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Racial Disparities in Obesity Treatment

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Abstract

Purpose of Review—Obesity rates in the USA have reached pandemic levels with one third of the population with obesity in 2015–2016 (39.8% of adults and 18.5% of youth). It is a major public health concern, and it is prudent to understand the factors which contribute. Racial and ethnic disparities are pronounced in both the prevalence and treatment of obesity and must be addressed in the efforts to combat obesity.

Recent Findings—Disparities in prevalence of obesity in racial/ethnic minorities are apparent as early as the preschool years and factors including genetics, diet, physical activity, psychological factors, stress, income, and discrimination, among others, must be taken into consideration. A multidisciplinary team optimizes lifestyle and behavioral interventions, pharmacologic therapy, and access to bariatric surgery to develop the most beneficial and equitable treatment plans

Summary—The reviewed studies outline disparities that exist and the impact that race/ethnicity have on disease prevalence and treatment response. Higher prevalence and reduced treatment response to lifestyle, behavior, pharmacotherapy, and surgery, are observed in racial and ethnic minorities. Increased research, diagnosis, and access to treatment in the pediatric and adult populations of racial and ethnic minorities are proposed to combat the burgeoning obesity epidemic and to prevent increasing disparity.

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Compliance with Ethical Standards

Conflicts of Interest Angel S. Byrd, Alexander T. Toth, and Fatima Cody Stanford declare they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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Keywords

Obesity; Overweight; Race; Ethnicity; Genetics; Weight loss medications; Bariatric surgery; Disparities; Socioeconomic status

Introduction

Prevalence and Epidemiology

Obesity is the most prevalent chronic disease and a leading cause of morbidity and mortality in the USA. By definition, obesity in adults is a body mass index (BMI) (calculated as weight (kg) divided by height (m^2)) that is ≥ 30 [1••]. This definition for obesity may soon be changing as BMI has been found to underestimate body fatness in South Asian children and to overestimate body fat composition in African American children [2]. Nevertheless, while further studies are needed to ascertain more suitable BMI criteria to account for racial/ethnic differences, obesity remains a problem and the dramatic increase in obesity over the past 2 decades must be addressed [3]. As of 2015–2016, more than one third of the US population had obesity (39.8% of adults and 18.5% of youth) [4••]. The cost of obesity and health- related diseases was approximately $300 billion dollars in 2009 alone [5•], and rising obesity rates significantly burden the healthcare infrastructure. Self-reported obesity among non-Hispanic and African American adults (2013–2015) was ≥ 35% in more than half of the USA [6].

Because of its multifactorial nature, it is important to carefully consider the factors that lead to the development of obesity, both in the pediatric and adult population, in order to devise the best treatment options and improve outcomes. Approximately 32–50% of children ages 2–19 years old have overweight or obesity in the USA. Obesity prevalence in the 2 to 5 year olds was 10.4% according to the 2007–2008 National Health and Nutrition Examination Survey (NHANES) and has since increased to 13.9% [4••, 7, 8]. The obesity prevalence rate is 14.6% among low-income, preschool children aged 2–4 years old according to the CDC Pediatric Nutrition Surveillance System [9]. Children with overweight or obesity have a higher chance of continued struggles with weight into adolescence and have a 70% chance of having overweight or obesity when adults [10–17].

Racial and ethnic disparities contribute to the childhood obesity epidemic [18•]. Rapid weight gain during infancy has been observed to influence African American children more than white children and predicts increased future health problems in this group [19•]. Similar observations have made it clear that obesity does not impact all groups equally and racial/ethnic differences must be taken into consideration when determining obesity prevalence and treatment strategies. Currently, the most at risk group is non-Hispanic African American women with the National Center for Health Statistics reporting an obesity prevalence of 54.8%, followed by Hispanic women with a prevalence of 50.6% [4••]. Among men, non-Hispanic African Americans are reported to have an obesity prevalence of 36.9% and Hispanics have the highest prevalence at 43.1% [4••], compared to non-Hispanic white and non-Hispanic Asian women and men (38.0, 14.8, 37.9, and 10.2%, respectively) [4••]. Overall rates of obesity are at an all-time high, and there is a growing gap in the prevalence of obesity rates based on race/ethnicity. Obesity in early life is a major predictor of obesity later in life and is compounded by racial and ethnic disparities. Therefore, it is necessary to consider racial and ethnic disparities and factors that contribute to childhood obesity as well as those that perpetuate and cause obesity in adults when considering treatments and interventions to combat the obesity epidemic.

