Published in final edited form as:

Pediatr Obes. 2021 October ; 16(10): e12792. doi:10.1111/ijpo.12792.

Racial and Socioeconomic Disparities in the Efficacy of a Family-based Treatment Program for Pediatric Obesity

Genevieve M. Davison¹, Lauren A. Fowler¹, Melissa Ramel¹, Richard I. Stein², Rachel P.K. Conlon³, Brian E. Saelens⁴, R. Robinson Welch¹, Michael G. Perri⁵, Leonard H. Epstein⁶, Denise E. Wilfley¹

¹Department of Psychiatry, Washington University School of Medicine, Mail stop 8134-29-2100, 660 S. Euclid, St. Louis, MO 63110, USA;

²Department of Medicine, Washington University School of Medicine, Campus Box 8031, 507 S. Euclid, St. Louis, MO 63110,

³Department of Psychiatry, University of Pittsburgh, 3811 O'Hara St., Pittsburgh, PA 15213, USA;

⁴Department of Pediatrics, University of Washington and Seattle Children's Research Institute, Seattle, WA, 2001 Eighth Ave., Suite 400, Seattle, WA 98121, USA;

⁵Department of Clinical & Health Psychology, University of Florida, PO Box 100185, Gainesville, FL 32610, USA;

⁶Department of Pediatrics, Division of Behavioral Medicine, University at Buffalo Jacobs School of Medicine and Biomedical Sciences, 3435 Main Street, Buffalo, NY 14214, USA;

Abstract

Background: Family-based behavioral weight loss treatment (FBT) is an evidence-based intervention for pediatric overweight/obesity (OV/OB), but little research has examined the relative efficacy of FBT across socioeconomic status (SES), and racial groups.

Method: 172 youth (7–11 y; 61.6% female; 70.1% White, 15.7% Black; child percent OV=64.2±25.2; 14.5% low-income) completed 4 months of FBT and 8 months of additional intervention (either active social facilitation-based weight management or an education control condition). Parents reported family income, social status (Barratt Simplified Measure of Social Status), and child race at baseline. Household income was dichotomized into < or > 50% of the area median family income. Race was classified into White, Black, or Other/multi-race. Treatment efficacy was assessed by change in child % OV (BMI % above median BMI for age and sex) and change in child BMI % of 95th percentile (BMI % of the 95th percentile of weight for age and sex). Latent change score models examined differences in weight change between 0–4 months, 4–12 months, and 0–12 months by income, social status, and race.

Contact Info: Genevieve M. Davison, Mail stop 8134-29-2100, 660 S Euclid, St. Louis, MO 63110, genevieve.davison@wustl.edu.

Author contributions. G.M.D. proposed study hypotheses. L.A.F., R.I.S., B.E.S., R.P.K.C., and D.E.W. guided analytic plan and interpretation. G.M.D. conducted final statistical analyses and drafted the initial manuscript. L.A.F., M.R., R.I.S., B.E.S., R.P.K.C., D.E.W., and L.H.E. assisted with manuscript review and editing. All authors read and approved the final manuscript and are personally accountable for the accuracy of the manuscript.

Results: Black children had, on average, less weight loss by 4 months compared to White children. Low-income was associated with less weight loss at 4 months when assessed independent of race. No differences by race, social status, or income were detected from 4–12-months or from 0–12 months.

Conclusions: FBT is effective at producing child weight loss across different SES and racial groups, but more work is needed to understand observed differences in initial efficacy and optimize treatment across all groups.

Keywords

childhood obesity; family-based treatment; health disparities; weight loss; race; income

Introduction

Recent estimates suggest that rates of overweight (OV) and obesity (OB) remain high among youth in the United States. Indeed, data from 2015 to 2016 indicate approximately 35.1% of youth aged 2–19 had OV or OB.¹ Pediatric OV/OB is associated with increased risk of poor health², including physical health problems such as asthma³, insulin resistance⁴, and coronary heart disease⁵, and worse mental health and psychosocial outcomes.^{2,6} Overweight and obesity are also associated with increased risk of disordered eating in youth.⁷

While overall rates of OV/OB are high in American youth, there are also notable racial and ethnic disparities in the prevalence of OV/OB. African American and Hispanic youth have higher rates of both OV and OB relative to White and Asian American youth.¹ Indeed, rates of severe obesity (defined as BMI ≥ 120% of the 95th percentile for age and sex) are 3 times higher among African American youth than White youth.¹ Socioeconomic status (SES) is also associated with different rates of OV/OB in children. Socioeconomic status can broadly be defined as an individual, family or group's position within a social hierarchy and their level of access to resources.⁸ It is usually assessed through some combination of income, education, and/or perceived occupational prestige (e.g., physician vs. day laborer).⁹ One study found that kindergarten-aged children in the lowest quintile of SES (as measured by parental education, occupation, and family income) were 70% more likely to have OV or OB compared to children in the highest quintile.¹⁰

Several factors may contribute to these disparities. Both non-white populations and those who are of low SES experience disproportionately greater stress than do those who are white or of higher SES.^{11,12} In turn, increased levels of stress are associated with higher prevalence of obesity and obesity-related comorbidity via the impact of stress on both physiology and behavior.¹³ Neighborhood environmental factors may also play a role in these disparities. Research suggests that low-SES groups and individuals of color in the U.S. are more likely to live in “food deserts” (neighborhoods with reduced access to grocery stores selling affordable, healthy food) and “food swamps” (neighborhoods with a higher density of fast food restaurants and convenience stores) compared to high-SES and White individuals.¹⁴ Living in “food deserts” and “food swamps” has been found to be associated with higher rates of childhood OV/OB, possibly due to decreased availability of healthy foods and increased availability of highly palatable, calorically dense foods.^{15,16}

Minority children and lower-SES children also experience disparities in access to physical activity facilities and participation in youth sports.^{17,18} Finally, in the U.S. context, systemic racism, both mediated by differences in SES and independently, has been identified as an important driver of health disparities via factors such as access to healthcare, neighborhood quality, and economic opportunity.¹⁹

Given increased rates of OV/OB among racial minority and low-SES youth, and their exposure to obesogenic environments, it is important that we understand how treatments for obesity may differentially impact these populations. At present, family-based treatment (FBT) for pediatric obesity is considered a first line behavioral treatment²⁰ and has demonstrated long-lasting weight loss in both children and parents.²¹ However, previous research focusing on FBT for pediatric obesity has found that demographic factors including child race and family income predict higher program drop-out and lower attendance.²² A 2017 review of other behavioral treatments for pediatric obesity (including non-family-based treatments) found that Black households and households with lower incomes had higher dropout rates and lower program engagement respectively.²³ The literature on behavioral weight loss treatments in adults has also found that on average, Black participants lose less weight than do White participants.²⁴

Work exploring the relation between demographics and FBT outcomes is limited. A recent analysis of the impact of race/ethnicity on treatment outcomes in FBT for pediatric obesity did not find evidence of differences between racial/ethnic minority children and White children in terms of weight loss or changes in energy intake or physical activity.²⁵ However, this study did not examine Black children specifically, and the association between SES and treatment outcomes in FBT for pediatric obesity is not commonly assessed. The American Psychological Association has specifically cited lack of outcome data by race and SES as a key gap in the accumulated literature on the effectiveness of behavioral treatments for pediatric obesity.²⁶

