

# Psychosocial predictors and moderators of weight management programme outcomes in ethnically diverse obese youth

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## Summary

**Background:** An important area of research in childhood obesity is the identification of factors that predict or moderate the responses to obesity intervention programmes, yet few studies have examined the impact of self-esteem and family functioning on obesity treatment outcomes.

**Objectives:** We sought to determine whether baseline self-esteem and family functioning predicted or moderated childhood obesity intervention outcomes at 6 months.

**Methods:** From 2009 to 2011, seventy-five 10–16 year old, racially/ethnically diverse obese youths with abnormal glucose tolerance were randomized to 6 months of an intensive family-based obesity lifestyle intervention (Bright Bodies) or routine outpatient Clinic Care. We examined youth self-concept, parent-rated family functioning and 6-month outcomes (youths' glucose tolerance, weight, body mass index and percent fat). We set the significance threshold as  $P \leq 0.05$  for moderator and predictor analyses.

**Results:** Having poor family functioning and self-concept scores indicating high anxiety and low self-esteem at baseline predicted poor 6-month outcomes overall (Bright Bodies and Clinic Care groups combined). Additionally, baseline self-esteem and family functioning moderated treatment effects such that Bright Bodies outperformed Clinic Care in youths with low self-esteem and poorly functioning families, whereas youths with high self-esteem and high-functioning families did similarly well with either intervention.

**Discussion:** Our findings suggest intensive family-based lifestyle programmes are particularly beneficial for youth with low self-esteem and poorly functioning families.

**Keywords:** adolescents, children, clinical trial, obesity.

**Abbreviations:** BB, Yale Bright Bodies Weight Management Program; CC, standard Clinic Care; OGTT, oral glucose tolerance test; BMI, body mass index; PH, Piers-Harris Children's Self-Concept Scale; FAD, McMaster Family Assessment Device

## Introduction

According to the Centers for Disease Control and Prevention, 17% of 2–19 year olds were obese in 2011–2012 in the United States (1). The cut-off for childhood obesity in the USA is  $\geq 95$ th percentile for gender and age based on the Centers for Disease Control and Prevention growth charts (2). Paediatric obesity has several negative sequelae including

increased risk of diabetes, cardiovascular impairment, musculoskeletal disorders, fatty liver disease and poor quality of life (3–5). While family-based obesity treatment programmes that include a combination of behaviour modification, nutrition education and physical activity have been characterized as the 'gold standard' in paediatric obesity treatment, some children do better in these programmes than others (6,7). Consequently, an important area of research

in childhood obesity is the identification of factors that predict or moderate the responses to obesity intervention programmes. Predictors are baseline patient characteristics that affect outcomes for all treatments; whereas, moderators are baseline patient characteristics that affect how much a patient benefits from receiving a specific treatment.

Prior research has suggested that younger age, female sex, parental weight loss, better impulse control, good parental mental health, social support and living in a neighbourhood with more parkland are predictors of positive outcomes in most childhood obesity interventions (8). On the other hand, baseline characteristics that moderate response to specific obesity interventions have not been identified (6,8). While paediatric weight management programmes have been linked to improvements in self-esteem (9), it has not been established whether baseline self-esteem or family functioning predict or moderate outcomes in family-based childhood obesity interventions (6,8,10,11).

The Yale Bright Bodies (BB) Weight Management Program is a family-based childhood obesity intervention designed for urban youth and was recently shown to improve anthropometric and metabolic profiles in comparison to standard Clinic Care (CC) in a randomized trial of obese children and adolescents with impaired glucose tolerance (12,13). Important outcomes of the study were that BB improved metabolic outcomes relative to CC after 6 months of treatment (13). Herein, we report the results of baseline self-esteem and family functioning data that were analyzed to determine whether they predicted or moderated anthropometric and glucoregulatory outcomes in these obese youths.

## Methods

The Bright Bodies participants, study design, treatment groups and anthropometric and glucoregulatory outcome measures have been detailed previously (12–14). In this manuscript, we provide a brief overview of the study.

