



Racial Disparities in Obesity Treatment Among Children and Adolescents

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Abstract

Purpose of Review With the growing obesity epidemic among children and adolescents, the evaluation of disease origin to slow disease progression is necessary. Racial disparities which are evident amid prevalence and treatment must be studied to counteract disease propagation.

Recent Findings Disparities are pronounced among Black and Hispanic pediatric patients prior to conception and birth due to genetic composition and fetal environment. Postnatal environment and psychosocial influences can further increase a child/adolescent's propensity to increased weight. Current treatment options including nutrition, physical activity, behavior modification, pharmacotherapy, and surgery are underutilized in communities of color due to limited access to care and cost.

Summary Data is limited to demonstrate disparities among treatment of obesity in children and adolescents. The reviewed studies show the role of race on disease treatment. Increased research efforts, especially in pharmacotherapy and metabolic and bariatric surgery (MBS), will help combat obesity in pediatric communities of color.

Keywords Pediatric/adolescent obesity treatment · Race · Disparities · Lifestyle intervention · Pharmacotherapy · Metabolic and bariatric surgery

Introduction

Obesity in children and adolescents is the most prevalent chronic disease which affects approximately 18.5% of US children age 2-17 years old [1]. Accompanying the increased

rate of obesity is the rising presence of multiple medical conditions including hypertension, type 2 diabetes, and non-alcoholic liver disease. Because a child or adolescent with obesity is 70% more likely to struggle with their weight as an adult [2], it is imperative to diagnose and treat obesity in pediatric patients to prevent progression into adulthood [3, 4].

Obesity disproportionately affects racial minority groups, especially Hispanic and Black children and adolescents [2, 5]. Asian American children and adolescents have the lowest rate of obesity [5]. The most recent National Health and Nutrition Examination (NHANES) survey from 2015-2016 demonstrated the prevalence of class I obesity, defined as body mass index (BMI) greater than 95th percentile but less than the 99th percentile or greater than 30 kg/m² (whichever is lower), was highest among Black females at 25.1% and Hispanic males at 20% in comparison to compared to 13.6% and 14.7% in White females and males, respectively [5]. In addition, the rate of severe obesity, characterized as BMI greater than 99th percentile, is higher among Black and Hispanic children and adolescents [5]. Obesity is a multifactorial disease with many contributing etiologies. This literature review is comprised of the most recent studies found on PubMed

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regarding the origin and management of obesity in children and adolescents. Because racial disparities contribute to the obesity epidemic at all ages, early identification of these inequalities within children and adolescents is imperative to effectively treat obesity.

Risk Factors for Obesity in Children and Adolescents in Racially Diverse Populations

Genetics

While obesity is often found to “run in families,” the specific genes that make a child more at risk for obesity is difficult to ascertain as environment clearly plays a role [6]. Racial disparities in obesity have prompted exploration for the genetic basis of these differences. Genome-wide association studies (GWAS) have found 551 genetic loci associated with obesity, including the most studied loci, FTO (fat mass and obesity related gene) [7]. However, most of the studies are conducted in participants of European descent [8]. Whenever FTO variants were studied in patients of African background or Black, the association with obesity was often not correlated [8]. There are no current studies to evaluate FTO variants in other racial minorities.

The African Ancestry Anthropometric Genetics Consortium (AAAGC) is a GWAS created to identify specific alleles for obesity related traits in those of African descent and to map loci originally associated in those of European ancestry [9]. After three stages of evaluation, less than 20 variants were discovered that are closely related to obesity, including a BMI variant single nucleotide polymorphism (SNP), rs16951275 on chromosome 5 and a *cis*-eQTL variant which is important in regulation of gene expression in subcutaneous and visceral adipose tissue [9]. Other GWAS like the Population Architecture using Genomics and Epidemiology (PAGE) and HiSpanic/Latino Anthropometry (HISLA) Consortium include Hispanic and Latino Americans to determine genetic etiologies of obesity [9]. There are 14 genotyped BMI loci including *ATP2A1*, *COBLL1*, *MAP2K5*, *POC5*, *SLC22A3*, and *TCF7L2* specifically present in Blacks [9]. The SNP, rs76493495 is another BMI variant found in Blacks and Hispanic/Latino Americans [9].

There are currently minimal studies evaluating racial disparities involved with specific monogenetic causes including Prader Willi Syndrome, leptin deficiency, and melanocortin 4 receptor (MC4R) deficiency [6]. However, one study evaluated a cohort of 312 children with severe early-onset obesity of Black or Latino ancestry and showed the prevalence of *MC4R* variants was 2.6 %, comparable to that of studies among children of European ancestry [10]. More investigations are

needed to fully evaluate the genetic causes of obesity in children and adolescents.