Thus, the present study seeks to examine whether race and SES are related to treatment outcomes among children enrolled in FBT and an accompanying maintenance intervention. The study also assesses the association of race and SES with attendance and attrition in FBT. Determining the degree to which FBT is effective in helping groups at increased risk for OV/OB lose weight will both inform treatment recommendations and provide future direction for treatment development. This study uses data from a randomized clinical trial testing the dose and content of social facilitation maintenance interventions on weight loss following 4 months of FBT.²⁷

Methods¹

Participants

Participants were children aged 7–11 years who had OV/OB based on a body mass index (BMI; weight in kilograms/height in meters²) greater than or equal to the 85th percentile for their age and sex and at least one parent whose BMI was greater than or equal

¹For detailed methods and procedures of the larger trial, see Wilfley et al., 2017.

to 25. Participants were recruited through media, advertisements, and provider referrals. Parent-child dyads participated at university-based clinics in St. Louis, Missouri and Seattle, Washington. At the time the study was conducted, 73.3% of the Seattle Metropolitan Area and 76.9% of the St. Louis Metropolitan Area were identified as White²⁸, while the median family income in these regions was \$85,600 and \$68,300, respectively.²⁹ Parents and children were excluded if either was participating in a different weight loss program, was using any medications that might affect weight, or had a psychiatric or medical condition that would interfere with their ability to participate. Parents and children provided written informed consent and assent, respectively. The institutional review boards at Seattle's Children's Hospital and Washington University School of Medicine approved the study (HRPO# 08-1014).

Procedures

From 0–4 months, parent-child dyads (n=241) participated in FBT. Following FBT, the 172 dyads who completed FBT and wished to continue with the study were randomized into two Social Facilitation Maintenance (SFM) conditions (months 4–12): a HIGH SFM condition (32 weekly sessions over 16 weeks), a LOW SFM condition (16 biweekly sessions over 32 weeks), and a CONTROL condition matched in dose/frequency with LOW SFM. The present study assesses weight status changes from baseline to 4 months (immediately post-FBT), from 4 to 12 months (maintenance phase), and from baseline to 12 months.

Family-Based Behavioral Weight Loss Treatment

FBT included sixteen, 30-minute individual family sessions each week as well as 45-minute separate parent and child group sessions. This treatment addresses health behavior change in parents and children through standard behavior change techniques such as reinforcement, stimulus control, preplanning, and parenting techniques.^{21,30} Modifications to the family's eating were facilitated by the Traffic Light Plan²¹, which categorizes foods as GREEN (GO), YELLOW (CAUTION), or RED (STOP) according to their nutrient density and energy and fat/sugar content. GREEN foods (mostly non-starchy vegetables and other nutritious low-calorie foods) have high nutrient density and low-fat content, while RED foods have low nutrient density and/or high fat, sugar, and/or calorie content. Parents and children were encouraged to limit their RED food intake and increase their GREEN food intake while also sticking to a calorie budget, increasing their physical activity, and decreasing sedentary behaviors.

SFM Interventions

Social facilitation maintenance HIGH and LOW conditions were similar in content, but the LOW group met every other week for 32 weeks (16 sessions total), while the HIGH group met weekly for 32 weeks. Both groups received content in 30-minute family sessions as well as 45-minute separate parent and child group sessions. These sessions focused on helping parents and children create a social and physical environment across all facets of their lives that was conducive to healthy behaviors and successful weight management. The goal was to help them generalize skills and tools learned during FBT to school, work, and home environments. The SFM intervention also focused on new content around helping youth and

caregivers navigate negative peer interactions such as bullying or teasing and emphasized building supportive social environments with family and peers.

Control Condition

The CONTROL condition was a weight management education only intervention (16, every other week sessions) in which parents and children received additional information about nutrition and physical activity and participated in hands-on activities such as cooking and shopping demos. The use of skills taught in FBT was not discussed.

Interventionist Training and Supervision

Interventionists were required to have bachelor's degrees or higher and were trained in program implementation prior to beginning treatment delivery. Families were randomly assigned to interventionists during both FBT and maintenance. Preparation for all interventionists consisted of protocol meetings to review program materials and problem solve program delivery issues as well as weekly supervision and monthly cross-site supervision calls.

Measures

Demographic variables were assessed at baseline through parent report, including parent and child race, ethnicity, age, and sex, parental occupation (and their own parents' occupations), household income, and highest level of education attained by the participating parent. Racial and ethnic categories corresponded to the National Institute of Health's (NIH) category definitions³¹ and included American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and White. Ethnicity included "Hispanic or Latino" and "Not Hispanic or Latino." The present study grouped child races as White (parent reported child was White only), Black (parent reported child was Black or African American only), and Other (all other racial categories and children of more than one race). Due to statistical power constraints, the study did not examine the impact of child ethnicity, and children identified as Hispanic were only categorized by race.

Socioeconomic status was assessed using two measures: the Barratt Simplified Measure of Social Status (BSMSS)³² and family income. The BSMSS is based on an individual's, their spouse's, and their parents' education and occupation. Those with more education and more prestigious occupations and those whose spouses and parents have more education and more prestigious occupations are assigned higher scores. BSMSS scores range from 8–66 with higher scores indicating higher social status (SS).

Family annual income was self-reported by the parent via 11 income categories. Categories 1–10 were in \$10,000 increments, while category 11 was >\$100,000. Families' income was analyzed by converting each category to the mid-point of the range (e.g., a family with category 1 (\$0 to \$10,000) would be converted to \$5,000). Family income was then compared to the Area Median Family Income (AMI)²⁹ for their metropolitan area and year in the study as defined by the U.S. Department of Housing and Urban Development (HUD) (\$85,600 for Seattle, \$68,300 for St. Louis). Family income was dichotomized such that

those with incomes below 50% of the area median were categorized as low-income based on HUD's definition of very low-income.³³

BMI for parents and children was calculated from measured weight (via calibrated electronic scales to the nearest 0.1 kg) and height (via stadiometer to the nearest 0.1 cm). Centers for Disease Control and Prevention norms from 2000³⁴ were used to determine child percentage overweight (child % OV; percentage that the child's BMI was above the median for their age and sex). Child % OV was chosen due to its sensitivity to change across a wide range of BMIs³⁵; a 9-unit change in child % OV was considered clinically significant.²⁷ Child BMI % of the 95th percentile (child's BMI as a % of the 95th percentile of weight for their age and sex) was also included as an outcome measure. This measure, which is increasingly popular within the pediatric obesity literature^{36,37}, was chosen to facilitate comparisons across studies.

Statistical Analyses

Bivariate analyses of participant demographics and raw change scores between baseline and post-FBT, between post-FBT and post-maintenance, and between baseline and post-maintenance were conducted using t-tests, Chi-square tests, and ANOVAs as appropriate. Tukey's HSD tests were used following significant ANOVA results. For purposes of comparison of raw change scores, social status was split at the median. Chi-square and t-tests were also used to assess the association between participant demographics and drop-out from FBT. Linear regression was used to assess the association between participant demographics and number of FBT sessions attended.

