention measures and participants who completed post-intervention.

To evaluate the associations of child sex, child age, and child race with baseline child QOL scores (total QOL score and physical, emotional, social, and school subscales), 15 separate independent t-tests were applied. The independent variables included child sex (male, female), child age (5 to < 9 years, 9 to 12 years), and child race (Black, White). Although the overall study did not exclude any race or ethnicity, for those analyses examining racial differences, only Black and White participants were included, given the limited sample sizes of other groups in this data set. Results informed use of covariates throughout Aims 2 and 3. Additionally, intervention was used as a covariate within AIM 3 analyses dependent on significant intervention effects identified within AIM 2.

AIM 1. Baseline QOL: Examine associations in the total child sample between baseline QOL with child BMI %ile, SSB intake, child physical activity and parent feeding approach at baseline.

To evaluate associations in the total child sample between baseline child QOL with child BMI %ile, SSB intake, child physical activity, and parent feeding approach (as measured by the CFQ), at baseline, two sets of linear regression analyses were applied. In the first set of models,

child measures at baseline (child BMI %ile, SSB intake, child moderate activity, and child vigorous activity) were all entered into each model to predict five separate baseline child QOL scores (total QOL, physical, emotional, social, and school subscales). In the second set of models, four parent baseline measures (CFQ subscales: restriction, pressure to eat, monitoring, and perceived responsibility) were all entered into each model to predict five separate baseline child QOL scores (total QOL, physical, emotional, social, and school subscales). Analyses were applied to the total sample as QOL scores of participants in control vs the NOURISH+ intervention group were not significantly different at baseline.

AIM 2. Quality of Life Change: Evaluate group differences (NOURISH+ vs control) from baseline to post-intervention in child QOL. To evaluate influences on QOL differences from baseline to post-intervention between NOURISH+ and control groups, we applied linear mixed models (LMMs). Within the current analysis, time, intervention (intervention vs control groups), a time*intervention interaction term, and covariates determined as significant in AIM 1 (i.e., sex, age group) were included as fixed effects. LMMs were selected for this analysis as they are capable of analyzing longitudinal data generated from multiple sources of variation instead of just one with the addition of both fixed and random effects (SAS, 1996). Fixed effects are factors that do not vary across individuals. For example, time is a fixed effect within the current study: it does not vary across individuals in the control or intervention group (Verbeke and Molenbberghs, 1997). Random effects within LMMs help to account for variability in the data not explained by the fixed effects, such as variability related to unobserved factors that may vary across individuals within the study, for example genetic variation across individuals (Tabachnick and Fidell, 2018). Traditional statistics rely on assumptions that may be violated if there is non-independence of data. Longitudinal studies, where the same individuals

are evaluated repeatedly, violate this assumption as they are more likely to provide more similar data across time points (Murphy et al., 2022). An advantage of the LMM is its ability to handle violations of the assumption of independence, as LMM incorporates random effects to provide analysis of individual variability and incorporate an adjustment for individual differences when predicting group scores (Tabachnick and Fidell, 2018). Additionally, LMMs prevent loss of statistical power due to missing data, as LMMs can provide valid estimates even with multiple missing data points (Schafer and Graham, 2002). Akaike information criterion (AIC) and Bayesian Information Criteria (BIC) were used to select the appropriate model as lower AIC and BIC values indicate better quality of fit (Wu et al., 2017). Based on the model's AIC and BIC values, an unstructured covariance structure provided best fit. After the initial models, sensitivity analyses were used to evaluate the effect of Black and White race on outcomes. For each QOL score (total QOL, physical, emotional, social, school subscales) a separate LMM included time, intervention, time*intervention, age group, and race as main effects (with only Black and White participants). When race was a significant main effect, the sample was stratified by race (i.e., one model with only Black participants and one model with only White participants) to explore how factors such as time and intervention influence QOL within Black and White participants.

AIM 3. Predictors of post-intervention QOL: Examine associations between post-intervention QOL scores with child BMI %ile, SSB intake, child physical activity and parent feeding approach at post-intervention.

To evaluate associations between post-intervention child QOL with child BMI %ile, SSB intake, child physical activity, and parent feeding approach at post-intervention in the total child sample, two sets of linear regression analyses were applied. In the first set of models, child measures at post-test (child BMI %ile, SSB intake, child moderate activity, and child vigorous

activity) were included as independent variables in each model. Dependent variables included post-intervention child QOL scores (total QOL, physical, emotional, social, and school subscales). The respective baseline QOL score was entered into the respective model as a covariate. Intervention was included as a covariate for the school subscale model, as school scores were significantly associated with intervention in AIM 2. All other models used the total sample (both control and NOURISH+ intervention) as AIM 2 determined that QOL scores were not significantly different by intervention.

In the second set of models, four parent measures at post-test (restriction, pressure to eat, monitoring, and perceived responsibility) were included as predictor variables in each model. Outcome variables were post-intervention Child QOL scores (total QOL, physical, emotional, social, and school subscales). The respective baseline QOL score was entered into the respective model as a covariate. Once again, intervention was included as a covariate for the school subscale model, as school scores were significantly associated with intervention in AIM 2.

Results

Descriptive Statistics

Demographic information about the child participants within this study can be found in Table 1. The mean BMI%ile for enrolled children was 96.97 (*SD* = 3.37), clinically indicative of obesity (BMI >95% for children), and their mean age was 9.01 years (*SD* = 1.92). Children were predominantly female (57.44%), Black (65.55%), and not Hispanic or Latino (83.33%). The current analyses include only one randomly selected sibling per family; thus, sample numbers are lower than total number of participants enrolled at baseline.

Table 1. *Demographic Characteristics of Child Participants at Baseline*

	N (%)
Sex	
Male	126 (37.50)
Female	193 (57.44)
Race	
Black	220 (65.55)
White	71 (21.13)
Other	21 (6.25)
Ethnicity	
Hispanic or Latino	17 (5.06)
Not Hispanic or Latino	280 (83.33)
Age Group	
Younger (5 to < 9)	137 (40.77)
Older (≥9)	178 (52.98)

Descriptive statistics for BMI%ile and QOL at baseline and post-intervention are presented in Table 2. Within table 2, baseline descriptive information is provided for the total sample of participants included in the analyses (n = 333) and information for the subsample of participants who completed NOURISH+ to the post-intervention assessment. There were no significant differences in completers vs non-completers for baseline QOL scores by sex (male, female), age group (5 < 9, 9-12), or race (Black, White). Data were assessed for univariate outliers through visual inspection and numerically examining the standardized scores and histograms.

Table 2*. Descriptive statistics for BMI%ile and QOL at baseline and post-intervention*

Scale	Baseline Total Sample n = 333	Baseline Completers Sample n = 259	Post-intervention n = 259
	M (SD)	*M (SD)*	*M (SD)*
BMI%ile	96.97 (3.37)	96.68 (4.20)	96.68 (4.20)
Total QOL	73.13 (15.44)	73.94 (15.28)	76.61 (16.07)
Physical	80.20 (15.70)	80.42 (15.85)	82.65 (15.23)
Emotional	66.79 (21.97)	67.66 (21.46)	71.24 (22.15)
Social	72.81 (23.50)	73.71 (23.56)	76.99 (22.79)
School	72.73 (18.78)	73.98 (18.11)	75.56 (19.31)

Note. BMI%ile = BMI percentile, QOL = Quality of Life, M= Mean, SD = Standard Deviation

T-tests

Table 3 presents the independent-samples t-tests used to evaluate differences in baseline child QOL scores (total QOL, physical, emotional, social, and school subscales) between sex (male and female), race (Black and White), and age group (younger and older). Between male and female children, only emotional functioning was significant with male participants reporting greater baseline emotional functioning; total, physical, social, and school were not significantly different between male and female participants at baseline. For race, White participants reported significantly greater scores for total QOL, physical, social, and school subscales compared with Black participants at baseline. Emotional subscale scores were not significantly different between Black and White participants at baseline. With younger and older age groups, participants in the older age group reported significantly greater total QOL, physical, emotional, and social subscale scores. School subscale scores were not statistically different between age groups.

