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Defining and Identifying Predictors of Rapid Response to Pediatric Obesity Treatment

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Abstract

Early weight loss (rapid response; RR) is associated with better outcomes in adults. Less is known about RR in children enrolled in weight-loss treatment. The aim of the current study was to establish a RR weight-loss threshold following 4-weeks of pediatric obesity treatment and identify characteristics associated with achieving RR. 137 children ages 8–12 with overweight/obesity and parents participated in six months of Family-Based or Parent-Based Treatment. Receiver Operating Characteristic curves evaluated how weight loss at week 4 related to decreases of 5% at post-treatment and 10% at 6- and 18-month follow-ups of BMIz, % distance of a child's BMI from the median BMI for sex and age, and percentage above the 95th percentile. Weight loss of 2.4–3.4% at week 4 predicted 5% change at post-treatment (AUC's =.68-.75; p's≤.002) and 10% change at 6-month follow-up (AUC's=.63-.70; p's ≤.02). No model was significant at 18-month follow-up. Amount of parent weight (lbs) change at week 4 was associated with child achieving RR. Males and Non-Hispanic Whites were more likely to achieve RR. This threshold could be used to mark early significant progress and guide clinical evaluations of treatment response to pediatric obesity treatment.

Keywords

Family-Based Intervention; Pediatrics; Parents; Childhood Obesity

Over one third of youth in the United States have overweight or obesity.[1] Given the significant health and psychosocial consequences of obesity,[2] and the persistence of obesity into adulthood,[3] it is imperative to identify factors related to improved treatment outcomes in children.

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Conflict of Interest

No conflict of interest was declared.

Rapid response (RR; i.e., losing more weight early in treatment) in adults predicts improved weight status up to 8 years later.[4–8] RR research in children and adolescents is sparse and has several limitations including small sample sizes, few studies with long term follow-up (>1 year), and wide ranges in age spanning several developmental periods (e.g., 5–25 years).[9–14] One study in children age 7–12 years showed that a loss of 4–8% of initial child body weight by the 8th session of a family-based behavioral weight-loss treatment (FBT) program was associated with children achieving short- (20 weeks) and long-term (2-year follow-up) weight-loss success (i.e., 5% to 10% BMI *z*-score reduction).[9] This study also showed that parent RR and treatment attendance were related to child RR. Another large (n=687) prospective study of children age 4–18 years in the United States[10] demonstrated that BMI reduction in the first month of treatment was significantly associated with greater 6- and 12-month BMI reduction.

Current guidelines for pediatric obesity treatment recommend persisting in treatment for three months before changing course.[15] However, there is no empirical evidence to support this timeframe. Furthermore, obesity treatment is moving towards precision medicine, which requires understanding the unique individual characteristics associated with treatment success and tailoring treatments accordingly.[16] Thus, further examination of the factors associated with RR, particularly amount of weight loss and time course of this weight loss, would be useful for the development of treatment guidelines. The aim of the current study was to identify a weight loss threshold of RR at 4-weeks of FBT treatment that could predict significant weight-loss outcomes in a sample of 137 children ages 8–12 years old. Secondarily, this study aimed to identify characteristics related to achieving RR. Together, this information can help guide clinical decision making and optimize pediatric obesity treatment.

Methods

Participants

Participants were 137 out of the 150 parent/child dyads enrolled in the Family, Responsibility, Education, Support and Health (FRESH) study (NCT01197443). Thirteen dyads were excluded due to the need for child weight data at week 4 to be included in analyses. Dyads were randomized to 6 months of family-based treatment (FBT; parent and child attend) or parent-based treatment (PBT; only parent attends).[17] Assessments were conducted at baseline, post-treatment, 6- and 18-month follow-up. Children were eligible to participate if they were between the ages of 8–12 years old and had a BMI percentile of 85–99.9. Both participating parent and child needed to be able to understand and speak English. All procedures were approved by UCSD and Rady's Children's Hospital Institutional Review Boards. All parents provided written informed consent and children provided assent.

Intervention

Interventions were similar in content; the only difference was that both parents and children attended treatment in FBT but only parents attended treatment in PBT. The main outcome paper demonstrated that PBT was non-inferior to FBT, and provides additional detail regarding eligibility requirements, treatments, and the CONSORT diagram.[17]

Measures

Anthropometrics ––Weight and height were measured in duplicate. The average value was used to calculate Body Mass Index (BMI) for parents (kg/m^2) and standardized BMI (BMIz),[18] % distance of a child's BMI from the median BMI for sex and age[19] (%distmed), and percentage above the 95th percentile[20] (%of95th) for children. Parent and child participants in the FBT group were weighed at each treatment session. Parents in the PBT group were weighed and self-reported their child's weight at each treatment session since the child did not attend. Anthropometrics were obtained in person for both groups at baseline, post-treatment and 6- and 18-month follow-up.