We used latent change score (LCS) modeling, a class of structural equation modeling³⁸, to evaluate the association of social status, income, and race with change in child % OV and child BMI % of 95th percentile following FBT and after the maintenance intervention phase. Compared to more traditional approaches, such as repeated measures ANOVA, this approach better accounts for the error structure in longitudinal data as well as individual differences in change.³⁸ A nested modeling approach (which added predictors of interest to the model one at a time) was used to construct a three-time point model examining change in child % OV and child BMI % of 95th percentile from baseline to post-FBT and from post-FBT to post-maintenance as well as a two-time point model examining change from baseline to post-maintenance. In this framework, observed variables—e.g., child % OV at baseline, post-FBT, and post-maintenance—were used to model change in child % OV. This approach also allowed us to control for baseline child % OV by incorporating it into the model. Maintenance condition was also included as a covariate. Social status, which was continuous, was standardized to allow for ease of comparison to race and dichotomized income-status variables. Models were fit using maximum likelihood estimation and full information maximum likelihood. All analyses were conducted using R (R Core Team: 2018) and the lavaan library.³⁹

Results

Participant Demographics

Table 1 describes the baseline characteristics of the sample. Of the 241 parent-child dyads that began FBT, 56 dropped out before completing the 16-week program, and an additional 13 were not randomized to maintenance intervention conditions. Of the 172 children who were randomized following FBT, the average age was 9.4 (SD=1.3) years, 61.6% were female, 70.1% were White, 15.7% were Black, and 13.4% were identified as another or multiple races. Average SS as assessed by the BSMSS was 44.0 (SD=10.2), 14.5% of participants had family income that was less than 50% of AMI, average baseline child % OV was 64.2 (SD=25.2), and average child BMI % of 95th percentile was 122.3 (SD=18.8). Relative to the demographics of the study's two sites, White participants may have been slightly underrepresented (70.1% vs 73.3% and 76.9% in the Seattle and St. Louis Metropolitan Regions). However, given documented racial disparities in the prevalence of overweight and obesity, White participants may have been slightly *overrepresented* relative to the overall population of children in the U.S. with overweight or obesity. Based on NHANES data corresponding to the study year¹, approximately 67.0% of U.S. children with overweight or obesity were White. Additionally, the study's sample may have skewed higher income. The median income of the 172 families randomized to FBT was \$85,000, close to the AMI of Seattle (\$85,600), but higher than the AMI for St. Louis (\$68,300). Social status was associated with study drop-out such that participants who stayed in treatment and were randomized to maintenance conditions had parents with slightly higher social status compared to participants who were not randomized to maintenance conditions (44.0 [SD=10.2] vs. 40.6 [SD=10.3], $p=0.024$). However, there were no demographics differences between those who completed four months of FBT and those who did not, and there were no other demographic differences among those who continued with the randomized maintenance phase of the study and those who did not continue. Similarly, there were no demographic differences in number of FBT sessions attended. Of the 241 families who enrolled in FBT, the average number of sessions attended was 11.7 (SD=4.9). Of the 172 families who continued to the maintenance phase of the study, the average number of FBT sessions attended was 14.3 (SD=1.7).

Bivariate Comparisons

Of the 172 children enrolled in maintenance interventions, children from households with <50% AMI had higher baseline % OV (78.1 [SD=29.5] vs. 61.9 [SD=23.8], $p=0.014$), lower SS (37.8 [SD=8.9] vs. 44.9 [SD=10.1], $p=0.001$) and were more likely to be non-White ($\chi^2(2)=30.99$, $p<0.001$) compared to children from households with ≥50% AMI. Compared to Black children and children of other races, White children had higher SS (45.6 [SD=9.6] vs. 40.1 [SD=10.5] and 40.0 [SD=11.6], $p=0.006$). Patterns of baseline characteristics were similar for the 241 children initially enrolled in FBT. See Table 2.

Table 3 presents a comparison of unadjusted mean difference scores between baseline and post-FBT and between post-FBT and post-maintenance across income and racial groups and between children with high and low social status (median split). On average, between baseline and post-FBT, children from households with ≥50% AMI had greater decreases

in child % OV compared to children from households with <50% AMI (−14.1 [SD=8.0] vs. −9.9 [SD=8.0], $p=0.022$). White children also had greater decreases in child % OV compared to Black children or children of other races (−14.5 [SD=8.2] vs. −10.8 [SD=6.6] and −10.5 [SD=8.1], $p=0.018$). Social status was not associated with differences in change in child % OV, and no income, race, or social status differences in % OV change were found between post-FBT and post-maintenance. Between baseline and post-maintenance, trend-level differences for change in child % OV were detected between White children and Black children or children of other races (−16.4 [SD=14.0] vs. −12.0 [SD=11.5] and −12.1 [SD=13.1], $p=0.092$). No other demographic differences in change in child % OV were found between baseline and post-maintenance. Similar patterns were observed among the 241 children enrolled in FBT. On average, children in this group saw a −13.1 unit decrease in % OV (SD=8.2). Children from households with ≥50% AMI had greater decreases in child % OV compared to children from households with <50% AMI (−13.9 [SD=7.9] vs. −8.9 [SD=8.3], $p=0.004$). White children also had greater decreases in child % OV compared to Black children or children of other races (−14.2 [SD=8.3] vs. −10.2 [SD=7.1] and −10.5 [SD=8.1], $p=0.015$). No differences were observed with respect to social status.

Similar patterns were also observed for child BMI % of 95th percentile. Between baseline and post-FBT, children from households with ≥50% AMI had greater decreases in child BMI % of 95th percentile compared to children from households with <50% AMI as did White children compared to Black children and children of other races. Table 3 presents unadjusted mean change scores for change in child BMI % of 95th percentile across race, income, and social status.

Latent Change Score Models

Results from the three-time point LCS model assessing the association of social status, income, and race with change in child % OV between baseline and post-FBT and between post-FBT and post-maintenance intervention are summarized in Table 4. In the full model, child % OV decreased on average by 13.1 (SE=1.5, $p<0.001$) units between baseline and post-FBT. The average change between post-FBT and post-maintenance, controlling for treatment condition, was non-significant (+1.0, SE=2.4, $p=0.66$). Child race was associated with differences in change in child % OV such that Black children had a decrease of 3.3 fewer % OV units compared to White children (SE=1.5, $p=0.031$) between baseline and FBT. No demographic factors were significantly associated with differences in the change between post-FBT and post-maintenance intervention. In models 1 and 2, which did not include race, income was significantly associated with differences in the change in child % OV between baseline and post-FBT (4.7, SE=1.8, $p=0.009$ in model 1 and 4.9, SE=1.8, $p=0.006$ in model 2). SS, which was coded continuously, was not significantly associated with differences in any model. Baseline child % OV was not associated with change at either time point in any of the three models. Similar results were found for change in child BMI % of 95th percentile. In the full model, between baseline and post-FBT, Black children displayed less weight loss compared to White children, and in models 1 and 2, income was significantly associated with differences in change. No demographic differences were found across the maintenance phase of the study. These results are summarized in Table 5.