Factors which Contribute to Obesity in Racially and Ethnically Diverse Populations

There are several factors that contribute to both pediatric and adult obesity. Weight status at an early age is a major predictor of overweight and obesity in later life [10–17]. Furthermore, in children less than 10 years old, risk of obesity as an adult among both children with obesity and children without obesity is observed to be doubled when parents struggle with obesity [20]. Evaluating the factors that contribute to the development of obesity at an early age and the roles they play in later life is crucial for developing new treatment approaches and for addressing the racial and ethnic disparities in obesity prevalence. Disparities in prevalence are apparent as early as the preschool years and factors including genetics, diet, physical activity, psychological factors, stress, income, and discrimination, result in higher rates of obesity among Hispanics and non-Hispanic African Americans. Of note, these factors continue to influence weight status throughout adulthood.

Genetics

Disparity in obesity prevalence between different racial/ethnic groups has prompted recent studies to explore genetic differences. Asian populations are known to have the lowest obesity rates while African Americans have the highest. Recent studies show that this disparity may exist because BMI may underestimate adiposity in Asian populations and concomitantly overestimate adiposity in African Americans. More research must be performed to determine the extent to which these differences should be factored into obesity prevalence [21, 22••, 23]. There are substantial genetic influences on BMI that have been observed through the study of identical and fraternal twins, either raised apart or together [24]. These studies have shown that non-genetic social and environmental factors may have less of an influence on obesity than genetics; however, the role of “nurture” vs. “nature” remains controversial. Other studies have shown that population characteristics and environmental contributions may impact obesity heritability [25]. Further research is needed to understand the importance of genetics in obesity while also globally assessing other parameters that impact obesity prevalence.

In addition to heritability, genetic research has focused on the expression of the genes that regulate hormones that control appetite. These hormones include leptin (satiety hormone), ghrelin (appetite stimulating hormone), cholecystokinin (digestion and satiety hormone), and other appetite hormones whose interaction with the body and hippocampus control hunger. For example, desensitization of leptin may explain the inability to control hunger and regulate energy homeostasis, and differences in hormone production, response, and release may explain higher obesity rates in different racial/ethnic groups [26]. A specific pathway where racial differences in hormone production have been discovered is in the production of brain-derived neurotrophic factor (BDNF). BDNF acts as a downstream regulator of the leptin-proopiomelanocortin pathway and lower expression of BDNF in the lower ventromedial hypothalamus has been associated with higher levels of adiposity and increased BMI in pediatric and adult patients [27]. The hypothalamic expression of BDNF is thought to be affected by single nucleotide polymorphisms (SNP) in the intronic region of the gene locus for BDNF [27]. Mou found that the minor allele rs12291063 CC genotype is significantly associated with lower levels of certain BDNF transcripts and as such is associated with lower expression of BDNF. Minor allele frequency of rs12291063 has previously been found to be higher in African Americans than in Caucasian cohorts, and Mou and colleagues evaluated the prevalence of this allele in African American and Hispanic cohorts and found the number of C alleles to be both significantly higher and also positively associated with increased BMI [27]. Chen G recently found further evidence that points to the role genes may play in differences in obesity prevalence based on race/ ethnicity. Their group evaluated samples from 1411 West Africans as well as samples from 9020 African Americans and found that samples from participants with obesity had higher levels of protein SEMA4D in serum samples and that elevated levels of serum SEMA4D were associated with a much higher risk for obesity [28••]. The group also found that carriers of the SEMA4D C allele were 4.6 BMI units heavier than those with the T allele [28••], and it is notable that among people of European and Asian descent, the SEMA4D protein is mono-morphic for the Tallele which highlights the importance genes may play in obesity prevalence. According to the National Health Interview Survey, foreign born men and women have a lower likelihood of obesity than those born in the USA.