Demographics ––Parents reported parent and child demographic characteristics (sex, age, race/ethnicity, income).

Statistical Analyses

Analyses were conducted using RStudio with R version 3.5.2 using the intention-to-treat population of the primary study. Receiver Operating Characteristic (ROC) curves determined the ideal threshold for percent weight change at week 4 of treatment that predicted 5% change at post-treatment and 10% change at the 6- and 18-month follow-up of BMIz, %of95th, and %distmed. The 5% and 10% targets were based on previous research defining these cut-points as successful weight loss in children.[9] Following previously used methods,[8] if week 4 weight was missing, weight data from week 3 and week 5 were averaged to create the "week 4" data. If participants had *either* week 3 or week 5 data, they were also included in the analyses with the week 3 or week 5 data used as "week 4" data. These methods imputed "week 4" data for 19 children resulting in "week 4" data for 137 children of the original 150 enrolled in the parent study (91%). Logistic regressions assessed whether demographic variables (age, sex, race/ethnicity) initial BMIz[1], treatment condition, and parent weight change at week 4 was associated with the child achieving RR as determined by the ROC analyses.

Results

ROC Analyses Identify Rapid Response (RR) to Treatment

Based on the ROC analyses across all metrics, RR was defined as at least a 2.4% weight loss at week 4 which equated to an average of 4.5 lbs (SD=1.94) in this sample. Within the sample, 45 participants (33%) achieved RR whereas 92 (67%) did not (see Table 1). Weight data were available for 119 children (87%) at post-treatment, 121 children (88%) at 6-month follow-up and 124 children (91%) at 18-month follow-up. ROC curves revealed that 2.4% weight loss at week 4 was the threshold most strongly associated with 5% BMIz decrease at post-treatment (AUC=0.72 (0.63–0.80), p<0.001; 86.8%/45.2% specificity/sensitivity) and 10% BMIz decrease at 6-month follow-up (AUC=0.65 (0.55–0.76), p= 0.016; 78.8%/50.7% specificity/sensitivity). The 2.4% threshold was also associated with a 5% decrease in %of95th at post-treatment (AUC=0.75 (0.67–0.83), p<.001; 86.4%/50.1% specificity/

[1]Other baseline weight metrics (%of95th and %distmed were both evaluated but same significant results were obtained so only BMIz presented)

sensitivity) and the 10% decrease in %distmed at 6-month follow-up (AUC=0.63 (0.53–0.73), p=0.02, 79.0%/49.3% specificity/sensitivity. Slightly higher thresholds of 3.1% was associated with a 5% decrease in %distmed at post-treatment (AUC=0.68 (0.59–0.77), p=0.002, 100%/28.6% specificity/sensitivity) and 3.4% was associated with a 10% decrease in %of95th at 6-month follow-up (AUC=0.70 (0.57–0.82), p=0.002; 93.7%/46.2% specificity/sensitivity). The ROC analyses suggested that these rates of weight loss early in treatment were not associated with 10% decrease at 18-month follow-up in any of these metrics (AUC's=.53-.56; p's >.25).

Characteristics Associated with Achieving Rapid Response

As shown in Table 2, males had 2.75 times higher odds of achieving RR than females, and White participants had 4.48 higher odds of achieving RR than Non-Hispanic, Non-White participants. Parent weight change was strongly associated with the odds of achieving RR, increasing by 1.16 for each pound of weight lost by the child's parent. Age, Hispanic ethnicity, income, treatment condition and baseline child weight metrics (BMIz, %of95th, %dismed) were not associated with achieving RR (p's>.05).

Discussion

Analyses showed that weight loss of 2.4–3.4% (~4.5 lbs) in children at week 4 predicted a 5% decrease at post-treatment and a 10% decrease at 6-month follow-up of all weight metrics. However, no rate of early weight loss was associated with 10% decrease in any child weight metrics at 18-month follow-up. These results are consistent with previous research that showed that child weight loss in the first month was related to 6- and 12-month weight loss.[10] While our current study did not find an association between RR and the 18-month follow-up, Goldschmidt and colleagues found that 8-week RR predicted 2 year follow-up weight loss.[9] One possible reason for this difference may be that Goldschmidt and colleagues evaluated FBT and maintenance treatments whereas this study did not include any treatment after the initial 6-month treatment.

This study also provides information regarding the individual characteristics related to treatment response. The current study showed that being White vs Non-Hispanic, Non-White and being male is associated with higher odds of achieving RR. Current findings corroborate that parent weight change is associated with RR,[9] supporting the importance of parents in child weight management.[17] Current guidelines suggest waiting 3–6 months before changing or intensifying interventions for pediatric obesity.[15] However, this study, in combination with a previous study,[10] suggests that weight loss at one month can predict longer term weight loss. Future research should evaluate whether clinical decisions about changing treatment can be made at 4 weeks and whether these specific characteristics should be incorporated into clinical decision-making.