## Participants

Participants were referred to the study by four urban paediatric clinics in New Haven, Connecticut, USA from 2009 to 2011. Eligible children and adolescents were 10–16 years old with a 2-h plasma glucose of 130–199 mg dL<sup>-1</sup> on oral glucose tolerance test (OGTT), body mass index (BMI) >95th percentile for age and gender, Tanner stage ≥2 and an interest in participating in an intensive lifestyle programme. Exclusion criteria included having diabetes, a

psychiatric disorder or an unstable medical condition. Youths participating in another lifestyle programme and youths taking medications affecting weight, insulin sensitivity or glucose metabolism were excluded. Of the 577 children assessed, 432 did not meet the primary inclusion criteria (a 2-h blood glucose of 130–199 mg dL<sup>-1</sup>), 53 did not meet other study criteria and 17 declined participation in the study, leaving a total of 75 children who were randomized. The Yale Human Investigation Committee approved the study, and written informed assent and consent were obtained from youths and parents.

Of the 75 youths who enrolled in the study, 77% (58, 31 BB and 27 CC) completed the study and are included in this secondary analysis (13). At baseline, there were no significant demographic or outcome measure differences between completers and drop-outs or by intervention group. For the completers, the mean age was 13 years old with a standard deviation of 2 years (range 10–16 years), 66% were girls, 40% were Hispanic White, 33% were non-Hispanic White and 24% were Black (race and ethnicity were based on parent-report). The annual household income was less than \$30 000 for 80% of participants, and parent reports were completed by female caregivers 90% of the time (13).

## Study design

In this parallel-group trial, eligible youths were randomized (1:1) to Bright Bodies (BB) or standard Clinic Care (CC) using electronic randomization with permuted blocks maintained by the study statistician to assure concealment. At the end of the 6-month study, youths randomized to CC were offered entry into BB.

## Treatment groups

### Bright Bodies (BB) program

The BB lifestyle programme was conducted at two New Haven public schools in the evenings. One site implemented the programme in Spanish with bilingual (English/Spanish) instructors. BB youths attended the programme twice a week for 6 months – once for a 50-min workout and once for a 90-min session (50-min workout and 40-min class on either nutrition or behaviour modification). Study dietitians emphasized a non-diet approach and used the *Smart Moves Workbook* offered in English and Spanish (12,14). Parents attended the programme weekly for nutrition classes and other classes that

focused on how to help their children make healthy lifestyle changes.

### Standard of care – Clinic Care (CC)

At the start of the study, CC youths attended one session with a study dietitian fluent in English and Spanish. During the session, the dietitian provided basic nutrition and exercise guidance, identified physical activities the youth enjoyed and developed goals with the child and family. A copy of the written goal sheet was mailed to the youth's usual clinician. CC youths followed up with their usual clinician every 2–3 months during the study. To ensure all clinicians could provide sound weight management guidance at follow-up visits, the study dietitian conducted training workshops for clinicians at the four referral clinics and supplied the clinics with educational materials that were distributed to patients.

### Anthropometric and gluco-regulatory outcome variables

Independent evaluators blinded to treatment condition obtained anthropometric (after shoes were removed) and gluco-regulatory assessments at baseline and 6 months at the Yale Center for Clinical Investigation. Outcomes examined were change in each of the variables listed later at 6 months. The primary outcome of the randomized control trial was change in 2-h blood glucose during OGTT. Of note, in a previous analysis, we found weight change only explained 13% of the change in 2-h glucose (13).

- *Anthropometrics*: Weight (kg), BMI ( $\text{kg m}^{-2}$ ), BMI z-score (2,15), percent body fat determined by a body fat analyzer (TBF 300, Tanita Corp, Arlington Heights, IL, USA), body fat mass calculated by multiplying percent body fat by the youth's total weight (kg) (16).
- *OGTT*: Fasting and 2-h blood glucose ( $\text{mg dL}^{-1}$ ) and insulin ( $\text{mIU L}^{-1}$ ) (OGTT procedure: 1.75  $\text{g kg}^{-1}$  body weight (max 75 g) of flavoured glucose (Orangedex; Custom Laboratories, Baltimore, MD, USA) was given orally, and blood samples were obtained for glucose and insulin every 30 min for 2 h).
- *Insulin Sensitivity*: Homeostasis model assessment of insulin resistance (HOMA-IR) (17) and whole-body insulin sensitivity index (WBISI) (18) were calculated using fasting and mean glucoses and insulins from the OGTT. These formulas were described previously (13).