Table 3. *T-test for QOL Equality of Means at Baseline.*

		Total QOL *M (SD)*	Physical *M (SD)*	Emotional *M (SD)*	Social *M (SD)*	School *M (SD)*
Sex	Male	74.7 (14.98)	82.09 (16.08)	70.28 (21.19)	75.36 (22.43)	71.19 (18.50)
	Female	72.05 (15.58)	78.69 (15.38)	64.74 (22.46)	71.32 (23.60)	73.45 (19.0)
	t-test	1.53	1.90	2.20	1.52	-1.05
	(p-value)	(.128)	(.058)	(.028)	(.129)	(.296)
Race	Black	71.67 (15.52)	78.99 (15.67)	65.73 (22.22)	71.36 (23.58)	70.61 (18.63)
	White	78.22 (14.07)	84.20 (15.24)	71.62 (21.59)	78.31 (21.06)	78.73 (18.43)
	t-test	-3.16	-2.45	-1.96	-2.21	-3.20
	(p-value)	(.002)	(.015)	(.051)	(.028)	(.002)
Age Group	5 < 9 y	69.63 (16.69)	77.32 (17.32)	63.87 (24.91)	65.44 (24.91)	71.90 (20.54)
	9 – 12 y	75.89 (13.62)	82.30 (14.06)	69.55 (19.85)	78.51 (20.00)	73.20 (17.20)
	t-test	-3.57	-2.82	-2.23	-5.02	-.60
	(p-value)	(<.001)	(.007)	(.027)	(<.001)	(.550)

Note: QOL = Quality of Life, M= Mean, SD = Standard Deviation.

AIM 1. Baseline QOL Regressions

Linear Regression Analysis

Five multiple regression models evaluated the associations between baseline QOL scores with child BMI%ile, SSB intake, moderate physical activity, and vigorous physical activity at baseline. Together the independent variables were significantly associated with baseline total QOL and physical scores. For baseline total QOL, baseline BMI%ile emerged as the only significant independent variable: greater BMI%ile was associated with poorer total QOL at baseline. Baseline BMI%ile and baseline moderate physical activity were significantly associated with baseline physical scores: lower BMI%ile and greater amounts of moderate physical activity were associated with greater physical scores at baseline. The multiple regression models evaluating associations between baseline emotional, social, and school subscales with the aforementioned predictors were not significant. Details of all five models with child predictors are shown in Table 4.

Table 4. *Linear Regression Analysis with Baseline QOL and Child Variables*

		B	*SE*	***β***	*p*	R^2
Total QOL					.024	.035
	BMI %ile	-.59	.25	-.13	.021	
	SSB	-.71	.41	-.10	.087	
	Moderate PA	.32	.23	.08	.179	
	Vigorous PA	.41	.42	.06	.329	
Physical					.005	.046
	BMI %ile	-.72	.26	-.15	.006	
	SSB	-.36	.42	-.05	.389	
	Moderate PA	.49	.24	.12	.039	
	Vigorous PA	.68	.43	.09	.110	
Emotional					.397	.013
	BMI %ile	-.40	.37	-.06	.281	
	SSB	-.47	.59	-.05	.426	
	Moderate PA	.45	.34	.08	.181	
	Vigorous PA	-.17	.60	-.02	.781	
Social					.087	.025
	BMI %ile	-.83	.39	-.12	.032	
	SSB	-.85	.63	-.08	.178	
	Moderate PA	.25	.36	.04	.485	
	Vigorous PA	.67	.64	.06	.295	
School					.098	.024
	BMI %ile	-.41	.31	-.07	.189	
	SSB	-1.1	.51	-.13	.024	
	Moderate PA	.07	.29	.01	.820	
	Vigorous PA	.46	.52	.05	.377	

Note: QOL= Quality of Life, BMI% = Body Mass Index percentile, SSB = Sugar Sweetened Beverage intake, PA= Physical Activity.

The second set of five multiple regression models evaluated associations between child baseline QOL scores (total QOL, physical, emotional, social, and school subscales) with baseline parent CFQ subscales (restriction, pressure to eat, monitoring, and perceived responsibility). Restriction and pressure to eat were significantly related to total QOL: greater restriction and pressure to eat were predictive of lower total QOL at baseline. Pressure to eat and monitoring were significantly associated with baseline social scores: greater pressure to eat and monitoring

were associated with lower social scores at baseline. Restriction emerged as the only significant independent variable associated with baseline school scores: greater restriction was associated with lower school scores at baseline. Emotional and physical subscales were not significantly associated with the parent CFQ measures. Details of all linear regression models with parent predictors are shown in Table 5.

Table 5. *Linear Regression Analysis with Baseline QOL and Parent Variables*

		B	*SE*	***β***	*p*	R^2
Total QOL					.008	.042
	Restriction	-3.38	1.23	-.15	.006	
	Pressure to eat	-1.99	.90	-.12	.027	
	Monitoring	-.37	.88	-.12	.676	
	Perceived responsibility	.69	1.20	.03	.563	
Physical					.129	.022
	Restriction	-2.54	1.28	-.11	.047	
	Pressure to eat	-1.17	.93	-.07	.210	
	Monitoring	-.072	.92	-.01	.937	
	Perceived responsibility	1.51	1.24	.07	.226	
Emotional					.201	.018
	Restriction	-2.79	1.81	-.09	.125	
	Pressure to eat	-2.25	1.32	-.10	.088	
	Monitoring	-.12	1.30	-.01	.929	
	Perceived responsibility	-.34	1.76	-.01	.846	
Social					.005	.044
	Restriction	-3.27	1.86	-.10	.080	
	Pressure to eat	-3.08	1.36	-.13	.024	
	Monitoring	-3.02	1.33	-.13	.024	
	Perceived responsibility	2.02	1.81	.06	.264	
School					.005	.045
	Restriction	-4.92	1.48	-.18	.001	
	Pressure to eat	-1.44	1.08	-.07	.182	
	Monitoring	1.74	1.06	.09	.103	
	Perceived responsibility	-.42	1.44	-.02	.771	

Note: QOL= Quality of Life

AIM 2. Quality of Life Change

Linear Mixed Models

Unstructured LMM provided optimum fit to assess the effects of the NOURISH+ with intervention, time, an intervention*time interaction term, and respective covariates (age group, sex) determined by AIM 1 for QOL scores (total QOL, physical, emotional, social, and school subscales). For total QOL, we found significant main effects of time, $F(1,249.43) = 19.54$, $p < .001$ and age group, $F(1,311.69) = 17.41$, $p < .001$; however, intervention and time*intervention were not significant. Table 6 summarizes the estimated fixed effects of the LMM for total QOL. Mean post-intervention scores were 3.40 points higher than mean baseline scores. Furthermore, the older age group reported 6.85 points higher average total QOL scores than the younger age group across time.

Table 6. *Estimated fixed effects of linear mixed model with time, intervention, and age group as fixed effects and time*intervention as an interaction term on total QOL scores*

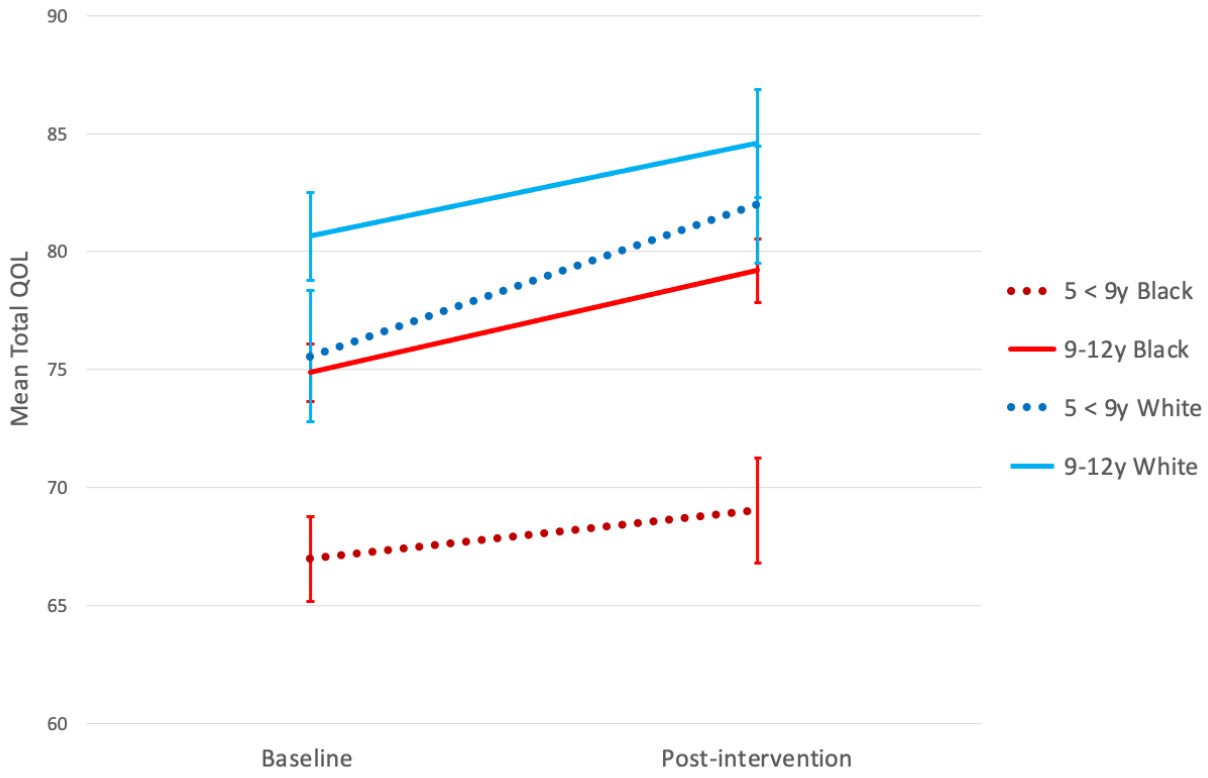
Effect	Estimate	*Test (df)*	*p*	95% CI	
				LL	*UL*
Time	-3.40	-3.44 (247.98)	.001	-5.34	-1.45
Intervention	1.26	.67 (288.31)	.503	-2.43	4.94
Time*Intervention[a]	.58	.41 (249.43)	.683	-2.20	3.35
Age Group	6.85	4.17 (311.69)	.001	3.62	10.09