Prenatal Factors

Maternal smoking during pregnancy has been associated with increased rates of childhood obesity [11–14]. One Centers for Disease Control and Prevention (CDC) report showed the percentage of self-reported habitual smokers was highest among American Indian/Native Alaskan populations (22.6%) compared to Non-Hispanic White Americans (15.0%) and Non-Hispanic Black Americans (14.6%)[15]. These results are comparable to another study conducted on across racial groups mentioned, as American Indian/Native Alaskan 4 years old were 10% more likely to have obesity [16]. Despite documented differences, women with less than a high school education level have an increased tendency to smoke throughout pregnancy [17].

Multiple studies have shown higher pre-pregnancy BMI and significant gestational weight gain correlates with an increased risk of obesity in children [18–20]. One particular study analyzed data from the Supplemental Nutrition Assistance Program (SNAP) in Wisconsin and found that for every 1 kg/m² increase in pre-pregnancy BMI, there was a 4.5% increase risk of obesity when compared to mothers with normal BMI [21]. Another study showed mothers who underwent Roux-en-Y gastric bypass (RYGB) surgery prior to pregnancy were less likely to deliver a large-for-gestational-age (LGA) child in comparison to mother’s with obesity[22]. LGA neonates are more likely to develop childhood obesity later in development [23–26]. There is minimal evidence to illustrate variation among racial minorities. However, Mehta and colleagues specifically evaluated LGA and the development of childhood obesity among Blacks living in the inner-city; LGA newborns were 2.5 times more likely to have childhood obesity than average size newborns [24].

Perinatal Factors

Research shows that duration of breastfeeding is inversely related to risk of childhood obesity [27]. One study found that infants who were breastfed for more than seven months were significantly less likely to develop overweight or obesity in their adolescence than those who were breastfed for less than 3 months [27]. In fact, breastfed infants were 22% less likely to struggle with obesity compared to those who were not breastfed at all [27]. There is mixed reasoning to explain this causation. While some evidence suggest the greater nutritional density in breast milk, prompts infants to feel more satiated with breast milk than formula, others have shown that the ability and time to breastfeed is indicative of a mother who is in a higher income bracket [27, 28]. The United States Bureau of Labor Statistics reported Black and Hispanic

women made the least amount of money in the USA [29]. Multiple reports have noted non-Hispanic Black children are 20% less likely than White children to be breastfed [30, 31]. Black women are also more likely to introduce formula earlier than other racial groups [32]. However, there is no consistent finding to support early introduction of solid foods is associated with increase prevalence of obesity [33]. More research must be done to conclude any correlation or causation between childhood obesity and introduction to solid foods.

Infancy and Childhood Factors

Nutrition

Intake of sugar-sweetened beverages among school aged children is associated with increased BMI [34, 35]. Multiple studies show an increased consumption of sugar-sweetened beverages among Black and Hispanic children in comparison to White children [35–38]. In addition, several studies demonstrate increased fast food intake among Black and Hispanic children compared to White children [30, 36, 39, 40]. Because higher consumption of fast food is associated with increased portion sizes [41], poor nutritional quality [42], and higher energy density, there is a definite relationship with obesity [43].

Consumption of increased processed foods among Hispanic and Black families from lower income is likely a result of the increased cost of healthier foods [44]. Studies demonstrate that healthy foods with high levels nutritional quality are far more expensive and less affordable than foods that contain added sugars, trans fats, or saturated fats [45]. Food insecurity defined as “having inadequate access to sufficient, safe, and nutritious food to meet dietary needs and food preferences for an active and healthy lifestyle” is also a contributor of increased obesity among children from low income families as there is often limited access to fresh produce and whole grains [46].

Having family meals has been shown to be protective against development of obesity due to higher quality diet in addition to other psychosocial benefits [47]. An investigation by Skala and colleagues examined racial differences in the home food environment among low-income, Black and Hispanic families of preschoolers [48]. Hispanic parents had more family-oriented meals and increased access to fresh fruits and vegetables compared to Black parents who were more likely to restrict and reward with dessert during meals, which is known to contribute to increased obesity prevalence [48].