### Psychosocial assessments

*Piers-Harris Children's Self-concept Scale* measured self-esteem and how participants viewed themselves (19). The Piers-Harris is internally consistent (Cronbach alpha for subscales 0.71–0.80), reliable (test–retest reliability coefficient 0.71 at 4 months) and correlated with other measures of self-concept like the Gordon How I See Myself Scale and Sears Self-Concept Inventory (19). Participants completed the scale at baseline and 6 months. The Piers-Harris has a total of 80 yes/no questions and the Total Score encompasses six subscales: *Behavioural Adjustment* (appropriate behaviour, 16 questions), *Intellectual and School Status* (17 questions), *Physical Appearance and Attributes* (13 questions), *Freedom from Anxiety* (14 questions), *Popularity* (social functioning, 12 questions) and *Happiness and Satisfaction* (overall happiness with oneself and with life, 10 questions). Some questions were included in multiple subscales. T-scores for each subscale are standardized for youth 7–18 years old. Higher scores indicate higher self-esteem.

*McMaster Family Assessment Device (FAD)* measured family functioning and was completed by parents at baseline and at 6 months (20). FAD had 53 statements about family dynamics divided into seven subscales. Parents rated how well each statement described their family using one of four responses: strongly agree, agree, disagree or strongly disagree. Each statement was scored 1–4, with lower scores indicating superior family functioning. The subscale scores were an average of the individual items within the subscale. Prior studies have demonstrated FAD subscales are internally consistent (Cronbach's alpha range 0.72–0.92), reliable (test–retest reliability coefficient 0.76 at 6 months) and significantly correlated with other measures of family functioning, like the Family Adaptability and Cohesion Evaluation Scales. FAD subscales are the following:

- *Problem Solving* (5 statements) assessed ability to resolve problems in the family.
- *Communication* (6 statements) assessed exchange of clear and direct verbal information.
- *Roles* (8 statements) assessed division of responsibility for completing tasks in the family.
- *Affective Responsiveness* (6 statements) assessed expression of love and other feelings.
- *Affective Involvement* (7 statements) assessed interest in one another.

- *Behaviour Control* (9 statements) assessed how behavioural standards were expressed and maintained.
- *General Functioning* (12 statements) assessed family functioning overall.

## Statistical analysis

Participants' demographics and clinical characteristics did not significantly differ between randomized groups, as shown in a previous publication (13). We compared baseline psychosocial assessments between BB and CC groups using the two-sample *t*-test. We used analysis of covariance to determine whether either intervention resulted in Piers-Harris or FAD change. Pearson's correlation coefficients (*r*) were calculated between baseline Piers-Harris/FAD subscales and anthropometric/metabolic change to investigate their association. We examined the moderating effects of baseline FAD or Piers-Harris subscales by including a group by baseline FAD/Piers-Harris subscale interaction in the model. A significant interaction indicated that the group difference (treatment effect) depended on baseline subscale level. The moderation effect was demonstrated by plotting the size of treatment effect vs. level of baseline subscale with 95% CI indicating the significance of treatment effect corresponding to each level of baseline subscale. We used SAS 9.3 (Cary, NC, USA), performed log transformation for normality when indicated, and set the level of significance as a two-tailed *P* value  $\leq 0.05$  for all analyses.

## Results

### Baseline patient psychosocial characteristics and change with treatment

Baseline Piers-Harris and FAD scores did not differ between study completers and dropouts (data not shown). Table S1 displays baseline psychosocial characteristics for youths who completed BB and CC. With the exception of FAD *Communication*, neither Piers-Harris nor FAD means (*M*) differed by intervention group at baseline. Baseline FAD *Communication* scores were higher (indicating poorer communication) in CC (*M* 2.2, *SD* 0.4) than in BB (*M* 2.0, *SD* 0.3) (*P*=0.05). Piers-Harris Subscale T-score means for the obese participants in our sample ranged from 49.3 to 55.3 (relative to standardized T-score of 50 with standard deviation of 10 for general youth populations). Neither BB nor

CC significantly changed FAD or Piers-Harris subscale scores at 6 months (data not shown).

### Predictors of outcomes

Table 1 displays relationships between baseline Piers-Harris/FAD Subscale scores and change in gluco-regulatory/anthropometric outcomes at 6 months. High baseline scores on two Piers-Harris Subscales were associated with improved secondary outcomes: *Freedom from Anxiety* was correlated with a reduction in fasting insulin; *Happiness and Satisfaction* was correlated with a reduction in BMI z-score and fasting glucose. Other baseline Piers-Harris Subscales were not associated with gluco-regulatory/anthropometric outcomes. There was a significant association between better baseline family functioning (in *Problem Solving*, *Communication*, *Affective Responsiveness*, *Affective Involvement* and *General Functioning* FAD domains) and lower body fat mass, lower 2-hour insulin, lower fasting glucose, lower 2-hour glucose and improved insulin sensitivity at 6 months. Only healthy family *Affective Responsiveness* was correlated with improvement in the primary outcome, 2-h blood glucose ( $r=0.41$ ,  $P < 0.001$ ).