*Note. a.*Baseline*Intervention. *QOL = Quality of Life.*

A sensitivity analysis evaluated the effect of Black and White race on total QOL outcomes and indicated a significant main effect of race, $F(1,282.16) = 13.07$, $p < .001$. Results from stratified models show that for Black participants, time, $F(1,174.57) = 14.97$, $p < .001$ and age group, $F(1,174.58) = 19.77$, $p < .001$ were significantly associated with total QOL; intervention and time*intervention were not significant, similar to the initial results. Post-intervention scores were on average 3.29 points higher than baseline scores. The older age group

of Black participants reported average of 8.86 points higher total QOL scores than the younger age group, t(212.93)=4.45, p < .001, CI [4.93, 12.79]. Among White participants, there was a significant main effect for time F(1,52.11) = 6.06, p = .017 with total QOL scores, but intervention, age group, and the time*intervention were not significantly associated with total QOL. Post-intervention scores were on average 4.40 higher than baseline scores. Figure 1 displays the change in total QOL for Black and White participants by age group over time.

Figure 1. *Mean total QOL scores in Black and White participants at baseline and post-intervention*



For physical subscale scores, there were significant main effects of time, $F(1,272.19) = 8.03$, p = .005 and age group, $F(1, 309.88) = 13.03$, p <.001; however, intervention and time*intervention were not significant. Post-intervention physical scores were 2.86 points higher than baseline scores. Furthermore, the older age group reported 5.47 points higher average

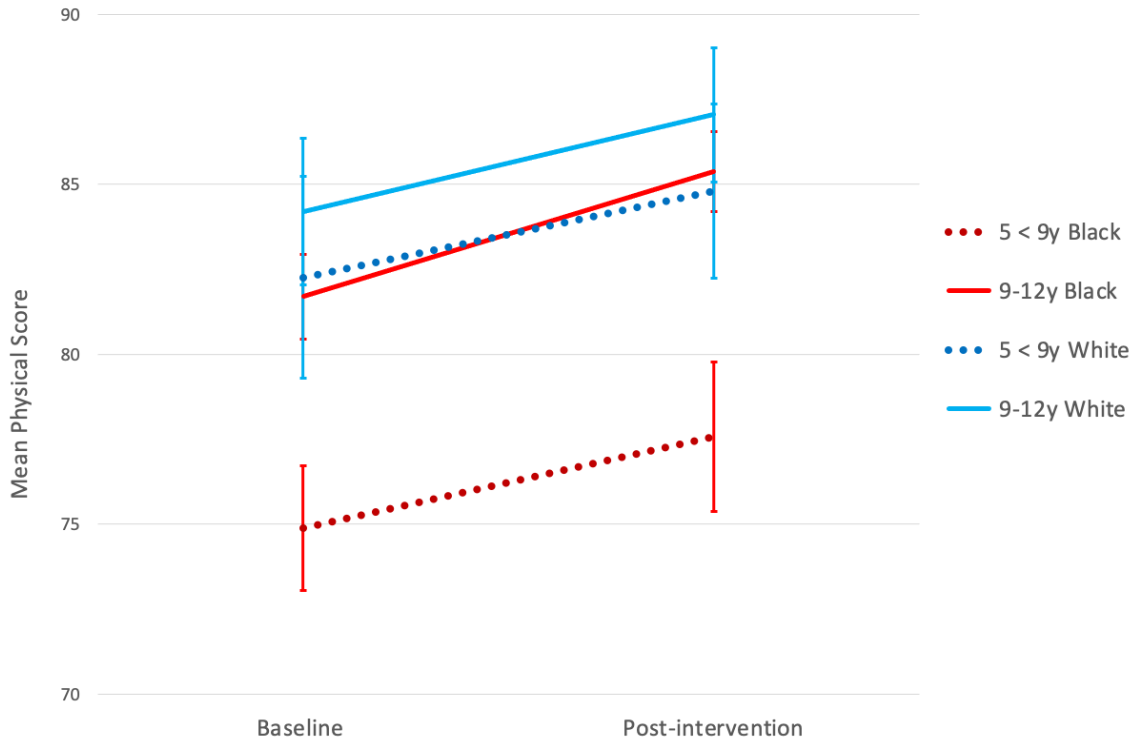
physical functioning scores than the younger age group. Table 7 summarizes the estimated fixed effects of the LMM for the physical subscale.

Table 7. *Estimated fixed effects of linear mixed model with time, intervention, and age group as fixed effects and time*intervention as an interaction term on physical subscale scores*

Effect	Estimate	*Test (df)*	*p*	95% CI	
				LL	*UL*
Time	-2.86	-2.08 (267.65)	.039	-5.57	-.15
Intervention	1.19	.65 (261.57)	.515	-2.40	4.78
Time*Intervention	.20	.10 (272.21)	.919	2.49	8.45
Age Group	5.47	3.61 (309.88)	<.001	-3.64	4.03

A sensitivity analysis evaluated the effect of Black and White race on physical scores and indicated a significant main effect of race, $F(1,283.28) = 6.82$, p =.009. Models stratified by race shown that amongst Black participants, findings were similar to those from the original LMM for physical scores with time, $F(1,191.14)=9.20$, p=.003 and age groups, $F(1,214.97)=15.18$, p <.001 being significantly associated with physical QOL. Post-intervention physical scores were on average 4.02 points higher than baseline scores. Older Black participants reported on average 7.09 points higher physical scores than younger Black participants. Results from the model with White participants differed from the original model; time, intervention, age groups, and time*intervention were not significantly associated with physical scores. Figure 2 displays the change in physical functioning scores for Black and White participants by age group over time.

Figure 2. *Mean physical subscale scores in Black and White participants at baseline and post-intervention*