Results from the two-time point LCS model assessing the association of social status, income, and race with change in child % OV between baseline and post-maintenance intervention are summarized in Table 6. In the full model, child % OV decreased on average by 12.9 (SE=2.9, $p<0.001$) units between baseline and post-maintenance. Income, SS, race, and baseline child % OV were not significantly associated with change in child % OV in any baseline to post-maintenance model. Results using child BMI % of 95th percentile as an outcome measure are again similar with respect to income, SS, race, and baseline weight status. These results are summarized in Table 7.

Fit statistics for the full three- and two-time point LCS models modeling change in child % OV (see Tables 4 and 6) suggest relatively poor model fit (model $X^2(15)=244.63$, $p<0.000$, root mean square error of approximation (RMSEA)=0.298, comparative fit index (CFI)=0.713, standardized root mean squared residual (SRMR)=0.251 and model $X^2(12)=232.96$, $p<0.000$, RMSEA=0.327, CFI=0.121, SRMR=0.272 respectively). However, the purpose of the present analysis is to assess the impact of income, SS, and race on change in child % OV rather than to generate an explanatory model. Therefore, we consider the model acceptable for the present study. Indeed, an analysis of model fit suggests that although some demographic variables may be associated with differences in change in % OV, overall, they explain relatively little of the overall variance in change scores. Fit statistics for the two models assessing change in child BMI % of 95th percentile were similar to those assessing change in child % OV (see Tables 5 and 7).

Discussion

The results of this study suggest that there are some demographic differences in FBT treatment outcomes for pediatric obesity. Specifically, Black children showed less change in weight status during four months of FBT compared to White children and low-income was associated with less weight loss when not controlling for race. The observed differences in weight change between groups were not large (about 3 units) and on average all groups achieved clinically significant relative weight loss, with no differences between groups detected during the maintenance phase of the study. When overall change between the beginning of the study and the end of the maintenance phase was assessed, no demographic variables remained significant when controlling for maintenance treatment group. With regard to drop-out, only social status was associated with decreased likelihood of continuing with the maintenance phase of the study after FBT, and this difference was relatively small. No demographic differences predicted study adherence as measured by number of FBT sessions attended. However, these results suggest that FBT, particularly when delivered over a short time period, may require adaptation, perhaps in content, delivery, format, or other aspects, in order to better serve Black children and families.

Interestingly, although social status differed by income and race, social status was not associated with differences in weight change. In contrast, when assessed apart from race and controlling for SS, income was quite strongly associated with both change in child % OV and change in child BMI % of 95th percentile following FBT. Socioeconomic status is a multifaceted construct typically understood as a combination of one's economic resources, education, and occupation.⁸ Measures like the BSMSS, which is based on an individual's,

their spouse's, and their parents' education and occupation do not directly capture the current financial or social resources available to that individual or their household. It is possible that a child's family's immediate economic circumstances, particularly low-income status, have a greater impact on their program outcomes than do their parent's social status.

While income was not associated with weight change when controlling for race, it should be noted that the present study contained a very small number of low-income, White participants making true effects of income difficult to detect. It is possible that a lack of financial resources makes it difficult for families to adhere to program goals. For example, families may face cost barriers when meal planning or grocery shopping. It is also possible that effects of income are cognitively and/or emotionally mediated. Previous research on FBT has found that behavioral economics factors such as delay discounting (i.e. the discounting of future rewards relative to more immediate rewards) blunt the effects of FBT⁴⁰ while research into the effects of poverty suggests that it can lead to deficits in this type of self-regulatory behavior⁴¹ as well as impede cognitive function more generally.⁴² Parents and children in low-income families may therefore experience difficulties with the self-regulation required to adhere to specific diet and physical activity goals. Poverty is also associated worse mental health in children⁴¹ and there is some evidence that suggests that psychopathology may be associated with worse obesity treatment outcomes for children with OV/OB.⁴³ It is also worth noting that the families who participated in the present study were somewhat higher income than families from their surrounding regions. It is possible that there are important income-based differences in motivation or ability to participate in programs like FBT that influenced study participation.

The substantial correlation observed in this sample between income and race, and the small size of these demographic groups, make drawing firm conclusions about independent effects difficult. Future research using a larger, and more socioeconomically and racially diverse sample, including socioeconomic diversity within racial groups, would allow for important comparisons including testing interactions between race and SES. For example, it is possible that although the current study did not find evidence for large disparities in treatment outcomes, the effect of being both low-income and non-White would be larger than the effect of belonging to either category alone. A more diverse large sample would also allow for more adequately powered racial comparisons. For example, evidence suggests that the prevalence of OV and OB among Asian American children is similar to or lower than the prevalence found in White children whereas Native American or Alaska Native and Native Hawaiian or Pacific Islander children experience higher rates of OV and OB.¹ Collapsing these groups into a single "other" category along with children of more than one race likely obscures important differences. Similarly, we were underpowered to examine differences by ethnicity between Hispanic and non-Hispanic participants. Given disparities in rates of obesity between Hispanic and non-Hispanic youth, examining whether and how ethnicity is associated with differential weight and health behavior change independent and/or interactively with race, income, and other factors is an important area of inquiry. Future research may also benefit from additional measures of SES. Beyond family income and aggregate measures of education and occupation, researchers in child development and health disparities have documented the importance factors such as accumulated wealth, income volatility, and human capital in the holistic assessment of SES.^{8,44}

The results of this study speak to the need to improve initial treatment for non-White families and children. Reviews of interventions for obesity in African American and other children of color suggest that FBT possesses several aspects consistent with preferences and strengths of these populations. Specifically, interventions (like FBT) that involve caregivers/parents, contain multiple components, and integrate goal-setting and lifestyle change were found to be most successful in non-White youth.^{45,46} Indeed, the results of the present study suggest that FBT shows similar retention among Black, White, and children of other and multiple races. However, literature reviews suggest that behavioral interventions should include more culturally and racially relevant materials and find that programs that emphasize enjoyment produce better results. An analysis of participants' subjective experience in FBT, with emphasis on their enjoyment and perception of the program's cultural appropriateness, may provide direction for further adaptation and optimization.

Attempts to optimize FBT for non-White families may also wish to explore other elements of FBT including the racial concordance and cultural competency of interventionists, as well as ways to mitigate the impact of racism and related stress that may make health behavior change more difficult. Future iterations of FBT should also consider the context in which children and families live and consider how factors such as neighborhood food environment or neighborhood safety affect treatment participation and outcomes. Finally, duration and dose of FBT may be a relevant consideration. Our previous research has indicated that both duration³⁰ and dose²⁷ of FBT and maintenance interventions have an impact on outcomes in general. In the context of demographic differences, although racial differences were detected in child weight change over four months of FBT, differences by race were not detected across the maintenance intervention phase or ultimately from baseline to the end of treatment contact. It is possible that children and families of color particularly benefit from more time in treatment. It is also possible that the maintenance interventions themselves (SFM HIGH and SFM LOW) produced additional benefits for these demographic subgroups.

Strengths and Limitations

To our knowledge, this is one of only a few studies to examine the impact of SES (specifically SS and income) on treatment outcomes in FBT for pediatric obesity as well as one of only a few to look at outcomes in Black children separate from other non-White children. The design of the study also allowed us to separate the effects of race, income, and SS on treatment outcomes.