Behavior

Parenting practices on children’s bedtime have been shown to affect BMI in all racial groups [49]. Nevarez

and colleagues showed that at two years of age, Black, Hispanic, and Asian infants slept fewer hours per day compared to White children [50]. Insufficient sleep in children can be related to several factors including sleeping with a television in the bedroom [36], sleeping near a small screen and having more screen time [51] and a later bedtime routine. Past studies have shown later bedtimes higher levels of television viewing and more television watching in the bedrooms among Black and Hispanic children as compared to White children [52, 53].

Several studies have shown lower levels of physical activity among Black and Hispanic youth compared to White youth [54, 55]. The 5-2-1-0 counseling tool is a nationally recognized pediatric obesity prevention program to promote healthy behaviors around nutrition, physical activity, and screen time in children from birth to 18 years of age [56]. In a cross-sectional national study using the 2011-2012 NHANES data, Haughton and colleagues showed that non-Hispanic Black children were less likely to meet the 5-2-1-0 nutrition and activity targets compared to their non-Hispanic counterparts [56]. Also, Hispanic adolescents were less likely to meet the targets compared to their non-Hispanic White counterparts [56].

Environment

Psychosocial stress including perceived discrimination, parental stress and stigma plays a significant role in obesity prevalence [57]. One study conducted by Heerman and colleagues reviewed survey results from the CDC National Survey of Children’s Health (NSCH) to assess if there was a relationship between adverse family experiences (AFEs) during childhood and the development of adolescent obesity [58]. Children with a history of AFEs were more likely to have overweight or obesity [58]. More specifically, children from age 10-17 years old who experienced greater than 2 AFE have 80% higher odds of obesity [58]. Unfortunately, Heerman and colleagues did not specifically evaluate this finding among children and adolescents of different racial groups.

Childcare arrangements in infancy may also increase risk of obesity in childhood and beyond, though the results are inconclusive [59, 60]. Black and White families are more likely to use a center-based childcare care compared to Hispanic families, who tend to rely on their family for child care responsibilities, particularly in infancy and toddlerhood [61, 62]. Many preschool aged children are not meeting their dietary and physical activity recommendations in a childcare center which could be contributing to obesity [63–66].

Treatment

Nutrition

Nutrition-based interventions include increasing access to fruits and vegetables, limiting intake of sugar-sweetened beverages, minimizing fat content in meals, adjusting nutrition standards in schools, and educating families about healthy nutrition practices [67–69]. Thus far, the efficacy of such treatments has been limited, showing only modest success in reducing BMI and other obesity related factors [67, 68, 70]. Multi-component interventions demonstrate similar results, although research suggests programs with environmental components have the potential to produce larger, long-term changes [68, 71–73]. This evidence emphasizes the need for additional research to determine if nutrition-related treatment options could provide longer-lasting positive health outcomes in children and adolescents with obesity.

Although some nutrition-based interventions have targeted childhood obesity, few have focused on addressing racial disparities. One study, designed for low-income students, implemented a multi-component program in which researchers modified school meals and developed a nutrition education course to evaluate overall health and academic achievement [74]. During the two-year trial, children in the intervention schools were more likely to have higher math score on the Florida Comprehensive Achievement Test and displayed significant weight decreases [74]. These findings emphasize the efficacy of such an approach to prevent obesity among low-income children, many of whom were Black and Hispanic [74].

SNAP, a federal nutrition assistance program, aims to improve dietary quality among its participants, many of whom are racial minorities [75]. Grummon and Taillie used information from the US Homescan Consumer Panel dataset to describe racial disparities in purchase outcomes in SNAP participants and non-participants. Their analysis determined Black individuals, both participants and nonparticipants, which purchased greater amounts of meats, sweeteners, sugar-sweetened beverages, sugar, and sodium. Black SNAP participants purchased more junk food, and SNAP participation in Black households was associated with increased calories purchased [75]. Overall, these data suggest White individuals had better dietary quality than other racial minorities, particularly Black participants. Therefore, SNAP may not alleviate existing racial disparities in dietary behaviors [75]. While this analysis did not directly evaluate dietary patterns in children and adolescents, the SNAP demographic characteristics accounted for household size, suggesting children are indirectly analyzed. Furthermore, studies evaluating food consumption in children and adolescents demonstrate similar trends regarding unhealthy eating habits [76, 77].

The lack of adequate research addressing nutrition paired with the increased risk of developing obesity in racial minorities emphasizes the urgency of identifying effective treatments. Future interventions must consider the myriad of factors that may contribute to unhealthy eating habits seen in racial minorities. For instance, inaccessibility of supermarkets, lack of fruits and vegetables, availability of fast food restaurants, proximity to convenient stores, and neighborhood socioeconomic status are known to contribute to unhealthy eating habits and the onset of childhood obesity [78–81]. By understanding the relationship between these factors, researchers can establish interventions tailored to the specific needs of children and adolescents from varying demographic backgrounds.