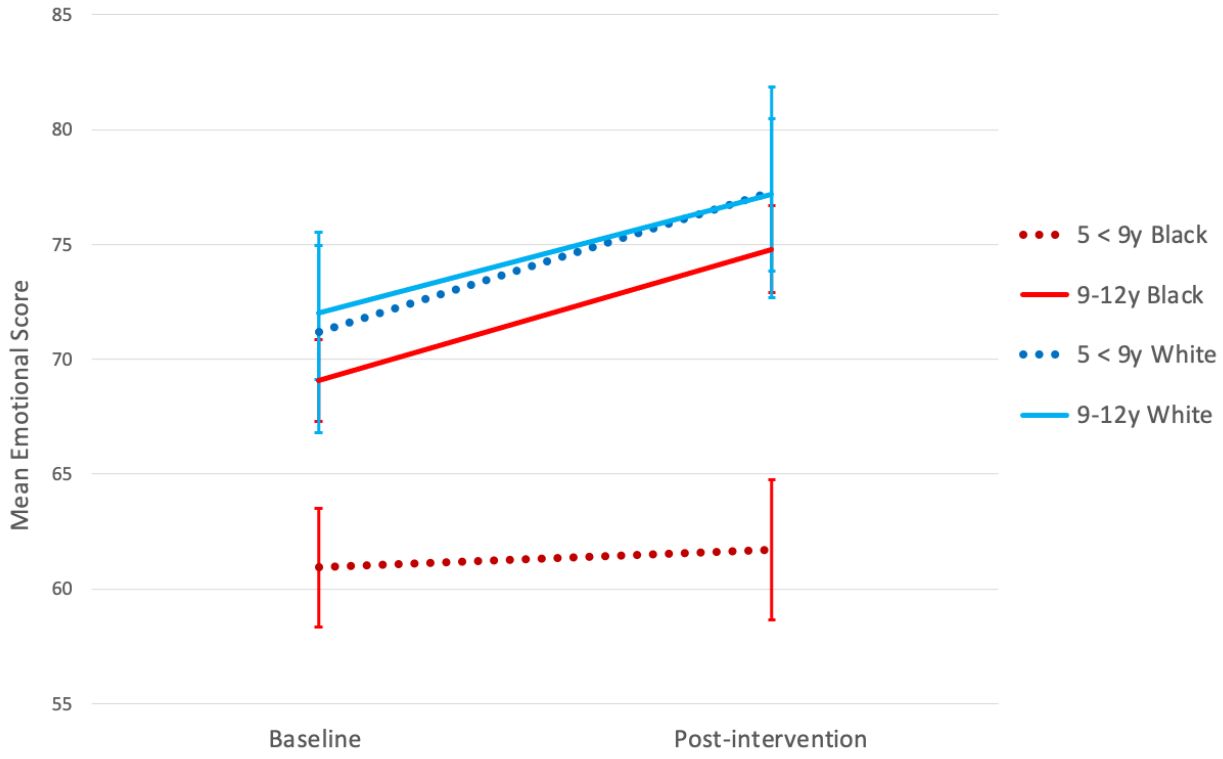
With emotional scores, there were significant main effects of time, $F(1,258.53)= 8.95$, $p = .003$ and age group, $F(1,307.18) = 9.48$, $p=.002$; however, intervention, sex, and time*intervention were not significant. Post-intervention emotional scores were 4.27 points higher than post-intervention scores. Furthermore, the older age group reported 7.01 points higher average emotional functioning scores than the younger groups. Estimated fixed effects from the emotional subscale LLM are summarized in Table 8.

Table 8. *Estimated fixed effects of linear mixed model with time, intervention, and age group as fixed effects and time*intervention as an interaction term on emotional subscale scores*

Effect	Estimate	*Test (df)*	*p*	95% CI	
				LL	*UL*
Time	-4.27	-2.34 (255.47)	.020	-7.87	-.67
Intervention	1.99	.73 (264.93)	.465	-3.37	7.36
Time*Intervention	.79	.30 (258.58)	.762	-4.32	5.89
Age Group	7.01	3.08 (307.18)	.002	2.53	11.49
Sex	-2.98	-1.30 (303.75)	.196	-7.50	1.54

Sensitivity analysis for race indicated a significant main effect for race, $F(1,280.71) = 5.63$, $p = .018$. Stratified models showed that results for Black participants were similar to those from the original LMM for emotional scores: main effects of time, $F(1,184.42) = 6.04$, $p = .015$ and age groups, $F(1,212.59) = 14.78$, $p < .001$. Intervention, time*intervention, and sex were not significantly associated with emotional scores. At post-intervention, Black participants reported on average 2.95 higher emotional scores compared to baseline. Older Black participants reported on average 10.49 points higher emotional scores than younger Black participants. The model with White participants differed from the original model; time, intervention, time*intervention, age group and sex were not significantly associated with emotional scores. Figure 3 displays the change in emotional functioning scores for Black and White participants by age group over time.

Figure 3. *Mean emotional scores in Black and White participants at baseline and post-intervention*



For social scores the LMM models indicated that time, $F(1,256.45) = 9.15$, $p = .003$ and age group, $F(311.91) = 30.41$, $p < .001$ were significant; however, intervention and time*intervention did not have significant main effects. Post-intervention social scores were 3.68 points higher than baseline scores. Furthermore, the older age group reported 13.01 points higher average social scores than the younger age group. Social subscale estimated fixed effects are summarized in Table 9.

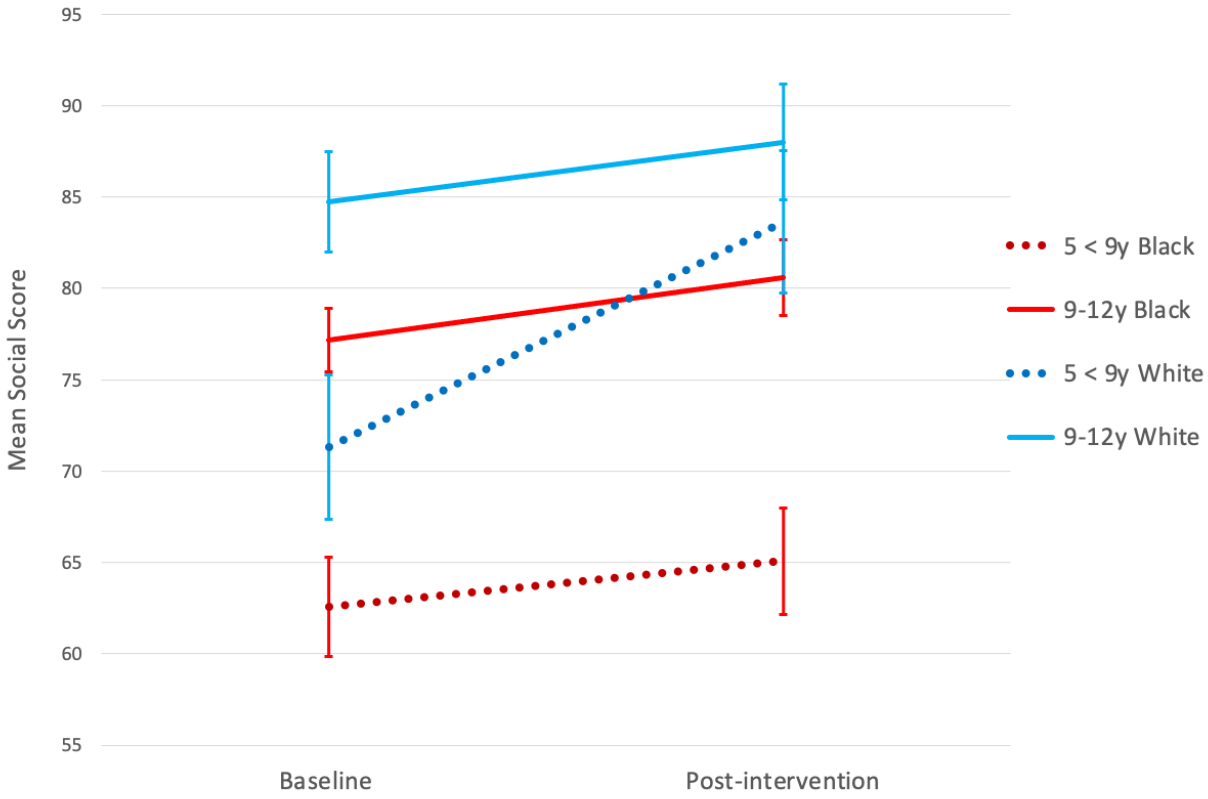
Table 9. *Estimated fixed effects of linear mixed model with time, intervention, and age group as fixed effects and time*intervention as an interaction term on social subscale scores*

Effect	Estimate	*Test (df)*	*p*	95% CI	
				LL	*UL*
Time	-3.68	-2.30 (254.02)	.022	-6.83	-.52
Intervention	-1.70	-.63 (282.69)	.528	-7.01	3.60
Time*Intervention	.46	.20 (256.46)	.840	-4.02	4.95
Age Group	13.01	5.51 (311.91)	<.001	8.37	17.65

Note. QOL = Quality of Life.

Sensitively analyses indicated that race was significantly associated with social QOL, $F(1,280.44) = 9.99$, p =.002. Stratified model results for Black and White participants were similar to the full model. Amongst Black participants, time, $F(1,180.09) = 4.86$, p=.029 and age group $F(1,213.01)= 27.48$, $p < .001$ were significantly associated with social scores; intervention and time*intervention were non-significant, similar to the initial results. At post-intervention, Black participants reported on average 2.62 points higher social scores than at baseline. Older Black participants reported an average of 14.91 points higher social scores than younger Black participants. Among White participants, time, $F(1,49.45) = 5.78$, p=.02 and age group, $F(1,62.88)=4.98$, p =.03 were significantly associated with social scores; intervention and time*intervention were non-significant similar to the initial results. At post-intervention, White participants reported an average of 6.85 points higher social scores than at baseline. Older White participants reported an average of 10.22 points higher social scores than younger White participants. Figure 4 displays the change in social functioning scores for Black and White participants by age group over time.