While differences in genes may help explain disparities in obesity among different racial and ethnic groups, gene expression does not occur independently from the environment. When considering socioeconomic status (SES) in childhood obesity, hormone oxytocin (OT) receptor polymorphisms may contribute to obesity. Bush found that there was a positive correlation with children who were carriers of the A allele of the OXTR gene and BMI and adiposity when children were raised in low SES environments. When raised in high SES environments, lower BMIs were observed. The obesity risk for children with the GG genotype was not influenced by SES [29]. Similarly, the National Health Interview Survey (1997—2005) found that foreign born men and women from Africa have a lower likelihood of obesity than African American’s born in the USA [30]. It is evident that health outcomes can be affected by certain genetic predispositions, but there is also an interplay between genetics and environmental factors [29].

Diet

Diet is one of the major contributors in the development of obesity. From birth, issues like infant breast feeding and the age of introduction of solid foods, intake of sugar-sweetened beverages, and fast-food consumption as well as the content of family meals all impact the prevalence of obesity. African American and Hispanic children are much more likely to be exposed to lower quality diets. More African American and Hispanic children consume sugar-sweetened beverages and fast food by the age of 2 years old compared to other racial/ ethnic groups [31]. Lower SES of many racial and ethnic minorities is a major contributor to suboptimal diets and is associated with the consumption of calorically dense foods with less nutritional value, including those high in saturated fats and hydrogenated or partially hydrogenated oils compared to more balanced diets consisting of healthier options like fresh fruits and vegetables and lean proteins, which are more likely to be consumed by members of wealthier SES [32–34].

Factors during pregnancy, infancy, and early childhood may also play a role in the racial and ethnic disparities seen in obesity prevalence as well as response to treatment. Pregnant African American and Hispanic women are more likely to already have overweight and obesity when compared with white women. Additionally, Hispanic women have a higher risk for gestational diabetes [35•, 36•, 37]. After birth, dietary habits and attitudes from childhood are largely controlled by parental food choices. Choices of less nutritious dietary options among adult Hispanic and African American parents as well as non-parents from less wealthy SES are not a result of lack of knowledge about healthy foods but instead the perception of the cost of healthy foods [38]. Indeed, this perception is not necessarily incorrect. Foods purchased in stores that are higher in nutrients associated with decreased risk for chronic disease, such as those high in dietary fiber, vitamins A, C, D, E and B-12, beta carotene, folate, iron, calcium, potassium, and magnesium often cost more than foods with nutrients high in trans fats, saturated fats, and added sugar [39]. However, diets consisting mainly of prepared foods purchased from convenience stores and fast-food chains as opposed to those purchased from whole food stores are on average more expensive [40]. These estimates of food cost do not take into account problems, such as food deserts, lack of access to stores with healthy food, as well as the effort and time that purchasing and preparing healthy food may take: all factors that may contribute to poor diet both in adults and children from low SES.

Physical Activity

Increased physical activity and access to resources decreases the risk of childhood obesity. [41, 42] Members of lower SES tend to have less access to opportunities to engage in organized sports and are less likely to have the means to pursue other recreational physical activities. However, when resources are provided, physical activity has been observed to increase. In lower income neighborhoods, in which children have access to playgrounds, lower BMI has been noted in males and females compared to children with similar SES who do not have playground access [43•].

Psychosocial Factors

The impact of psychosocial factors, such as deprivation, trauma, and neglect has been considered, but more studies are needed to draw conclusions regarding impact on obesity [44]. Factors including stress, income, sleep, and racism have been associated with obesity. In response to increased stress, leptin induces pro-oxidation and increased synthesis of pro-inflammatory cytokines and inflammatory mediators, such as interleukin 6 (IL-6) and C-reactive protein (CRP), respectively. There are reported correlations between childhood obesity and increased IL-6 and CRP levels. In adults, increased leptin is associated with increased CRP concentrations [45, 46]. Adiponectin is needed for its anti-inflammatory effects and it contributes to homeostasis and prevents oxidative stress. Reports have shown decreased levels of adiponectin in individuals with obesity [47, 48]. In pre-pubertal boys, there is a reported increase and negative association with anti-oxidation, suggesting a link between aseptic inflammation and oxidative stress and childhood obesity [49]. It has also been shown that parent stressors impact childhood obesity and African American and Hispanic children raised in single-parent households and children from low-income families were at major risk of partaking in activities, such as fast-food consumption at rates that were correlated with parent stressors [34].