However, the small percentage of low-income and non-White participants, and the overlap in these samples (i.e., higher percentage of lower-income families were non-white), and corresponding low statistical power, make it difficult to draw firm conclusions or thoroughly explore interactions between SS, income, and race. Future research should also explore the possible interaction of maintenance interventions and income and race. The social facilitation conditions targeted factors that may be salient to the groups under study including the social and physical environment and may also need to be adapted for these groups (e.g., the importance of social contact with extended family members).

Conclusions

This study found evidence that the effects of FBT for pediatric obesity on child % OV and child BMI % of 95th percentile may be attenuated for Black children, but that these differences are relatively small and short-lived. Income and social status were not associated with differences in change in child weight, although an effect of income was present when not controlling for race. Further research using larger and more racially and socioeconomically diverse samples is needed to explore possible interactions between SS, income, and race. More work may also be needed to optimize FBT for children of color, particularly Black children.

Acknowledgements.

We would like to acknowledge the contributions of Washington University in St. Louis faculty members Joshua Jackson and Desiree White who served on G.M.D.'s masters committee for which an initial draft of this manuscript was prepared and offered their guidance and feedback.

Funding.

This research was funded by the National Institute of Child Health and Human Development (NICHD) (grant R01HD036904 to D.E.W.); National Institute of Mental Health (grant K24MH070446 to D.E.W.); National Center for Research Resources (NCRR) (grants KL2RR024994 [R.I.S.], UL1RR024992, and UL1RR025014); National Heart, Lung, and Blood Institute (grant T32HL130357 [G.M.D.]); the NIDDK Nutrition Obesity Research Center (grant P30DK056341); National Center for Advancing Translational Sciences (University of Washington Clinical and Translational Science Award) of the National Institutes of Health (grants UL1TR000448 and UL1TR000423); St. Louis Children's Hospital Foundation (Washington University Pediatric and Adolescent Ambulatory Research Consortium); and institutional support from Washington University School of Medicine and Seattle Children's Research Institute.

Conflicts of interest.

G.M.D. reports grants from NHLBI, National Institutes of Health, during the conduct of the study. L.A.F. reports grants from NICHD, National Institutes of Health, and grants from NHLBI, National Institutes of Health, during the conduct of the study. R.I.S. reports grants from NIH/NICHD, during the conduct of the study; and grants from PCORI, outside the submitted work. M.G.P. reports grants from NIH, during the conduct of the study. D.E.W. reports grants from NIH, during the conduct of the study; personal fees from Weight Watchers, personal fees from Sunovion, and personal fees from Center for Children's Healthy Lifestyles & Nutrition, outside the submitted work.

References

1. Skinner AC, Ravanbakht SN, Skelton JA, Perrin EM, Armstrong SC. Prevalence of obesity and severe obesity in US children, 1999–2016. *Pediatrics*. 2018;141(3). doi:10.1542/peds.2017-3459
2. Halfon N, Larson K, Slusser W. Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of us children aged 10 to 17. *Acad Pediatr*. 2013;13(1):6–13. doi:10.1016/j.acap.2012.10.007 [PubMed: 23200634]
3. Visness CM, London SJ, Daniels JL, et al. Association of childhood obesity with atopic and nonatopic asthma: Results from the National Health and Nutrition Examination Survey 1999–2006. *J Asthma*. 2010;47(7):822–829. doi:10.3109/02770903.2010.489388 [PubMed: 20707763]
4. Steinberger J, Moorehead C, Katch V, Rocchini AP. Relationship between insulin resistance and abnormal lipid profile in obese adolescents. *J Pediatr*. 1995;126(5):690–695. doi:10.1016/S0022-3476(95)70394-2 [PubMed: 7751990]
5. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics*. 1999;103(6):1175–1182. doi:10.1542/peds.103.6.1175 [PubMed: 10353925]

6. Strauss RS. Childhood obesity and self-esteem. *Pediatrics*. 2000;105(1):e15–e15. doi:10.1542/peds.105.1.e15 [PubMed: 10617752]
7. Goldschmidt AB, Aspen VP, Sinton MM, Tanofsky-Kraff M, Wilfley DE. Disordered eating attitudes and behaviors in overweight youth. *Obesity*. 2008;16(2):257–264. doi:10.1038/oby.2007.48 [PubMed: 18239631]
8. Shavers VL. Measurement of socioeconomic status in health disparities research. *J Natl Med Assoc*. 2007;99(9):1013–1023. doi:10.13016/avw3-9cvx [PubMed: 17913111]
9. Bradley RH, Corwyn RF. Socioeconomic Status and Child Development. *Annu Rev Psychol*. 2002;53(1):371–399. doi:10.1146/annurev.psych.53.100901.135233 [PubMed: 11752490]
10. Williams AS, Ge B, Petroski G, Kruse RL, McElroy JA, Koopman RJ. Socioeconomic status and other factors associated with childhood obesity. *J Am Board Fam Med*. 2018;31(4):514–521. doi:10.3122/jabfm.2018.04.170261 [PubMed: 29986976]
11. Hayes JA, Chun-Kennedy C, Edens A, Locke BD. Do double minority students face double jeopardy? Testing minority stress theory. *J Coll Couns*. 2011;14(2):117–126. doi:10.1002/j.2161-1882.2011.tb00267.x
12. Vliegenthart J, Noppe G, van Rossum EFC, Koper JW, Raat H, van den Akker ELT. Socioeconomic status in children is associated with hair cortisol levels as a biological measure of chronic stress. *Psychoneuroendocrinology*. 2016;65:9–14. doi:10.1016/j.psyneuen.2015.11.022 [PubMed: 26708067]
13. Rand CSW, Kulda JM. Stress and obesity. *Stress Med*. 1985;1(2):117–125. doi:10.1002/smi.2460010208
14. Block JP, Scribner RA, Desalvo KB. Fast food, race/ethnicity, and income: A geographic analysis. *Am J Prev Med*. 2004;27(3):211–217. doi:10.1016/j.amepre.2004.06.007 [PubMed: 15450633]
15. Schafft KA, Jensen EB, Hinrichs CC. Food Deserts and Overweight Schoolchildren: Evidence from Pennsylvania*. *Rural Sociol*. 2009;74(2):153–177. doi:10.1111/j.1549-0831.2009.tb00387.x
16. Hager ER, Cockerham A, O'Reilly N, et al. Food swamps and food deserts in Baltimore City, MD, USA: Associations with dietary behaviours among urban adolescent girls. *Public Health Nutr*. 2017;20(14):2598–2607. doi:10.1017/S1368980016002123 [PubMed: 27652511]
17. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics*. 2006;117(2):417–424. doi:10.1542/peds.2005-0058 [PubMed: 16452361]
18. Hyde ET, Omura JD, Fulton JE, Lee SM, Piercy KL, Carlson SA. Disparities in Youth Sports Participation in the U.S., 2017–2018. *Am J Prev Med*. 2020. doi:10.1016/j.amepre.2020.05.011
19. Phelan JC, Link BG. Is Racism a Fundamental Cause of Inequalities in Health? *Annu Rev Sociol*. 2015;41(1):311–330. doi:10.1146/annurev-soc-073014-112305
20. Coppock JH, Ridolfi DR, Hayes JF, St. Paul M, Wilfley DE. Current Approaches to the Management of Pediatric Overweight and Obesity. *Curr Treat Options Cardiovasc Med*. 2014;16(11):1–15. doi:10.1007/s11936-014-0343-0
21. Epstein LH, Paluch RA, Roemmich JN, Beecher MD. Family-Based Obesity Treatment, Then and Now: Twenty-Five Years of Pediatric Obesity Treatment. *Heal Psychol*. 2007;26(4):381–391. doi:10.1037/0278-6133.26.4.381
22. Williams NA, Coday M, Somes G, Tylavsky FA, Richey PA, Hare M. Risk factors for poor attendance in a family-based pediatric obesity intervention program for young children. *J Dev Behav Pediatr*. 2010;31(9):705–712. doi:10.1097/DBP.0b013e3181f17b1c [PubMed: 21057255]
23. Ligthart KAM, Buitendijk L, Koes BW, van Middelkoop M. The association between ethnicity, socioeconomic status and compliance to pediatric weight-management interventions – A systematic review. *Obes Res Clin Pract*. 2017;11(5). doi:10.1016/j.orcp.2016.04.001
24. Goode RW, Styn MA, Mendez DD, Gary-Webb TL. African Americans in Standard Behavioral Treatment for Obesity, 2001–2015: What Have We Learned? *West J Nurs Res*. 2017;39(8):1045–1069. doi:10.1177/0193945917692115 [PubMed: 28322668]
25. Eichen DM, Rhee KE, Strong DR, Boutelle KN. Impact of Race and Ethnicity on Weight-Loss Outcomes in Pediatric Family-Based Obesity Treatment. *J Racial Ethn Heal Disparities*. 2020;1–7. doi:10.1007/s40615-019-00694-6