Figure 4. *Mean social scores in Black and White participants at baseline and post-intervention*



For school scores the LMM indicated significant main effects of time, $F(1,268.03)= 4.55$, $p = .034$ and intervention, $F(1,312.44) = 4.23$, $p=.040$. Time*intervention did not display a significant main effect on school functioning and age group was not included as a covariate based on AIM 1. Post-intervention school scores were 2.84 points higher than baseline scores. The intervention group reported 3.40 points higher average school scores than the control group. Therefore, both groups changed significantly over time, and there were group differences between intervention and control group. Estimated fixed effects from the school subscale LLM are summarized in Table 10.

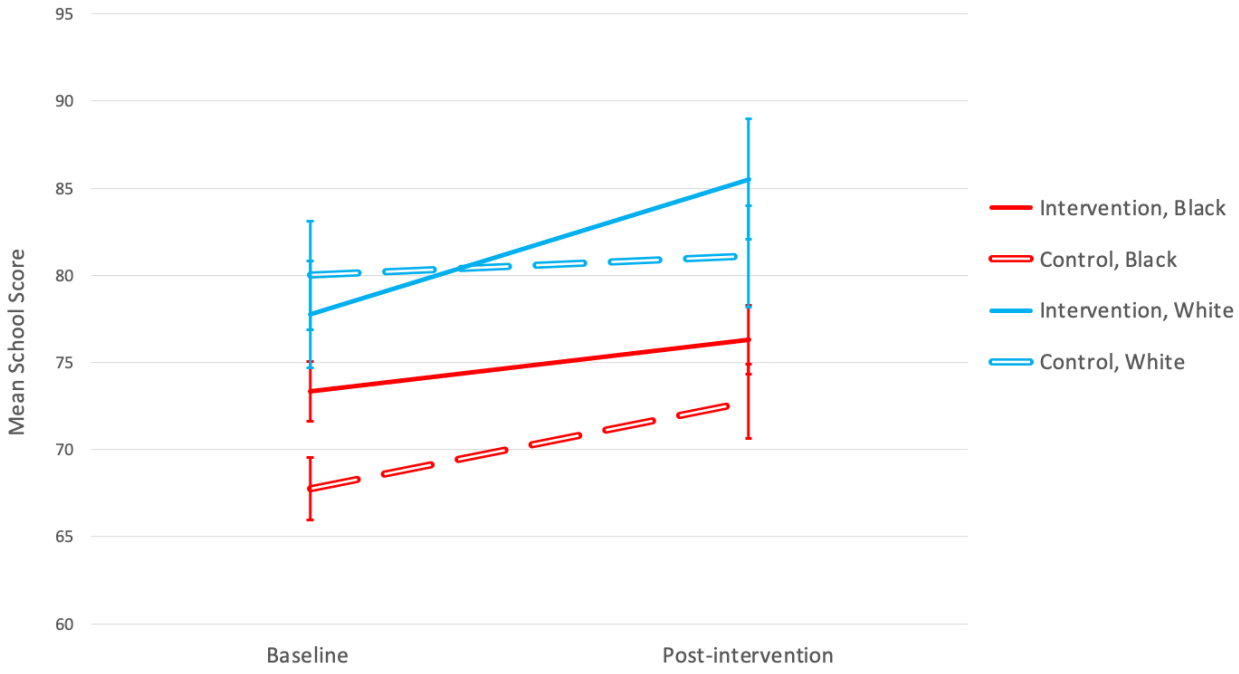
Table 10. *Estimated fixed effects of linear mixed model with time, intervention, and age group as fixed effects and time*intervention as an interaction term on school subscale scores*

Effect	Estimate	*Test (df)*	*p*	95% CI	
				LL	*UL*
Time	-2.84	-1.82 (265.12)	.069	-5.91	.23
Intervention	3.40	1.47 (275.07)	.144	-1.17	7.98
Time*intervention	.98	.45 (268.03)	.656	-3.35	5.32

Note. QOL = Quality of Life.

Sensitively analyses indicated that race was significantly associated with social QOL, $F(1,279.96) = 12.69$, $p < .001$. Models stratified by race shown that amongst Black participants, time, $F(1,177.89) = 4.79$, $p = .030$ and intervention, $(1,205.82) = 3.98$, $p = .047$ were significantly associated with social scores; whereas time*intervention was non-significant, similar to the initial results. At post-intervention, Black participants reported on average 3.79 points higher school scores than at baseline. Black participants within NOURISH+ reported an average of 3.74 points higher school scores than Black participants in the control group. Results from the model with White participants differed from the original model; time, intervention and time*intervention were not significantly associated with school scores. Figure 5 displays the change in school scores for Black and White participants by age group over time.

Figure 5. *Mean school scores in Black and White participants at baseline and post-intervention*



AIM 3. Predictors of Post-Intervention QOL

Linear Regression Analysis

All five multiple regression models evaluating associations between post-intervention QOL with post-intervention BMI%ile, SSB intake, moderate physical activity, and vigorous physical activity as predictors, were significant. However, only baseline QOL scores, entered as covariates, were significantly associated with the respective outcome variables. Details of all five models with child independent variables are shown in Table 12.

Table 12. *Linear Regression Analysis with Post-Intervention QOL and child independent variables*

		B	*SE*	***β***	*p*	R^2
Total QOL					<.001	.563
	Baseline total QOL	.78	.05	.74	<.001	
	PI BMI%	.01	.19	.00	.941	
	PI SSB	-.82	.47	-.08	.079	
	PI Moderate PA	.27	.19	.06	.155	
	PI Vigorous PA	.08	.24	.01	.752	
Physical					<.001	.261
	Baseline physical	.45	.05	.49	<.001	
	PI BMI%	-.04	.22	-.10	.858	
	PI SSB	-.74	.55	-.08	.183	
	PI Moderate PA	.28	.22	.07	.215	
	PI Vigorous PA	-.04	.30	-.01	.901	
Emotional					<.001	.335
	Baseline emotional	.57	.06	.57	<.001	
	PI BMI%	-.13	.31	-.02	.681	
	PI SSB	-1.4	.78	-.10	.074	
	PI Moderate PA	.44	.32	.08	.163	
	PI Vigorous PA	.41	.41	.05	.323	
Social					<.001	.511
	Baseline social	.72	.05	.71	<.001	
	PI BMI%	-.08	.29	-.01	.786	
	PI SSB	-.39	.72	-.03	.592	
	PI Moderate PA	.37	.29	.06	.200	
	PI Vigorous PA	-.06	.38	-.01	.871	
School					<.001	.317
	Baseline school	.57	.06	.55	<.001	
	Group	-.90	2.13	-.02	.674	
	PI BMI%	-.12	.27	-.02	.669	
	PI SSB	-.76	.71	-.06	.283	
	PI Moderate PA	.27	.28	.05	.334	
	PI Vigorous PA	.27	.36	.04	.451	

Note: QOL= Quality of Life, PI BMI% = Post-intervention Body Mass Index percentile, PI SSB = Post-intervention Sugar Sweetened Beverage intake, PI Moderate PA= Post-intervention Moderate Physical Activity, PI Vigorous PA = Post-intervention Vigorous PA.

Five of the multiple regressions included independent variables related to the parent, including the independent variables of: post-intervention restriction, pressure to eat, monitoring, and perceived responsibility. Each model was significant, and baseline QOL scores emerged as statistically significant in each model. In addition to baseline QOL scores, pressure to eat was

significantly associated with post-intervention emotional subscale; greater pressure to eat was associated with lower post-intervention emotional scores. Pressure to eat was also significantly associated with post-intervention school scores; greater pressure to eat was associated with lower post-intervention school scores. Results from these models are presented in Table 13.