### Moderation of treatment effects

#### *Piers-Harris Children's Self-Concept Scale*

Figure 1 displays Piers-Harris Subscales that significantly moderated treatment effects ( $P_{\text{interaction}} \leq 0.05$ ). Low baseline self-esteem regarding *Physical Appearance and Attributes* moderated treatment effects on 2-h OGTT glucose (the primary outcome) at 6 months ( $P_{\text{interaction}} = 0.03$ ), such that BB outperformed CC by  $-27 \text{ mg dL}^{-1}$  (95% CI,  $-42$  to  $-12$ ) in youths with physical self-esteem one standard deviation (SD) below the mean but not at one SD above the mean (BB treatment effect,  $-1 \text{ mg dL}^{-1}$ ; 95% CI,  $-18$  to  $16$ ) (Fig. 1(a)). BB also outperformed CC in terms of other gluco-regulatory and anthropometric outcomes at 6 months in youths with lower Piers-Harris Self-Concept scores in three domains: *Physical Appearance and Attributes* for fasting glucose, 2-h glucose, 2-h insulin and insulin sensitivity (Fig. 1(a)); *Intellectual and School Status* for weight and BMI (Fig. 1(b)); *Happiness and Satisfaction* for 2-h insulin (Fig. 1(c)). That is, youths with lower self-appraisals of their physical appearance, intellect, and/or overall happiness particularly benefited from BB. BB and CC treatment effects did not significantly differ in youths with positive self-concept of their physical appearance, intellect, and/or overall happiness with themselves and life.



**Table 1** Pearson correlations of baseline self-esteem and family functioning with metabolic/anthropometric change at 6 months (Bright Bodies and Clinic Care groups combined)

| Baseline predictors                            | Metabolic/Anthropometric variable         | Pearson <i>r</i> | <i>P</i> Value | N  |
|--|---|------------------|----------------|----|
| Piers-Harris Subscale (T-Score)                |   |                  |                |    |
| Physical Appearance/Attributes                 | Body fat (%)                              | 0.26             | 0.07           | 50 |
|  | Body fat mass                             | 0.24             | 0.09           | 50 |
| Freedom from Anxiety                           | Fasting insulin <sup>a</sup>              | −0.27            | 0.05           | 52 |
| Happiness and Satisfaction                     | BMI z-score                               | −0.17            | 0.05           | 56 |
|  | Fasting glucose                           | −0.32            | 0.02           | 55 |
| Family Assessment Device Subscale <sup>b</sup> |   |                  |                |    |
| Poor Problem Solving                           | 2-h insulin <sup>a</sup>                  | 0.35             | 0.02           | 46 |
|  | Insulin sensitivity (WBISl)               | −0.27            | 0.08           | 42 |
| Poor Communication                             | Fasting glucose                           | 0.29             | 0.04           | 49 |
|  | 2-h glucose                               | 0.26             | 0.07           | 50 |
|  | 2-h insulin <sup>a</sup>                  | 0.36             | 0.01           | 46 |
|  | Insulin sensitivity (WBISl)               | −0.36            | 0.02           | 42 |
| Poor Affective Responsiveness                  | Fasting glucose                           | 0.33             | 0.02           | 49 |
|  | 2-h glucose                               | 0.41             | <0.001         | 50 |
|  | 2-h insulin <sup>a</sup>                  | 0.53             | <0.001         | 46 |
|  | Insulin sensitivity (WBISl)               | −0.39            | 0.01           | 42 |
| Poor Affective Involvement                     | Body fat mass                             | 0.32             | 0.04           | 44 |
| Poor Behavioural Control                       | BMI                                       | 0.25             | 0.08           | 50 |
|  | Body fat mass                             | 0.28             | 0.07           | 44 |
|  | Fasting glucose                           | 0.27             | 0.06           | 49 |
|  | Fasting insulin <sup>a</sup>              | 0.26             | 0.08           | 46 |
|  | 2-h insulin <sup>a</sup>                  | 0.25             | 0.09           | 46 |
|  | Insulin resistance (HOMA-IR) <sup>a</sup> | 0.28             | 0.06           | 45 |
|  |   |                  |                |    |
| Poor General Functioning                       | Fasting glucose                           | 0.38             | 0.01           | 49 |
|  | 2-h insulin <sup>a</sup>                  | 0.37             | 0.01           | 46 |
|  | Insulin sensitivity (WBISl)               | −0.27            | 0.08           | 42 |