Early adolescent racial/ethnic minorities with overweight or obesity are more likely to engage in harmful eating habits and weight control behaviors [50]. Compared to white children, African American, Hispanic, and Asian children sleep less at all age periods, with the most sleep deprivation noted between the ages of 6 months to 7 years old. Factors including living in noisier environments, being exposed to stress and violence, children sleeping with parents and/or siblings, sub- par bedding, inconsistent bedtime routines, and early exposure to TV are all factors that may explain decreased sleep among disadvantaged children [51]. Lower obesity risk has been associated with childhood and adolescent healthy sleep patterns [52]. Therefore, decreased sleep quality in racial/ethnic minorities may be another underlying cause of increased obesity.

From 2003 to 2007, there was a 23–33% increase in childhood obesity in low education and income households as well as higher unemployed households [53]. There is less recognition of weight concerns in low-income families resulting in decreased efforts to intervene with healthy lifestyle modifications [54]. There is a greater likelihood that non-Hispanic African American men and women underestimate BMI [55]. As income decreases in women in the USA, obesity rates increase. Yet, higher income does not always correlate with lower obesity levels. At higher income and education levels, non-Hispanic African American and Mexican American men have higher rates of obesity when compared to those with lower income and education levels [9]. Therefore, obesity does not always discriminate along the socioeconomic spectrum as might be expected.

The Black Women's Health Study suggests that African American women experience racism more than Whites, which may contribute to increased prevalence of obesity in African American women. There are also fewer supermarkets with fresh produce options, fewer recreational options, and more fast-food chains in African American neighborhoods when compared to white neighborhoods with similar SES [56••].

Treatment

The aforementioned factors must be taken into consideration when choosing the most suitable treatment options for obesity. When obesity is diagnosed, management varies based on the treatment facility, but the standard of care for the treatment of obesity is made up of three main components: behavioral lifestyle interventions, pharmacologic therapy, and bariatric surgery. These three components make up the backbone of a combined multidisciplinary team, particularly in specialty weight treatment clinics at major academic medical centers.

Behavioral Lifestyle Intervention—The first-line treatment for obesity is lifestyle modification with additional behavioral therapy, generally overseen by a physician and often includes a reduced-calorie diet with lean protein fruit and vegetables, increased physical activity, and limiting screen time [57]. Behavioral treatment therapies increase adherence to lifestyle modification programs [58] and are often incorporated into intensive lifestyle intervention programs [59]. Lifestyle intervention programs are often more successful when they involve more visits at a higher frequency [60] Average weight loss from these programs is somewhere between 8 and 10% weight loss depending on how long the program lasts [59, 61]. Recent research trials have attempted to augment standard lifestyle and behavioral treatment programs to cater to diverse populations by adding contextually specific treatment, which includes individual health coaching and the linking of families to neighborhood/community resources. However, so far, these programs have failed to show statistically significant differences from normal behavioral therapy and lifestyle interventions [62]. This result seems to remain true for racial/ethnic minorities. One clinical trial tailored an evidence-based behavioral weight loss program to African American women in the rural south by adding community-based strategies to support healthy lifestyles, but the trial did not show a difference between the standard tailored program versus the program with the addition of community strategies [63•]. Information on the impact of behavioral therapy in specific racial/ethnic groups is limited as race specific results are often underreported. A narrative review of large randomized prospective clinical trials on the outcomes of standard behavioral treatments for weight loss found that the majority of studies reviewed from 2001 to 2015 met or exceeded enrollment of African Americans based on population estimates in the USA, but less than half of reported outcomes analyzed race [64]. It was also found that at 6 months of standard behavioral therapy for weight loss, African American participants consistently lost less weight than white participants [64].