Table 13. *Linear Regression Analysis for post-intervention QOL with parent independent variables*

		B	*SE*	***β***	*p*	R^2
PI Total QOL					<.001	.558
	Baseline total QOL	.77	.05	.73	<.001	
	Restriction	-1.29	1.01	-.06	.207	
	Pressure to eat	-1.41	.74	-.08	.057	
	Monitoring	.36	.89	.02	.689	
	Perceived responsibility	-.65	.97	-.03	.501	
PI physical					<.001	.235
	Baseline physical	.45	.06	.46	<.001	
	Restriction	-1.27	1.26	-.06	.313	
	Pressure to eat	-1.28	.92	-.08	.166	
	Monitoring	-.12	1.12	-.01	.918	
	Perceived responsibility	-1.47	1.2	-.07	.226	
PI emotional					<.001	.347
	Baseline emotional	.572	.05	.56	<.001	
	Restriction	-3.09	1.67	-.10	.066	
	Pressure to eat	-2.49	1.23	-.11	.044	
	Monitoring	2.14	1.49	.08	.151	
	Perceived responsibility	-.92	1.61	-.03	.571	
PI social					<.001	.505
	Baseline social	.70	.05	.71	<.001	
	Restriction	-1.66	1.53	-.05	.280	
	Pressure to eat	1.04	1.12	.04	.352	
	Monitoring	.98	1.36	.03	.470	
	Perceived responsibility	-.001	1.47	.00	.999	
PI school					<.001	.306
	Baseline school	.55	.06	.52	<.001	
	Group	.46	2.07	.01	.826	
	Restriction	-1.69	1.53	-.06	.270	
	Pressure to eat	-3.01	1.11	-.15	.007	
	Monitoring	-.84	1.34	-.04	.532	
	Perceived responsibility	-.32	1.45	-.01	.827	

Note: QOL= Quality of Life, PI= Post-intervention

Discussion

Children with obesity report QOL levels comparable to those found in children with other serious pediatric diseases, such as end-stage renal disease on hemodialysis, cerebral palsy with

diplegia, mood disorders, and newly diagnosed cancer (Ingerski et al., 2010; Schwimmer et al., 2003; Varni et al., 2007). QOL is an important measure for children with obesity as it encapsulates psychosocial domains impacted by factors such as self-esteem, body image, social support, and weight-related stigma that significantly impact wellbeing in this population (Diao et al., 2020; Fan et al., 2021; Varni et al., 2007). Children's QOL has shown improvement following participation in pediatric obesity interventions, regardless of significant weight loss which is often used as a primary outcome for pediatric obesity interventions (Griffiths et al., 2010; Hoedjes et al., 2018; Vallis, 2016; Willie et al., 2008). Thus, QOL scores have become an important metric for clinical decision making and research outcomes in children with obesity.

Parent-focused interventions have shown to improve health related behaviors in children with obesity (Golan & Crow, 2004; Cardel et al., 2020). However, few studies have assessed the impact of parent-focused interventions on QOL in children with overweight and obesity. The current study compared changes in the QOL scores (total and subscale) of children of parents enrolled in a six-week parent-focused intervention program, NOURISH+, with children of parents in a control condition. Results indicated that only school scores were significantly higher in the intervention group compared with the control group at post-intervention; however, these differences cannot be attributed to the intervention itself as the two groups did not significantly differ in their improvement over time. Furthermore, improvement in QOL over time was reported for total QOL and all subscales (physical, emotional, social, and school) in both the intervention and control groups. There was not significant differences in the degree of this improvement over time across the two groups. Many pediatric obesity interventions have reported positive QOL outcomes within control groups, and investigators have attributed these results to potential intervention effects within control groups, such as increased peer socialization

or structured time with adults (Finne et al., 2013; Lek et al., 2021; Williams et al., 2019). Within the current study, there was a possible self-selection bias, as all participants were parents of children with overweight or obesity who desired engagement in a healthy lifestyle change program. Therefore, parents in the control group might have simultaneously initiated health behavior changes within their family units that contributed to the increases in children's QOL over time within the control group. Additionally, the impact of the intervention was likely limited due to its relatively short length; most pediatric obesity interventions are much longer in duration, including those that that have yielded improvements in children's QOL scores (Diao et al., 2020; Hoedjes et al., 2018; Steele et al., 2012). This shorter length was intentionally selected based on parent feedback in the NOURISH pilot (Mazzeo et al., 2012) and is more feasible for busy families of school-age children. However, perhaps future research should consider adding additional online or booster sessions to determine if increased intervention dosage yields stronger effects.

Despite the lack of significant differences in mean QOL scores between the intervention and control groups, both groups did manifest improved QOL over time. Varni and colleages (2003) determined that a 4.4-point change in the total score for child self-report represents a minimal clinically meaningful difference (MCID). In the current study, the total sample's mean total QOL improved 3.4 points from baseline to post-intervention. When stratified by race, Black participants reported a 3.29 improvement from baseline to post-intervention, and White participants reported a 4.4-point improvement from baseline to post-intervention. Therefore, the overall sample's QOL improvement was close to a MCID, and when stratified by race, White participants did manifest a MCID over time. This improvement is significant as MCID reflect the specific point difference that would confer beneficial change from the individual's perspective

and potentially warrant a change in their clinical care (Jaeschke et al., 1989). For Black participants average change over time was slightly under the 3.4 point cut off, but appears to be going in a positive direction.

Sensitivity analyses indicated significant differences in mean QOL scores between Black and White participants for all QOL scores (total, physical, emotional, social). These findings contrast with existing literature which generally indicates that QOL impairments are equally evident across all racial ethnic groups in children with obesity (Fallon et al., 2005; Wallander et al., 2013; Zeller and Modi, 2006). Moreover, some studies indicate Black youth with overweight and obesity report less impairment in QOL compared with White youth (Fallon et al., 2005; Modi et al., 2006; Wallander et al., 2013). Given this prior research, the observed racial differences in QOL scores at baseline and post-intervention are concerning. Future research should explore and reconsider the assumption that Black children with overweight and obesity experience equal or less impairment in QOL.

Differences in QOL by age group were also evident in the current study. Older participants (nine to twelve years) reported higher QOL (total QOL, physical, emotional, and social subscales) scores at baseline and post-intervention than younger participants (five to less than nine years). These age differences were also evident when groups were stratified by race. Younger Black participants (five to less than nine years) reported significantly lower QOL (total QOL, physical, social, and school subscales) at baseline and post-intervention compared with older (nine to twelve) Black children. These results contrast with existing research that has found a negative association between QOL and age among children and adolescents with obesity. For example, results of a study with 4083 Australian children aged 4-17 years showed consistent decrements in QOL after age nine (Killedar et al., 2020). However, that study used longitudinal

data over time to analyze the evolution of individuals' QOL over time, while the current study grouped children into older versus younger groups, comparing these groups rather than the individual to themselves. Nonetheless, these findings suggest that children younger than nine might also experience poor QOL, particularly young black children.

It is important to consider the systemic factors that could be associated with the significantly lower QOL reported by young Black children, such as the adultification of young black children (Koch & Kozhumam, 2022). Adultification is defined as the process in which young Black children are forced to assume social, emotional, and physical adult roles as a result of systemic racism (Burton, 2007). This phenomenon has been associated with poorer health outcomes in Black Children as young as 5 and is associated with discrimination within the school, healthcare, and community environments (Koch & Kozhumam, 2022). More research is needed to elucidate the experience of young Black children with obesity and overweight, perhaps using a qualitative approach to explore their unique experiences, including the effects of weight on their perceived functioning and QOL.

At baseline the only measured variable associated with children's total QOL scores was BMI%ile. This association has been identified in numerous prior studies, which have indicated greater detriments in total QOL scores as BMI increases in children (Ingerski et al., 2010; Schwimmer et al., 2003; Varni et al., 2007). This decrement in QOL is likely related to a variety of factors; one study of obese youth with similar demographics to the current study (predominantly female, Black, average age 12.7) reported that depressive symptoms, perceived social support from classmates, degree of overweight, and SES were associated with QOL (Zeller and Modi, 2006). Similarly, within the current study, physical subscale scores were predicted by BMI%ile and moderate physical activity. Previous research has demonstrated an

inverse relationship between child BMI and physical subscale scores (Schwimmer et al., 2003; Zeller and Modi, 2006). The relationship between BMI and physical scores is likely due to decreases in functional ability and increases in chronic pain associated with greater BMI in children (O'Malley et al., 2021). Furthermore, previous studies have revealed a positive correlation between physical activity and physical QOL scores (Wafa et al., 2016).