<sup>a</sup>Log transformed<sup>b</sup>For the McMaster Family Assessment Device, higher scores indicate lower functioning, and 'poor' is added as a prefix to the subscales to make the table easier to understand.Correlations with *P* value < 0.10 are listed. Changes were calculated as (6 months – baseline), so positive correlation indicates the predictor was associated with an increase (or less of a decrease) in outcome measure. Ns differ due to missing data.

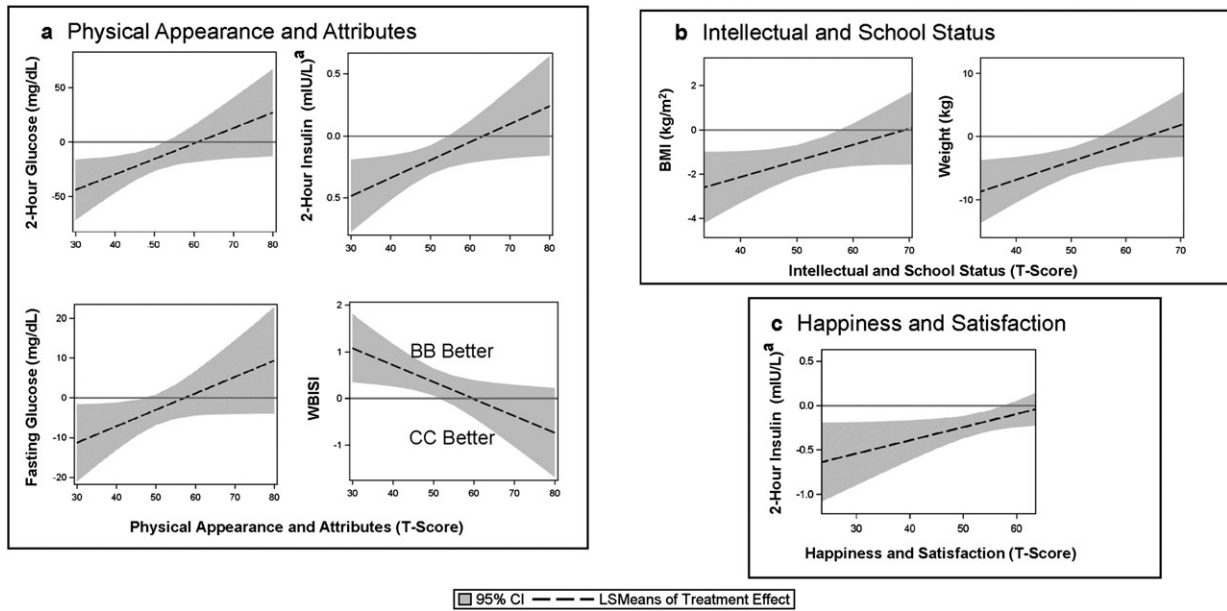
BMI, body mass index; HOMA-IR, homeostasis model assessment of insulin resistance; WBISl, whole body insulin sensitivity index.