26. Summary of the clinical practice guideline for multicomponent behavioral treatment of obesity and overweight in children and adolescents. *Am Psychol.* 2020;75(2):178–188. doi:10.1037/amp0000530 [PubMed: 32052993]
27. Wilfley DE, Saelens BE, Stein RI, et al. Dose, content, and mediators of family-based treatment for childhood obesity: a multisite randomized clinical trial. *JAMA Pediatr.* 2017;171(12):1151–1159. doi:10.1001/jamapediatrics.2017.2960 [PubMed: 29084318]
28. US Census Bureau. United States Census, 2010. United States Census 2010.
29. U.S. Department of Housing and Urban Development. Income Limits. <https://www.huduser.gov/portal/datasets/il.html#2009>. Published 2009. Accessed August 3, 2020.
30. Wilfley DE, Stein RI, Saelens BE, et al. Efficacy of maintenance treatment approaches for childhood overweight: A randomized controlled trial. *J Am Med Assoc.* 2007;298(14):1661–1673. doi:10.1001/jama.298.14.1661
31. NIH. Race and Ethnic Categories and Definitions for NIH Diversity Programs and for Other Reporting Purposes NOT-OD-15–089. National Institutes of Health. <https://grants.nih.gov/grants/guide/notice-files/not-od-15-089.html>. Published 2015. Accessed June 28, 2020.
32. Barratt W. The Baratt simplified measure of social status (BSMSS).
33. U.S. Department of Housing and Urban Development. Transmittal of Fiscal Year (FY) 1998 Public Housing/Section 8 Income Limits. <https://www.huduser.gov/portal/datasets/il/fmr98/sect8.html>. Published 1998. Accessed August 3, 2020.
34. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Adv Data.* 2000;(314):1–27.
35. Paluch RA, Epstein LH, Roemmich JN. Comparison of methods to evaluate changes in relative body mass index in pediatric weight control. *Am J Hum Biol.* 2007;19(4):487–494. doi:10.1002/ajhb.20608 [PubMed: 17546615]
36. Gulati AK, Kaplan DW, Daniels SR. Clinical tracking of severely obese children: A new growth chart. *Pediatrics.* 2012;130(6):1136–1140. doi:10.1542/peds.2012-0596 [PubMed: 23129082]
37. Kelly AS, Barlow SE, Rao G, et al. Severe obesity in children and adolescents: Identification, associated health risks, and treatment approaches: A scientific statement from the American Heart Association. *Circulation.* 2013;128(15):1689–1712. doi:10.1161/CIR.0b013e3182a5cfb3 [PubMed: 24016455]
38. Kievit RA, Brandmaier AM, Ziegler G, et al. Developmental cognitive neuroscience using latent change score models: A tutorial and applications. *Dev Cogn Neurosci.* 2018;33:99–117. doi:10.1016/j.dcn.2017.11.007 [PubMed: 29325701]
39. Rosseel Y. Lavaan: An R Package for Structural Equation Modeling and More Version 0.5–12 (BETA).; 2012. <http://cran.r-project.org/>. Accessed February 23, 2020.
40. Best JR, Theim KR, Gredysa DM, et al. Behavioral economic predictors of overweight children's weight loss. *J Consult Clin Psychol.* 2012;80(6):1086–1096. doi:10.1037/a0029827 [PubMed: 22924332]
41. Evans GW, English K. The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Dev.* 2002;73(4):1238–1248. doi:10.1111/1467-8624.00469 [PubMed: 12146745]
42. Mani A, Mullainathan S, Shafir E, Zhao J. Poverty impedes cognitive function. *Science (80-).* 2013;341(6149):976–980. doi:10.1126/science.1238041
43. Braet C, Beyers W. Subtyping Children and Adolescents Who Are Overweight: Different Symptomatology and Treatment Outcomes. *J Consult Clin Psychol.* 2009;77(5):814–824. doi:10.1037/a0016304 [PubMed: 19803562]
44. Duncan GJ, Magnuson KA. Off with hollingshead: Socioeconomic resources, parenting, and child development. In: *Socioeconomic Status, Parenting, and Child Development* ; 2014:83–106. doi:10.4324/9781410607027-11
45. Ickes MJ, Sharma M. A review of childhood obesity prevention interventions targeting African American children. *Vulnerable Child Youth Stud.* 2011;6(2):103–123. doi:10.1080/17450128.2011.564227
46. Seo DC, Sa J. A Meta-Analysis of Obesity Interventions Among U.S. Minority Children. *J Adolesc Heal.* 2010;46(4):309–323. doi:10.1016/j.jadohealth.2009.11.202

Table 1.**Participant Demographics**

	Enrolled in FBT	Randomized to Maintenance Interventions
Characteristic	% or Mean (SD)	
Child Age	9.4 (1.3)	9.4 (1.3)
Child % Female	62.7	61.6
Annual Income		
\$0–50,000	28.2	24.4
\$50,001–100,000	38.2	38.3
>\$100,000	32.0	36.6
<50% Area Median Income	16.2	14.5
Social Status	43.0 (10.3)	44.0 (10.2)
Hispanic (any race)	10.4	11.0
Child race		
White	71.8	70.1
Black	15.4	15.7
Other	12.9	13.4
Asian	0.8	1.2
American Indian or Alaska Native	0.0	0.0
Native Hawaiian or Pacific Islander	0.4	0.6
More Than One Race	11.2	11.2
Unknown/Not reported	0.4	0.6
Baseline Child % OV	66.0 (26.1)	64.2 (25.2)
Baseline Child BMI % of 95 th percentile	123.6 (19.4)	122.3 (18.8)
Observations	241	172

OV=Overweight, BMI=Body Mass Index

Table 2.