In addition to these child measures, links between parent feeding behaviors and baseline and post-intervention QOL were evaluated. At baseline, parents reporting greater pressure to eat, restriction, and monitoring were more likely to have children with lower baseline total QOL, social, and school scores. Furthermore, parents with greater post-intervention scores on the measure of pressure to eat were more likely to have children with lower post-intervention emotional and school subscales. These findings add to existing literature suggesting that greater parent control of child eating behaviors might inadvertently have a negative impact on child outcomes (Clark et al., 2007). For example, Steele and colleagues (2011) used latent growth curve modeling to examine associations between parent control of children's food intake (using the CFQ) and child weight outcomes, and identified associations between high and low parental control over food intake and higher zBMI; in contrast, moderate parental control was linked to beneficial outcomes. Similarly, Clark and colleagues (2007) recommend parents who are concerned about a child's weight receive guidance and support to avoid using inappropriate child-feeding behaviors, such as excessive restriction of the child's eating. These findings confirm the importance of incorporating parent education for parents in interventions aiming to improve QOL of children with overweight and obesity.

Future Research

There are many opportunities for future research to continue to explore effective strategies to improve the QOL of children in vulnerable populations, including Black children with overweight and obesity. Results of the current study provided new insights into the unique vulnerability of younger (five to less than nine years) Black children, who reported significantly lower QOL at baseline, compared with same age White children and older Black and White children. Furthermore, very few studies have investigated associations between race and QOL within samples of children seeking pediatric obesity treatment. Future studies should explore additional factors associated with within-group variations in QOL various racial-ethnic groups. A more in-depth exploration of these within-group factors could help avoid a deficit-based perspective on marginalized groups, which can sometimes occur when they are compared with a White sample (Goodnow, 2002). Moreover, few studies have compared impairment in younger vs older children. More attention should be given to factors associated with low QOL in young children with obesity, particularly as rates of this condition have increased to 12.7% for children aged 2-5 years and 20.7% for children aged 6-11 years within the United States (Stierman et al., 2021).

Strengths and Limitations

This study offers insight into the impact of race and age on QOL in children with overweight and obesity. It also offers a snapshot of factors associated with lower baseline and post-intervention QOL. However, this study is not without limitations. As mentioned before, the NOURISH+ intervention was relatively short as a six-week intervention compared with other pediatric obesity interventions that typically last six months to one year (McGovern et al., 2008). This shorter intervention period was selected in response to feedback received from parent participants in the NOURISH pilot; specifically, they noted that a shorter intervention length was

more feasibility for their families. However, it is possible that with a longer parent-focused intervention, significant differences between the intervention and control group would emerge over time.

Additionally, when considering the significant main effect of age noted in the overall sample across QOL outcomes (except school), it is possible that the significant difference noted between younger and older Black participants was related to the children's interpretation of the measure, rather than relative differences in QOL. Although the PedsQL 4.0 is widely used to measure pediatric QOL, it has yet to be validated within a primarily Black sample. Thus, these significant differences could be related to cultural influences on the interpretation of the questions from young Black participants. Future studies should consider assessing the validity of the PedsQL 4.0 with a community sample of young (>9) Black participants.

Another important limitation to consider is that we were unable to control for all variables associated with racial/ethnic differences, such as education, marital status, and income. The findings of this study, particularly those related to race, might be confounded by these variables, which should be systematically investigated in future research. The sample included treatment-seeking parents of children with overweight and obesity and therefore might not be generalizable to non-treatment seeking parents. Furthermore, the sample primarily included children with overweight or obesity from families in the Richmond, Virginia metropolitan area who identified as Black or White, therefore results might not generalize to parents who self-identify as part of other racial/ethnic groups, parents with children in different age groups, or those from other geographic locations.

The current study investigated the impact of a parent-focused pediatric obesity intervention on children's QOL. Results suggest that parent-focused interventions can improve

QOL school subscale scores in children with obesity. Further, Black children aged five to under nine reported the lowest QOL, both at baseline and at post-intervention, across all QOL domains, although their scores did improve over time. Future research should investigate the impact of race and age QOL in children with overweight and obesity. Future studies should also consider variables that this study indicated were associated with baseline and post-intervention QOL, such as BMI%ile, moderate physical activity, and parent's control of child eating.

Appendix A

Demographic Questions (Parent Form)

Date of Birth: __ __/__ __/__ __ __ __

Ethnicity (circle one): Hispanic/Latino or Not Hispanic/Latino
Race (circle one):
1. American Indian/Alaska Native
2. Asian
3. Native Hawaiian or Other Pacific Islander
4. Black or African American
5. White
6. Other/More than one race
Specify:_____

Gender: Male____ Female____

How many children do you have? __

	Date of Birth		Ethnicity?	Race(same options for Parent race info)	If other race, specify
Enrolled Child 1		M/F	Yes/No		
Enrolled Child 2		M/F	Yes/No		
Enrolled Child 3		M/F	Yes/No		

Appendix B

PedsQL 4.0 (Young Child Report Ages 5-7)

Instructions for interviewer:
I am going to ask you some questions about things that might be a problem for some children. I want to know how much of a problem any of these things might be for you.

Show the child the template and point to the responses as you read.
If it is <u>not at all</u> a problem for you, point to the smiling face
If it is <u>sometimes</u> a problem for you, point to the middle face
If it is a problem for you <u>a lot</u>, point to the frowning face
I will read each question. Point to the pictures to show me how much of a problem it is for you. Let's try a practice one first.

	Not at all	Sometimes	A lot
Is it hard for you to snap your fingers	☺		

Ask the child to demonstrate snapping his or her fingers to determine whether or not the question was answered correctly. Repeat the question if the child demonstrates a response that is different from his or her action.
Think about how you have been doing for the last few weeks. Please listen carefully to each sentence and tell me how much of a problem this is for you.
After reading the item, gesture to the template. If the child hesitates or does not seem to understand how to answer, read the response options while pointing at the faces.

PHYSICAL FUNCTIONING (problems with…)	Not at all	Some times	A lot
1. Is it hard for you to walk	0	2	4
2. Is it hard for you to run	0	2	4
3. Is it hard for you to play sports or exercise	0	2	4
4. Is it hard for you to pick up big things	0	2	4
5. Is it hard for you to take a bath or shower	0	2	4
6. Is it hard for you to do chores (like pick up your toys)	0	2	4
7. Do you have hurts or aches (*Where?*_____)	0	2	4
8. Do you ever feel too tired to play	0	2	4

Remember, tell me how much of a problem this has been for you for the last few weeks.

EMOTIONAL FUNCTIONING (problems with…)	Not at all	Some times	A lot
1. Do you feel scared	0	2	4
2. Do you feel sad	0	2	4
3. Do you feel mad	0	2	4
4. Do you have trouble sleeping	0	2	4
5. Do you worry about what will happen to you	0	2	4

SOCIAL FUNCTIONING (problems with…)	Not at all	Some times	A lot
1. Is it hard for you to get along with other kids	0	2	4
2. Do other kids say they do not want to play with you	0	2	4
3. Do other kids tease you	0	2	4
4. Can other kids do things that you cannot do	0	2	4
5. Is it hard for you to keep up when you play with other kids	0	2	4

SCHOOL FUNCTIONING (problems with…)	Not at all	Some times	A lot
1. Is it hard for you to pay attention in school	0	2	4
2. Do you forget things	0	2	4
3. Is it hard to keep up with schoolwork	0	2	4
4. Do you miss school because of not feeling good	0	2	4
5. Do you miss school because you have to go to the doctor's or hospital	0	2	4

Appendix C

PedsQL 4.0 (Child Report Ages 8-12)

DIRECTIONS

On the following page is a list of things that might be a problem for you.
Please tell us how much of a problem each one has been for you
during the past ONE month by circling:
0 if it is never a problem
1 if it is almost never a problem
2 if it is sometimes a problem
3 if it is often a problem
4 if it is almost always a problem

There are no right or wrong answers.
If you do not understand a question, please ask for help.