### McMaster Family Assessment Device

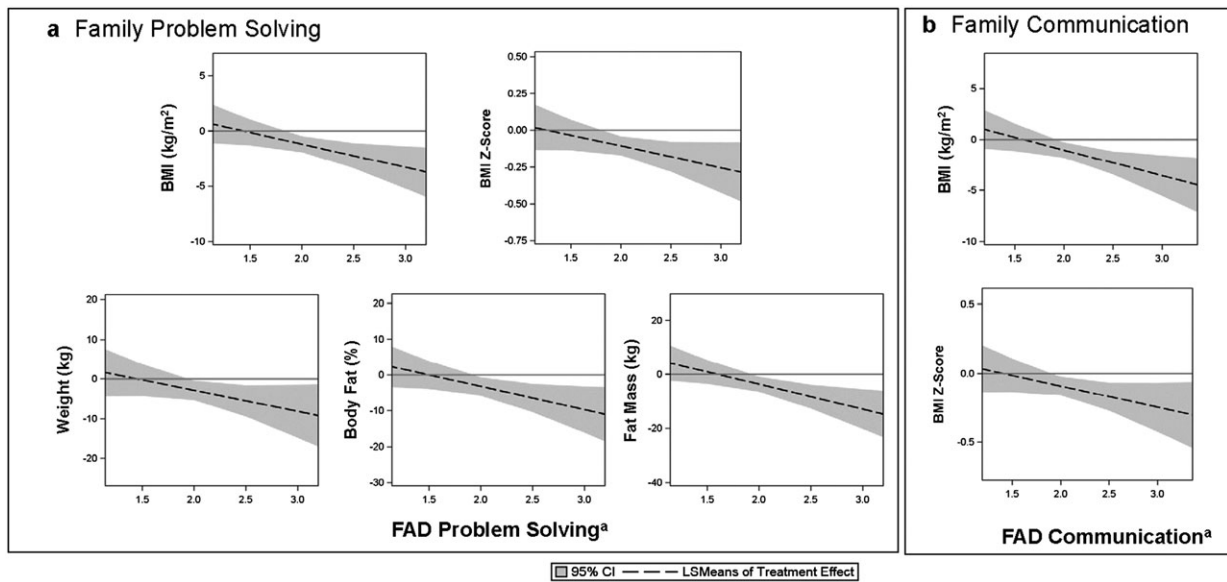
Figure 2 displays FAD Subscales that significantly moderated effects ( $P_{\text{interaction}} \leq 0.05$ ). BB especially outperformed CC in terms of anthropometric outcomes at 6 months in youths with poor family functioning (high FAD score) in two domains: *Problem Solving* for weight, BMI, BMI z-score, percent body fat and body fat mass (Fig. 2(a)); *Communication* for BMI and BMI z-score (Fig. 2(b)). That is, youths in families with poor problem solving and communication especially benefitted from BB. BB and CC treatment effects did not significantly differ in youths from families with good family problem solving and/or communication.

### Discussion

Moderators help clinicians match particular patients with particular treatments. We found that self-esteem and family functioning moderated obesity intervention treatment effects at 6 months. Specifically, we found that in terms of glucoregulatory and anthropometric outcomes, youths with low self-esteem and poor family functioning especially benefitted from the intensive family-based obesity intervention (Bright Bodies, BB) relative to routine outpatient treatment (Clinic Care, CC). For participants with high self-esteem and high-functioning families, BB and CC treatment effects did not significantly differ. Our results build on work published by Braet and Beyers in 2009 that



**Figure 1** Moderation of Treatment Effects by Piers-Harris Children's Self-Concept Subscales: Physical Appearance and Attributes (a), Intellectual and School Status (b), Happiness and Satisfaction (c). When the 95% CI is below zero, Bright Bodies (BB) outperformed Clinic Care (CC), except for WBISI (whole-body insulin sensitivity index) in which BB outperformed CC if 95% CI is above zero as noted because higher WBISI is good, whereas lower values for all other outcomes are good. <sup>a</sup>Log transformed. BMI, body mass index; CI, confidence interval; LSMeans, least square means.



**Figure 2** Moderation of Treatment Effects by McMaster Family Assessment Device (FAD) Subscales: <sup>a</sup>(a) Family Problem Solving and (b) Family Communication. When the 95% CI is below zero, Bright Bodies (BB) outperformed Clinic Care (CC). <sup>a</sup>Higher FAD scores on the x-axis indicate poorer family functioning. BMI, body mass index; CI, confidence interval; LSMeans, least square means.

found that inpatient obesity treatment increased unhealthy dietary restraint in a subgroup of children and adolescents with anxiety and depression symptoms (21). Braet and Beyers surmised that baseline psychopathology and other baseline patient

characteristics could be used to tailor obesity treatments to fit a particular child (i.e. personalized medicine) (21). Our study findings suggest baseline self-esteem and family functioning can help identify ideal treatment modalities for obese youth.

Our finding that participants with low self-esteem (in the domains of intellect, physical characteristics and overall happiness) and poor family functioning (in communication and problem solving domains) especially benefitted from the BB programme (relative to CC) is likely related to BB counselling sessions involving the youngster that addressed issues related to self-esteem like 'Loving Yourself Inside and Out' and 'Bullies, Teasers, and Other Annoying People'. BB also helped parents identify non-weight-related character strengths of their child. Additionally, BB had components that addressed family functioning, for instance, parent sessions were designed to facilitate communication between parent and youth and also to help parents collaborate with their child to overcome weight loss difficulties. While low self-esteem (11) and poor family functioning (10) are associated with poor glucoregulatory outcomes in the absence of specialized treatment, our findings demonstrate that intensive family-based treatments can lessen the impact of low self-esteem and poor family functioning on outcomes.