Baseline Sample Characteristics, by Income and Race

	<50 % AMI	50 % AMI	White	Black	Other
% or Mean (SD)					
Enrolled in FBT, N=241					
Baseline Child % OV	75.0 [*] (26.6)	64.2 (25.9)	63.8 [*] (27.1)	76.6 (22.7)	65.3 (20.8)
Race					
White	38.5 ^{***}	78.3	100.0	0.0	0.0
Black	35.9 ^{***}	11.1	0.0	100.0	0.0
Other	25.6 ^{***}	10.6	0.0	0.0	100.0
Child's Age	9.3 (1.4)	9.5 (1.3)	9.4 (1.2)	9.8 (1.5)	9.0 (1.5)
Child % Female	66.7	61.6	59.5	75.7	64.5
Social Status	36.6 ^{***} (9.1)	44.2 (10.1)	44.3 ^{**} (9.8)	39.5 (10.6)	40.1 (11.7)
Observations	39	198	173	37	31
Randomized to Main. Interventions, N=172					
Baseline Child % OV	78.1 ^{**} (29.5)	61.9 (23.8)	62.0 (27.0)	71.0 (18.6)	67.6 (20.9)
Race					
White	24.0 ^{***}	78.9	100.0	0.0	0.0
Black	40.0 ^{***}	11.6	0.0	100.0	0.0
Other	36.0 ^{***}	6.2	0.0	0.0	100.0
Child's Age	9.3 (1.5)	9.5 (1.3)	9.4 (1.2)	9.8 (1.4)	9.0 (1.4)
Child % Female	64.0	60.96	60.66	70.37	56.52
Social Status	37.8 ^{***} (8.9)	44.9 (10.1)	45.6 ^{**} (9.6)	40.1 (10.5)	40.0 (11.6)
Observations	25	146	122	27	23

Comparisons between <50 % AMI and 50% AMI made via t-test and chi-square test, comparisons between racial groups made via ANOVA and chi-square test as appropriate. OV=Overweight, AMI=Area Median Income.

*
p<0.05,

**
p<0.01,

p<0.001.

Table 3.

Change in Child % Overweight and Child BMI % of 95th Percentile Over Study Period, by Income, Social Status, and Race

	Baseline Child % OV	Child % OV Baseline to Post-FBT	Child % OV Post-FBT to Post-Maintenance	Child % OV Baseline to Post-Maintenance
	Mean (SD)			
Full Sample	64.2 (25.2)	-13.4 (8.1)	-1.5 (9.3)	-15.1 (13.7)
Income				
<50 % AMI	78.1 (29.5)	-9.9* (8.0)	-1.8 (10.5)	-12.1 (14.0)
50 % AMI	61.9 (23.8)	-14.1 (8.0)	-1.4 (9.2)	-15.7 (13.6)
Social Status				
<Median	69.4 (27.3)	-13.4 (8.2)	-1.6 (10.0)	-15.4 (14.0)
Median	59.0 (22.0)	-13.4 (8.0)	-1.4 (8.8)	-14.8 (13.4)
Race				
White	62.0 (27.0)	-14.5* (8.2)	-1.6 (9.4)	-16.4 [†] (14.0)
Black	71.0 (18.6)	-10.8 (6.6)	-1.2 (8.8)	-12.0 (11.5)
Other	67.6 (20.9)	-10.5 (8.1)	-1.2 (10.1)	-12.1 (13.1)
	Baseline Child % of 95 th	Child % of 95 th Baseline to Post-FBT	Child % of 95 th Post-FBT to Post-Maintenance	Child % of 95 th Baseline to Post-Maintenance
	Mean (SD)			
Full Sample	122.3 (18.8)	-10.6 (6.1)	-2.1 (6.9)	-12.8 (10.1)
Income				
<50 % AMI	133.3 (23.3)	-8.2* (6.1)	-2.5 (7.9)	-11.0 (10.6)
50 % AMI	120.5 (17.3)	-11.0 (6.0)	-2.0 (6.8)	-13.2 (10.1)
Social Status				
<Median	125.9 (20.7)	-10.6 (6.1)	-2.0 (6.6)	-12.6 (14.0)
Median	118.7 (16.0)	-10.6 (6.1)	-2.2 (7.3)	-13.0 (13.4)
Race				
White	120.6 (19.9)	-11.4* (6.1)	-2.1 (7.0)	-13.7 (10.4)
Black	126.5 (14.2)	-8.5 (4.9)	-1.9 (6.6)	-10.4 (8.6)
Other	126.2 (16.4)	-8.5 (6.2)	-2.1 (7.3)	-10.9 (10.4)

Comparisons between <50 % AMI and 50% AMI, <Median and Median Social Status made via t-test, comparisons between racial groups made via ANOVA. BMI=Body Mass Index, OV=Overweight, AMI=Area Median Income.

[†]p<0.10,

*p<0.05. N=172.

Table 4.

Predictors of Change in Child % Overweight, Conditional Latent Change Score Model, Baseline to Post-FBT, and Post-FBT to Post-Maintenance

	Model 1	Model 2	Model 3
Post-FBT			
Baseline Child % OV	−0.031 (0.022)	−0.027 (0.023)	−0.027 (0.023)
<50% AMI (Ref.= 50% AMI)	4.678 ** (1.793)	4.901 ** (1.783)	3.172 † (1.886)
Social Status		0.482 (0.571)	0.707 (0.579)
Race (Ref.=White)			
Black			3.293 * (1.526)
Other			3.448 † (1.952)
Post-Maintenance			
Baseline Child % OV	0.021 (0.031)	0.018 (0.033)	0.019 (0.032)
Treatment Condition (Ref.=Control)			
SFM LOW	−3.687 ** (1.777)	−3.700 ** (1.776)	−3.725 * (1.774)
SFM HIGH	−7.412 *** (1.676)	−7.456 *** (1.682)	−7.508 *** (1.675)
<50% AMI (Ref.= 50% AMI)	−0.816 (1.964)	−0.913 (2.013)	−1.381 (2.299)
Social Status		−0.226 (0.733)	−0.135 (0.753)
Race (Ref.=White)			
Black			0.798 (1.855)
Other			1.229 (2.334)
Intercepts			
Baseline Child % OV	64.151 *** (1.917)	64.151 *** (1.917)	64.151 *** (1.917)
Child % OV Post-FBT	−12.063 *** (1.380)	−12.384 *** (1.446)	−13.093 *** (1.457)
Child % OV Post-Maintenance	−1.067 (2.273)	1.270 (2.402)	1.041 (2.366)
Model Fit Statistics			
Chi-square	221.028 ***	233.634 ***	244.610 ***
RMSEA	0.370	0.343	0.298
CFI	0.733	0.722	0.713
SRMR	0.295	0.270	0.251
R ²			
Child % OV Post-FBT	0.058	0.057	0.106
Child % OV Post-Maint.	0.240	0.241	0.231

This table presents the results of a nested conditional latent change score model, in which the change in Child % OV between baseline and post-FBT and between post-FBT and post-maintenance is predicted by baseline Child % OV, treatment condition (for post-FBT to post-maintenance), <50% AMI, social status, and race. Standard errors in parentheses. OV=Overweight, AMI=Area Median Income, RMSEA=Root Mean Square Error of Approximation, CFI=Comparative Fit Index, SRMR=Standardized Root Mean Square Residual. N=172;

† p < 0.10,

* p < 0.05,

** p < 0.01,

 $p < 0.001$.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 5.