In the past ONE month, how much of a problem has this been for you …

ABOUT MY HEALTH AND ACTIVITIES (problems with…)	Never	Almost Never	Some times	Often	Almost Always
1. It is hard for me to walk more than one block	0	1	2	3	4
2. It is hard for me to run	0	1	2	3	4
3. It is hard for me to do sports activity or exercise	0	1	2	3	4
4. It is hard for me to lift something heavy	0	1	2	3	4
5. It is hard for me to take a bath or shower by myself	0	1	2	3	4
6. It is hard for me to do chores around the house	0	1	2	3	4
7. I hurt or ache	0	1	2	3	4
8. I have low energy	0	1	2	3	4

ABOUT MY FEELINGS (problems with…)	Never	Almost Never	Some times	Often	Almost Always
1. I feel afraid or scared	0	1	2	3	4
2. I feel sad or blue	0	1	2	3	4
3. I feel angry	0	1	2	3	4
4. I have trouble sleeping	0	1	2	3	4
5. I worry about what will happen to me	0	1	2	3	4

HOW I GET ALONG WITH OTHERS (problems with…)	Never	Almost Never	Some times	Often	Almost Always
1. I have trouble getting along with other kids	0	1	2	3	4
2. Other kids do not want to be my friend	0	1	2	3	4
3. Other kids tease me	0	1	2	3	4
4. I cannot do things that other kids my age can do	0	1	2	3	4
5. It is hard to keep up when I play with other kids	0	1	2	3	4

ABOUT SCHOOL (problems with…)	Never	Almost Never	Some times	Often	Almost Always
1. It is hard to pay attention in class	0	1	2	3	4
2. I forget things	0	1	2	3	4
3. I have trouble keeping up with my schoolwork	0	1	2	3	4
4. I miss school because of not feeling well	0	1	2	3	4

5. I miss school to go to the doctor or hospital	0	1	2	3	4

Appendix D

Sugar Sweet Beverage Intake (Child Form)

*(if <1/week, indicate monthly)

1. Do you drink soda?
Yes
No
a. How many do you think you drink each week? _____

2. Do you drink sweet tea?
Yes
No
a. How many do you think you drink each week? _____

3. Do you drink sweet coffee?
Yes
No
a. How many do you think you drink each week? _____

4. Do you drink juice (e.g.,Kool-Aid, Capri Sun, or juice in a box)?
Yes
No
a. How many do you think you drink each week? _____

5. Do you drink energy drinks?
Yes
No
a. How many do you think you drink each week? _____

6. Do you drink sports drinks, like Gatorade or Vitamin Water?
Yes
No
a. How many do you think you drink each week? _____
*if child appears to be struggling with these questions, have him/her think about yesterday, and what they drank then.
7. What are your three favorite types of drinks (not including milk or water)?
a. _____
b. _____
c. _____

Appendix E

7- Day Physical Activity Recall (Child Form)

Participant ID_____ Date: _____ Day of Week:_____ Interviewer:_____

1. Were you employed in the last seven days? 0. No (skip to Q4) 1. Yes
2. How many days of the last seven did you work? ____days
3. How many total hours did you work in the last seven days? ____hours last week
4. What two days do you consider your weekend days? _____, _____ (mark days below with a squiggle)
5. What opportunities did you have for structured physical activities (e.g., sports, dance) in the past seven days? _____

		DAYS						
		1	2	3	4	5	6	7
	SLEEP							
Morning	Moderate							
	Hard							
	Very Hard							
Afternoon	Moderate							
	Hard							
	Very Hard							
Evening	Moderate							
	Hard							
	Very Hard							
Total Min per Day	Strength							
	Flexibility							

Worksheet Key

Rounding: 10-22 min = .25 23-37 min = .50 38-52 min = .75 53-1:07 hr/min = 1.0 1:08-1:22 hr/min = 1.25

*denotes a work-related activity ~A squiggly line denotes a weekend day.

Totals

Moderate: ___ Hard:___

Very Hard: ___ Vig (hard+very hard):_____

Version 2

6. Compared to your physical activity over the past three months, was last week's physical activity more, less, or about the same?
1. More 2. Less 3. About the same

7. Do you have a TV in your room?
0. No 1. Yes

INTERVIEWER:
Please answer questions below and note any comments on interview.
8. Were there any problems with the 7-Day PAR interview? 0. No 1. Yes (if yes, please explain)
Explain any problems you had with this interview:

9. Do you think this was a valid 7-Day PAR interview? 0. No 1. Yes

10. Please list below any activities reported by the subject which you don't know how to classify.

11. Please provide any other comments you may have in the space below.

Appendix F

Child Feeding Questionnaire (Parent Form)

INSTRUCTIONS:
Please circle one number for each question which best corresponds to your answer. Please complete a separate form for each child (the first form will be for your oldest child--Child A, 2nd form for the next oldest child, Child B, and 3rd for the youngest child, Child C.

Which child are you completing this questionnaire for? Child A Child B Child C

	Never	Seldom	Half of time	Most of time	Always
1. When your child is at home, how often are you responsible for feeding her/him?	**1**	**2**	**3**	**4**	**5**
2. How often are you responsible for deciding what your child's portion sizes are?	**1**	**2**	**3**	**4**	**5**
3. How often are you responsible for deciding if your child has eaten the right kind of foods?	**1**	**2**	**3**	**4**	**5**

Using the scale below, please indicate how you would classify **your own weight** at **each of these 4 time periods** listed below (Please circle ONLY ONE number for each time period).

	Markedly underweight	Underweight	Average	Overweight	Markedly overweight
4. Your Childhood (5 to 10 years old)	**1**	**2**	**3**	**4**	**5**
5. Your Adolescence	**1**	**2**	**3**	**4**	**5**
6. Your 20's	**1**	**2**	**3**	**4**	**5**
7. Currently	**1**	**2**	**3**	**4**	**5**

Using the scale below, please indicate how you would classify **your child's weight** at **each of these 4 time periods** listed below. (Please circle ONLY ONE number for each time period)

	Markedly underweight	Underweight	Average	Overweight	Markedly overweight
8. Your child during the first year of life	**1**	**2**	**3**	**4**	**5**
9. Your child as a toddler	**1**	**2**	**3**	**4**	**5**
10. Your child as a pre-schooler	**1**	**2**	**3**	**4**	**5**
11. Your child kindergarten through 2nd grade	**1**	**2**	**3**	**4**	**5**
12. Your child 3rd through 5th grade	**1**	**2**	**3**	**4**	**5**
13. Your child from 6th through 8th grade	**1**	**2**	**3**	**4**	**5**

Using the scale below, please circle one number for each question which best corresponds to your answer.

	Unconcerned	Slightly Unconcerned	Neutral	Slightly Concerned	Concerned
14. How concerned are you about your child *eating too much* when you are not around him/her?	**1**	**2**	**3**	**4**	**5**
15. How concerned are you about your child having to diet to maintain a desirable weight?	**1**	**2**	**3**	**4**	**5**
16. How concerned are you about your child becoming overweight?	**1**	**2**	**3**	**4**	**5**

Using the scale below, please circle one number for each question which best corresponds to your answer.

	Disagree	**Slightly Disagree**	**Neutral**	**Slightly Agree**	**Agree**
17. I have to be sure that my child does not eat too many sweets *(candy, ice cream, cake, or pastries).*	**1**	**2**	**3**	**4**	**5**
18. I have to be sure that my child does not eat too many high *fat foods*.	**1**	**2**	**3**	**4**	**5**
19. I have to be sure that my child does not eat too many of her/his favorite foods.	**1**	**2**	**3**	**4**	**5**
20. I intentionally keep some foods out of my child's reach.	**1**	**2**	**3**	**4**	**5**
21. I offer sweets *(candy, ice cream, cake, pastries)* to my child as a reward for good behavior.	**1**	**2**	**3**	**4**	**5**
22. I offer my child his/her *favorite foods* in exchange for good behavior.	**1**	**2**	**3**	**4**	**5**
23. If I did not guide or regulate my child's eating, s/he would eat too many *junk foods.*	**1**	**2**	**3**	**4**	**5**
24. If I did not guide or regulate my child's eating, s/he would eat too much of her/his favorite foods.	**1**	**2**	**3**	**4**	**5**
	Disagree	**Slightly Disagree**	**Neutral**	**Slightly Agree**	**Agree**
25. My child should always eat all of the food on his/her plate.	**1**	**2**	**3**	**4**	**5**

26. I have to be especially careful to make sure my child eats enough.	**1**	**2**	**3**	**4**	**5**
27. If my child says "I'm not hungry," I try to get her/him to eat anyway.	**1**	**2**	**3**	**4**	**5**
28. If I did not guide or regulate my child's eating, s/he would eat much less than s/he should.	**1**	**2**	**3**	**4**	**5**

Using the scale below, please circle one number for each question which best corresponds to your answer.

	Never	**Rarely**	**Sometimes**	**Mostly**	**Always**
29. How much do you keep track of the *sweets (candy, ice cream, cake, pastries)* that your child eats?	**1**	**2**	**3**	**4**	**5**
30. How much do you keep track of the *snack food (potato chips, Doritos, cheese puffs)* that your child eats?	**1**	**2**	**3**	**4**	**5**
31. How much do you keep track of the *high fat foods* that your child eats?	**1**	**2**	**3**	**4**	**5**

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