While patients with low self-esteem and poor family functioning particularly benefitted from the weight management programme, at the end of the intervention youths who began with higher scores on self-esteem and family functioning measures still had better outcomes overall. Specifically, when examining outcomes regardless of intervention type, we found that self-concept scores indicating greater overall happiness with oneself and/or less anxiety were associated with better BMI z-score, fasting glucose and fasting insulin outcomes. These findings underscore the importance of addressing mental health when treating childhood obesity and highlight an opportunity for interventions that simultaneously emphasize psychological and physical well-being. For instance, an effective family-based obesity intervention developed by Danielsen *et al.*, included techniques like emotion regulation and examination of automatic thoughts, which are core components of cognitive behavioural therapy for anxiety and depression (22). Successful use of psychological interventions as a means to enhance medical outcomes have been documented in paediatric asthma, type 1 diabetes mellitus, and cystic fibrosis (23), and our work demonstrates the relationship between psychological well-being and intervention efficacy in childhood obesity and abnormal glucose tolerance.

Additionally, when looking at intervention outcomes overall, we found better family functioning was associated with better glucoregulatory outcomes and reduced fat mass. How a family dealt with adversity, communicated, expressed love and

showed interest in one another affected how successful obesity intervention was. Our results fit well with a study that demonstrated four sessions of family therapy focused on communication, appropriate limit setting, expressing feelings and consistency significantly lowered BMI z-score in obese children (24). Similarly, a prior study found that obese teenagers who rated their families as high functioning were more likely to sustain weight loss 1 year after a summer camp obesity intervention (25).

Bright Bodies did not significantly affect self-esteem or family functioning. Of note, prior studies have found that weight management programmes increase self-esteem in children (9), and the evidence is particularly robust regarding the mental health benefits of physical activity (26). However, because the primary outcome of the present study was glucose tolerance, it was not powered to detect change in self-esteem or family functioning, which may explain why we did not find a relationship between intervention and improvement on psychosocial measures. Furthermore, family functioning and self-esteem were surprisingly within normal limits at baseline, and it may be harder to improve these measures when they are already normal (ceiling effect).

A strength of our study is that many participants were low-income African-Americans and Hispanics, making our results more generalizable to low-income African-American and Hispanic communities in the USA, which often have high childhood obesity rates (1) and distinct cultural traditions that affect obesity (27–29). On the other hand, our study has some limitations. Family functioning was measured using parent ratings on the FAD, which may have overestimated levels of healthy family functioning given that parent reports of family functioning are often more positive than the reports given by their children (30). Moreover, we had limited information on the children's family structures (e.g. lacked marital status of parents and involvement of extended family members as caregivers). Another limitation is that youth with psychiatric disorders and youth treated with pharmacotherapies for obesity were excluded from the study; therefore, our findings may not be generalizable to obese youth with psychiatric comorbidity or obese youth taking commonly prescribed medications like metformin. Additionally, we did not adjust for multiple comparisons. However, because of the exploratory feature of this study that aimed to be hypothesis-generating, we prioritized reducing type II error so that we did not overlook important findings. Although several findings are quite robust as evidenced by not only *P* values but also magnitude of effects; further investigation is still warranted.

Despite these limitations, our study is the first to identify moderators that can help clinicians and families decide between two common childhood obesity treatments: a brief health education intervention with standard outpatient follow-up (CC) and an intensive family-based lifestyle intervention (BB). Our findings suggest that intensive, family-based interventions are especially beneficial for youth with low self-esteem and poorly functioning families.

### Conflict of interest statement

No conflict of interest was declared.

### Author contributions

M. Savoye, P.N. and F.L. conceived the study. M. Savoye and M. Shaw collected the data. Y.X., F.L. and J.T. conducted the data analysis. All authors assisted with data interpretation and writing the manuscript.

### Role of the funders/sponsors

Funders/sponsors did not have a role in the design and conduct of the study; collection, management, analysis and interpretation of the data; or preparation, review or approval of the manuscript.

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## Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**Table S1.** Baseline Self-Esteem and Family Functioning