Predictors of Change in Child BMI % of 95th Percentile, Conditional Latent Change Score Model, Baseline to Post-FBT, and Post-FBT to Post-Maintenance

	Model 1	Model 2	Model 3
Post-FBT			
Baseline Child % 95 th Percentile	−0.045 [†] (0.023)	−0.041 [†] (0.024)	−0.041 [†] (0.024)
<50% AMI (Ref.= 50% AMI)	3.439 [*] (1.360)	3.570 ^{**} (1.350)	2.230 (1.426)
Social Status		0.300 (0.425)	0.474 (0.431)
Race (Ref.=White)			
Black			2.641 [*] (1.128)
Other			2.583 [†] (1.480)
Post-Maintenance			
Baseline Child % 95 th Percentile	0.009 (0.032)	0.006 (0.033)	0.007 (0.033)
Treatment Condition (Ref.=Control)			
SFM LOW	−2.758 [*] (1.316)	−2.770 [*] (1.316)	−2.776 [*] (1.315)
SFM HIGH	−5.445 ^{***} (1.238)	−5.485 ^{***} (1.243)	−5.512 ^{***} (1.237)
<50% AMI (Ref.= 50% AMI)	−0.747 (1.484)	−0.831 (1.525)	−1.125 (1.728)
Social Status		−0.197 (0.541)	−0.148 (0.555)
Race (Ref.=White)			
Black			0.603 (1.369)
Other			0.664 (1.703)
Intercepts			
Baseline Child % of 95 th Percentile	122.275 ^{***} (1.426)	122.275 ^{***} (1.426)	122.275 ^{***} (1.426)
Child % 95 th Post-FBT	−5.577 [*] (2.656)	−6.053 [*] (2.775)	−6.580 [*] (2.777)
Child % 95 th Post-Maintenance	−0.329 (3.876)	0.065 (4.091)	−0.118 (4.004)
Model Fit Statistics			
Chi-square	221.444 ^{***}	233.644 ^{***}	244.386 ^{***}
RMSEA	0.370	0.343	0.298
CFI	0.729	0.718	0.709
SRMR	0.296	0.271	0.252
R ²			
Child % 95 th Post-FBT	0.065	0.063	0.114
Child % 95 th Post-Maint.	0.239	0.241	0.232

This table presents the results of a nested conditional latent change score model, in which the change in Child BMI % of 95th Percentile between baseline and post-FBT and between post-FBT and post-maintenance is predicted by baseline Child BMI % of 95th Percentile, treatment condition (for post-FBT to post-maintenance), <50% AMI, social status, and race. Standard errors in parentheses. BMI=Body Mass Index, AMI=Area Median Income, RMSEA=Root Mean Square Error of Approximation, CFI=Comparative Fit Index, SRMR=Standardized Root Mean Square Residual. N=172;

[†] p < 0.10,

^{*} p < 0.05,

**
p<0.01,

p < 0.001.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 6.

Predictors of Change in Child % Overweight, Conditional Latent Change Score Model, Baseline to Post-Maintenance

	Model 1	Model 2	Model 3
Post-Maintenance			
Baseline Child % OV	−0.018 (0.039)	−0.014 (0.041)	−0.012 (0.039)
Treatment Condition (Ref.=Control)			
SFM LOW	−2.645 (2.763)	−2.620 (2.767)	−2.629 (2.721)
SFM HIGH	−6.111* (2.508)	−6.037* (2.497)	−6.226* (2.464)
<50% AMI (Ref.= 50% AMI)	3.764 (2.924)	3.924 (2.990)	1.658 (3.524)
Social Status		0.379 (1.026)	0.732 (1.049)
Race (Ref.=White)			
Black			4.565 [†] (2.715)
Other			4.599 (3.723)
Intercepts			
Baseline Child % OV	64.151*** (1.917)	64.151*** (1.917)	64.151*** (1.917)
Child % OV Baseline to Post-Maintenance	−11.503*** (2.938)	−11.842*** (3.053)	−12.919*** (2.943)
Model Fit Statistics			
Chi-square	209.189***	221.426***	232.963***
RMSEA	0.444	0.394	0.327
CFI	0.170	0.152	0.121
SRMR	0.337	0.299	0.272
R ²			
Child % OV Post-Maint.	0.073	0.072	0.072

This table presents the results of a nested conditional latent change score model, in which the change in Child % OV between baseline and post-maintenance is predicted by baseline Child % OV, treatment condition, <50% AMI, social status, and race. Standard errors in parentheses. OV=Overweight, AMI=Area Median Income, RMSEA=Root Mean Square Error of Approximation, CFI=Comparative Fit Index, SRMR=Standardized Root Mean Square Residual. N=172;

[†]
p < 0.10,

*
p < 0.05,

**
p < 0.01,

p < 0.001.

Table 7.

Predictors of Change in Child BMI % of 95th Percentile, Conditional Latent Change Score Model, Baseline to Post-Maintenance

	Model 1	Model 2	Model 3
Post-Maintenance			
Baseline Child % of 95 th Percentile	−0.042 (0.040)	−0.039 (0.042)	−0.036 (0.040)
Treatment Condition (Ref.=Control)			
SFM LOW	−1.919 (2.047)	−1.905 (2.051)	−1.894 (2.014)
SFM HIGH	−4.431 [*] (1.864)	−4.395 [*] (1.860)	−4.527 [*] (1.827)
<50% AMI (Ref.= 50% AMI)	2.600 (2.217)	2.668 (2.265)	0.972 (2.657)
Social Status		0.179 (0.759)	0.449 (0.776)
Race (Ref.=White)			
Black			3.576 [†] (1.998)
Other			3.230 (2.761)
Intercepts			
Baseline Child % of 95 th Percentile	122.275 ^{***} (1.426)	122.275 ^{***} (1.426)	122.275 ^{***} (1.426)
Child % of 95 th Baseline to Post-Maintenance	−5.948 (4.809)	−6.305 (5.062)	−7.340 (4.837)
Model Fit Statistics			
Chi-square	210.363 ^{***}	222.240 ^{***}	233.450 ^{***}
RMSEA	0.445	0.395	0.328
CFI	0.153	0.136	0.104
SRMR	0.338	0.299	0.272
R ²			
Child % of 95 th Post-Maint.	0.074	0.073	0.073

This table presents the results of a nested conditional latent change score model, in which the change in child BMI % of 95th percentile between baseline and post-maintenance is predicted by baseline child BMI % of 95th percentile, treatment condition, <50% AMI, social status, and race. Standard errors in parentheses. BMI=Body Mass Index, AMI=Area Median Income, RMSEA=Root Mean Square Error of Approximation, CFI=Comparative Fit Index, SRMR=Standardized Root Mean Square Residual. N=172;

[†] p < 0.10,

^{*} p < 0.05,

^{**} p < 0.01,

^{***} p < 0.001.