Nevertheless, behavioral modification is important even if it appears less effective in certain populations and should be initiated from an early age. Behavioral strategies which support and reinforce healthy dietary and physical activity behaviors are helpful to prevent pediatric obesity, and these are particularly important in low-income and ethnic minority children because levels of physical inactivity and harmful dietary patterns are often more pronounced in African Americans and Hispanics since concurrent elevated levels of type 2 diabetes and other comorbidities are observed in these populations to the point that overall life expectancy is reduced [65, 66]. Family-based behavioral treatments, where parents with overweight and obesity are treated alongside their children, provide superior results to treatment of parent and child treated separately. The effect of child attendance to weight management programs may play a negligible effect on weight loss as both parent and child, and parent only therapy, have been shown to yield similar weight loss in both parents and their children [67, 68]. Unfortunately, even if these treatment options are able to help families pursue lifestyle changes, these changes may be harder for racial and ethnic minorities to implement. Non-Hispanic African Americans and Hispanics are more likely to face food insecurity, which makes it much harder to adhere to lifestyle suggestions regarding diet and may play a role in findings that minorities lose less weight than white patients in behavioral lifestyle intervention treatments [69].

Weight Loss Medications

The use of medications to treat obesity is another cornerstone in obesity treatment. Recent studies have posited that combining lifestyle modification with long-term pharmacotherapy may maximize weight loss [61]. Obesity medications that are currently FDA-approved include orlistat, topiramate/phentermine, lorcaserin, bupropion/naltrexone, and liraglutide [70]. New medications and therapies are being developed. One potential target for drug development is brown fat, which has the potential to activate thermogenesis through the uncoupling of the electron transport chain from ATP production, which results in the dissipation of energy as heat and increased caloric burn [71]. Research has shown that pharmacotherapy results can range from very substantial weight loss to modest or no weight loss [72]. The FDA and medical community have been slow to adopt the use of current weight loss medications secondary to a history of harmful medications and their use in the past, such as Fen-Phen, a previously approved combination of fenfluramine and phentermine, which was widely prescribed and caused pulmonary hypertension and heart valvulopathy [73]. Nevertheless, the obesity epidemic necessitates the ongoing consideration of the medical community to consider the proper use of pharmacotherapy in the treatment of obesity. It has been shown that patients have a range ofresponses to pharmacotherapy and this may be influenced by race/ethnicity. Metformin is a widely used first-line drug for diabetes treatment. In African Americans and Whites, metformin has been shown to cause a significant increase in HDL-C levels, but it has not been shown to have this same effect in Hispanics [74•]. This result suggests that African Americans and Whites are possibly more responsive than Hispanics to metformin use and that racial and ethnic identity is a factor that should be considered when evaluating weight loss medications and pharmacotherapy [74•]. There is limited data available on race and ethnicity and response to weight loss medications, but sibutramine, another medication that has been withdrawn from the market, was reported to produce greater weight loss in Whites than in African American patients. Additionally, orlistat was associated with higher weight loss in Whites than in African Americans. In lorcaserin, Whites lost significantly more weight than both African Americans and Hispanics but when placebo-adjusted weight loss was reported the differences in weight loss closed substantially [75]. The research is therefore mixed on the subject of how much race and ethnicity play a role in response to weight loss medications and further research is needed. Nevertheless, pharmacotherapy remains a useful tool in weight loss therapies for patients with obesity and should be studied by the medical community to overcome any doubts triggered by the less than perfect history of previous medications.

Weight Loss Surgery

Of all treatment modalities, weight loss surgery is the most effective treatment for moderate to severe obesity, which leads to durable weight loss and to resolution of comorbidities including type 2 diabetes, hypertension, obstructive sleep apnea, non-alcoholic fatty liver disease, and obesity related infertility [76–80]. While most studies demonstrate that racial and ethnic minorities respond to weight loss surgery with less weight loss, there is still a significant benefit conferred to individuals who proceed with weight loss surgery regardless of racial/ ethnic status.

Research has shown that men are less likely than women, and African Americans are less likely than Whites, to have considered bariatric surgery [81], while data on other racial and ethnic groups is lacking. Men and African Americans may be less likely to consider bariatric surgery because men and African Americans generally report higher quality of life scores relative to their BMI [82]. African Americans are often, less likely diagnosed with obesity, and therefore less likely to be referred to weight loss surgery centers. It may also be possible that African American men are less likely to perceive their excess weight as problematic due to societal norms. Excess weight seems to influence African Americans' and men's views about themselves and their lives less than other groups and is perhaps due to differing societal ideals and pressures regarding weight among different race and ethnic backgrounds and among different gender identities. Research has also shown that while Hispanics and African Americans are less likely to proceed with surgery than Whites these racial differences are largely dissipated when research is adjusted for socioeconomic factors, indicating that the determinants of who receives surgery may be socioeconomic rather than racially/ethnically determined [83••]. Obesity is more prevalent among middle-aged, rural, economically disadvantaged, and racial and ethnic minority populations; these groups have much more limited access to bariatric surgery, which is due to a combination of rural location as well as Medicare/Medicaid policies surrounding the reimbursement of solely high volume bariatric surgery centers that are located in urban centers [84]. While racial and ethnic differences are related to access and utilization of surgery, it appears that socioeconomic factors and societal norms may play the largest roles in disparities in who receives bariatric surgery.