Physical Activity

Regular physical activity is known to improve weight status in children, making it a common lifestyle intervention for treating childhood obesity [82, 83]. Programs targeting physical activity aim to decrease sedentary behavior, increase time spent engaging in moderate-to-vigorous physical activity, and educate families about the benefits of staying active [82, 84, 85]. Such interventions are effective, to some extent, in improving body mass index (BMI) and preventing obesity [69, 82, 86, 87]. Increased physical activity is also associated with improved bone health, cardiometabolic health, cognition, and reduced risk of depression in children and adolescents [83]. Thus, treatments addressing physical activity have additional health benefits beyond reducing weight status, further elucidating their usefulness. Although programs evaluating physical activity have demonstrated some efficacy, research suggests a multi-level approach is most beneficial [69, 88, 89]. This method often involves behavior modification alongside education curriculums in which both physical activity and nutrition are targeted.

Considering certain racial minorities have an increased risk of developing childhood obesity [5, 76, 90, 91], it is critical for researchers to develop treatments which can minimize such disparities. Some research has successfully targeted physical activity to treat childhood obesity. However, the number of studies is limited and fail to show consistent or long-term changes in positive health outcomes. One study developed a school-based aerobic exercise program for Black and Hispanic adolescents [92]. After the 12-week intervention, females and males exhibited a decrease in BMI and resting heart rate, although the changes seen in males were not statistically significant [92].

A similar program was designed to analyze the impact of moderate-to-vigorous physical activity on body composition and cardiovascular fitness in Black girls [93]. Results indicated a decrease in percent body fat and BMI in both normal weight and overweight girls [93]. Another study targeted

preschool age Black and Hispanic children for obesity prevention by implementing a multi-level program focused on nutrition and physical activity [94]. Black preschoolers in the intervention group demonstrated significantly smaller relative changes in BMI while Latino preschoolers did not [94, 95]. Based on the results of this study, researchers adjusted their methodology to include a curriculum for parents. At the 1-year follow-up, Latino preschoolers, both in the experimental group and control group, had lower BMI and BMI Z-scores [96]. Despite this, the obesity rate in the study sample was still somewhat higher compared to a nationally representative sample [96]. Although these interventions produced varied results, they illustrate potential benefits of targeting physical activity and implementing health education courses to address obesity in children of racial minorities. Furthermore, they underscore the importance of developing programs tailored to specific demographics that consider cultural differences [94]. Overall, the lack of clinically significant, long-term effects suggests a need for the development of additional treatment options as a way to mitigate the effects of racial disparities in childhood and adolescent obesity.

Behavioral Modification

Behavioral therapy is another mainstay of weight management that includes collaboration between patients and their patient care team including physicians, nurses, and nutritionists. There are different types of behavioral therapy including cognitive behavior therapy (CBT) which encourages children and adolescents to self-regulate their nutrition and physical activity [97]. Within these sessions, patients can expect to modify their behaviors through goal setting, accountability, self-monitoring, stimulus control, problem solving, and meal planning [98].

The Behavioral Choice Treatment (BCT) program is a group-based intervention that helps patients view eating and exercise as a choice [98]. This program has shown significant long-term weight loss within primary care settings and has demonstrated success among Black patients [98].

Weight loss programs that are family-focused are found to have greater success than individualized programs. Studies have shown that family-based weight loss interventions lead to a significant decrease in percent overweight compared to those utilizing the standard of care [99–104] and that family participation and cohesion within Black patients leads to increased weight loss [105]. However, a recent review by Ash and colleagues showed that while Hispanic American families are widely represented in studies evaluating the efficacy of family-based interventions, Black/African-American families are historically underrepresented [106].

Several racial disparities exist in terms of access to behavioral therapy and success within family-based weight loss treatment programs. Behavioral therapy is

most effective when conducted in person for at least fourteen sessions within a 6-month period [98]. However, due to issues with primary care provider (PCP) communication, differences in social class perception, and tendency for making same-day appointments, attending these necessary appointments is difficult for Black and Hispanic families [107]. Further, successful family-based interventions require access to parks and open spaces for maximized weight loss, but Black and Hispanic families have limited access to these resources given their tendency to live within more urban communities. Therefore, although studies have shown promising weight loss success when behavioral modification is utilized, racial lifestyle differences can significantly impact meaningful weight loss within Black and Hispanic communities compared to their White counterparts.