While socioeconomic factors and racial and ethnic differences may intertwine to influence access to bariatric surgery, it appears that the effect of surgery on obesity co-morbidity resolution may not be influenced by race and ethnicity, especially in the remission of type II diabetes where bariatric surgery leads to high remission across all racial and ethnic groups [85•, 86]. It is important, however, to note that in a retrospective study, Istfan N. found that all racial and ethnic groups had a decrease in hemoglobin A1c after Roux-en-Y gastric bypass, but there was a significant increase in the hemoglobin A1c levels of African Americans at 2 year follow-up, while these levels remained stable in Hispanic and white patients [87••].

Race and ethnicity have also been explored in the context of weight loss response to bariatric surgery. Studies have shown that non-Hispanic White adults report better weight loss after bariatric surgery than non-Hispanic African Americans and Hispanics [88]. Conversely, in a 2014 study by Coleman and Brookey of 840 Roux-en-Y gastric bypass patients, non-Hispanic African American men had significantly better weight loss compared to non-Hispanic white men after adjusting for weight at time of surgery, demographics, and self-reported health and behavior [89]. To further complicate the issue, Khorgami and colleagues demonstrated that in a geographic area where Hispanics were the majority, weight loss up to 2 years after Roux-en-Y gastric bypass surgery was similar among non-Hispanic Whites and Hispanics both of whom had significantly better weight loss than non- Hispanic African Americans [88]. Race and ethnicity seem to have less of an influence in adolescent surgical patients. In the Bariatric Outcomes Longitudinal Database, which followed 827 adolescents who underwent weight loss surgery, the mean estimated weight loss for all ethnic groups differed by a maximum of only 1.5 kg [86]. Surgery type may have an influence on whether or not race and ethnicity are determinants of weight loss as evidenced by work done by Coleman KJ and colleagues who created a registry system, which was used to track the progress of both Roux-en-y gastric bypass and sleeve gastrectomy patients. The Roux-en-y gastric bypass group differed significantly by race and ethnicity with regards to excess body weight loss. White patients lost significantly more excess body weight than non-Hispanic African American and Hispanic patients and no difference in percent of excess weight loss was observed based on racial and ethnic group in patients who underwent a sleeve gastrectomy [90]. Currently, there is a general consensus among the medical community that African Americans and Hispanics lose less weight than Whites in response to weight loss surgery, but there is evidence that factors, such as community composition, majority or minority status, surgery type, sex, and age, all may be important influencers of weight loss differences between racial and ethnic groups. In addition to differences in weight loss results following bariatric surgery among different racial and ethnic groups, there have also been differences observed in mortality and complications faced after bariatric surgery. The American College of Surgeons National Surgical Quality Improvement Program study from 2005 to 2007 found that African Americans were 2.5 times more likely to suffer pulmonary emboli, Hispanic patients were close to four times more likely to suffer postoperative acute renal failure, and both American Indians/Alaskan natives and Hispanics required postoperative transfusions at higher rates than other racial and ethnic groups [91].

Conclusion

While studies generally show that without adjustment or without novel populations, weight loss therapies are less effective in racial and ethnic minorities; it is important to recognize that these disparities may be by-products of the different negative factors and challenges faced by minority populations. Weight loss surgery still remains the most effective treatment for patients with moderate to severe obesity and should be used when appropriate in conjunction with lifestyle modification and pharmacotherapy. It is important to diagnose obesity in racial and ethnic minority groups, due to the higher likelihood of obesity, and we should ensure access to evidence-based treatment modalities as we combat societal roadblocks and inequalities, which make it more challenging for racial and ethnic minorities to benefit from care for their obesity.

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