Pharmacotherapy

Pharmacotherapy is an underutilized option in treatment of obesity in children and adolescents with BMI $\geq 95^{\text{th}}$ percentile with a comorbidity or BMI $\geq 120^{\text{th}}$ percentile of 95th percentile [108]. The most commonly prescribed anti-obesity medications (AOMs) in children and adolescents include orlistat, FDA approved in children over 12 years old and phentermine, FDA approved in adolescents over the age of 16 [108]. As of December 2020, Setmelanotide and Liraglutide 3.0 mg are additional medications FDA approved for treatment of obesity in children and adolescents. Other medications, including metformin, phentermine-topiramate, and bupropion-naltrexone, are prescribed for treatment of obesity in children and adolescents off-label.

Pharmacotherapy is underutilized in pediatric populations and, if prescribed, is often only used if care is received within a multidisciplinary obesity care center. This is especially evident among Hispanic and Black children and adolescents who are mainly treated for obesity in a primary care center as referral to advanced level of care is limited. The cost of AOMs is a factor in considering use among patients from lower socioeconomic backgrounds, which disproportionately affects Latino and Black patients. Though a number of private insurance companies cover weight loss medications, only seven states provide coverage through Medicaid: Alabama, North Dakota, South Carolina, South Dakota, Virginia, Wisconsin, and Delaware [109]. In addition, some AOMs including orlistat have been shown to be less effective in Blacks in comparison to Whites [2]. The efficacy of other medications between racial groups has not been studied [2]. Nevertheless, the reason for these weight loss differences remains unclear but must be considered when it comes to optimizing weight loss pharmacotherapy.

Metabolic and Bariatric Surgery

Metabolic and bariatric surgery (MBS), including Roux-en-Y gastric bypass (RYGB) and vertical sleeve gastrectomy (VSG), is the most effective tool available to treat moderate to severe obesity in children and adolescents [110]. Leading medical organizations including the American Academy of Pediatrics (AAP) and the American Society of Metabolic and Bariatric Surgery (ASMBS) support early referral for MBS consideration in patients with a BMI \geq 120% of the 95th percentile with an associated comorbidity or BMI \geq 140% of the 95th percentile [110, 111]. MBS continues to be underused, especially in racial minorities [112].

Nunez Lopez and colleagues conducted a retrospective review of adolescent bariatric surgery using the Bariatric Outcome Longitudinal Database (BOLD). While Black patients have a higher preoperative BMI and are more likely to have hypertension, obstructive sleep apnea, and asthma prior to surgery, there was no statistical difference in weight loss and resolution of comorbidities when comparing Black and White patient population [113]. However, the authors note that minority adolescents are less likely to undergo bariatric surgery [113].

There are many barriers regarding consideration of MBS among children and adolescents with severe obesity. While access to care is multifactorial, race and socioeconomic status are important considerations in regard to insurance authorization for surgery [114]. Just under 50% of pediatric patients who qualify for surgery receive insurance coverage initially following request for authorization [114, 115]. While age less than 18 years old is the most common reason for denial, Perez and colleagues have shown authorization for bariatric surgery is most common among White females with private insurance [115]. Black and Hispanic adolescents with Medicaid are less likely to receive authorization in comparison to their White counterparts [115]. The authors hypothesize, and minorities are less likely to appeal following initial denial [115].

To ensure quality and safety, clinical guidelines recommend bariatric surgery should be performed at a pediatric center approved by through the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) [110]. Unfortunately, there is a lack of these centers throughout the country which contributes to the lack of pediatric providers referring children and adolescents with severe obesity for early surgical consideration. The disproportionate number of centers is even more evident within geographical areas serving minority populations.

Conclusion

Considering the increasing number of Black and Hispanic pediatric patients with obesity and obesity-related conditions,

most recently including COVID-19, there is a growing need to treat obesity early and often to halt disease progression into adulthood. Obesity with its biological origins such as genetic makeup is in turn altered by various environmental conditions both prenatally and throughout one's life. Similar to the adult population, there are clear disparities in the response and utilization of the most effective treatment modalities including pharmacotherapy and bariatric surgery. In order to adequately address the obesity epidemic, there is a need to focus more research efforts specifically on treatment within underserved populations with emphasis in children and adolescents.

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Declarations

Conflict of Interest Veronica R. Johnson, Nonyerem O. Acholonu, Ana C. Dolan, Ashwin Krishnan, Emily Hsu-Chi Wang, and Fatima Cody Stanford declare that they have no conflict of interest.

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