Strengths of the study include a diverse sample of children participating in the most efficacious model of treatment for pediatric obesity with data available up to 18 months following treatment. Moreover, multiple weight metrics, including %of95th and %distmed, were used which are better for children with severe obesity. However, it is unknown whether these findings would generalize to other pediatric samples, including those with more severe

obesity as enrollment was limited to participants at 99.9% BMI. Further, since treatment was only provided to children in the FBT arm, weight was obtained in the laboratory from children in FBT but self-reported weight was obtained for children in PBT during treatment. All children came to the laboratory for the main assessments and follow-up periods. Also, the lack of a 12-month follow-up prevented us from establishing whether RR would have predicted weight change at that time point. Future studies should evaluate how long RR can accurately predict long-term weight-loss results in youth.

Conclusion

The current study shows that RR is associated with achieving a significant weight loss up to six months following treatment. Being male and early parent weight loss increased the likelihood of achieving RR whereas Non-Hispanic, Non-White children were less likely than Whites to achieve RR. These results support that clinical decisions related to maintaining or changing pediatric obesity treatment should be considered following one month of treatment, contrary to current guidelines that suggest waiting at least three months.

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References

1. Fryar CD, Carroll MD, Ogden CL. Prevalence of overweight, obesity, and severe obesity among children and adolescents aged 2–19 years: United States, 1963–1965 through 2015–2016. 2018.
2. Dixon JB. The effect of obesity on health outcomes. Mol Cell Endocrinol. 2010;316(2):104–108. [PubMed: 19628019]
3. Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do obese children become obese adults? A review of the literature. Prev Med. 1993;22(2):167–177. [PubMed: 8483856]
4. Elfhag K, Rossner S. Initial weight loss is the best predictor for success in obesity treatment and sociodemographic liabilities increase risk for drop-out. Patient Educ Couns. 2010;79(3):361–366. [PubMed: 20223613]
5. Feig EH, Lowe MR. Variability in Weight Change Early in Behavioral Weight Loss Treatment: Theoretical and Clinical Implications. Obesity 2017;25(9):1509–1515. [PubMed: 28845608]
6. Unick JL, Neiberg RH, Hogan PE, et al. Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. Obesity. 2015;23(7):1353–1356. [PubMed: 26110890]
7. Carels RA, Cacciapaglia HM, Douglass OM, Rydin S, O'Brien WH. The early identification of poor treatment outcome in a women's weight loss program. Eat Behav. 2003;4(3):265–282. [PubMed: 15000970]
8. Unick JL, Hogan PE, Neiberg RH, et al. Evaluation of early weight loss thresholds for identifying nonresponders to an intensive lifestyle intervention. Obesity. 2014;22(7):1608–1616. [PubMed: 24771618]
9. Goldschmidt AB, Stein RI, Saelens BE, Theim KR, Epstein LH, Wilfley DE. Importance of early weight change in a pediatric weight management trial. Pediatrics. 2011;128(1):e33–39. [PubMed: 21690118]

10. Gross AC, Kaizer AM, Kelly AS, et al. Long and Short of It: Early Response Predicts Longer-Term Outcomes in Pediatric Weight Management. Obesity. 2019;27(2):272–279. [PubMed: 30677263]
11. Braet C Patient Characteristics as Predictors of Weight Loss after an Obesity Treatment for Children. Obesity. 2006;14(1):148–155. [PubMed: 16493133]
12. Jelalian E, Hart CN, Mehlenbeck RS, et al. Predictors of Attrition and Weight Loss in an Adolescent Weight Control Program. Obesity. 2008;16(6):1318–1323. [PubMed: 18356834]
13. Gow ML, Baur LA, Ho M, et al. Can early weight loss, eating behaviors and socioeconomic factors predict successful weight loss at 12- and 24-months in adolescents with obesity and insulin resistance participating in a randomised controlled trial? Int J Behav. 2016;13:43–43.
14. Wiegand S, Keller KM, Lob-Corzilius T, et al. Predicting Weight Loss and Maintenance in Overweight/Obese Pediatric Patients. Horm Res Paediatr. 2014;82(6):380–387. [PubMed: 25531074]
15. Barlow SE. Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. Pediatrics. 2007;120(Supplement 4):S164–S192. [PubMed: 18055651]
16. Kelly AS, Marcus MD, Yanovski JA, Yanovski SZ, Osganian SK. Working toward precision medicine approaches to treat severe obesity in adolescents: report of an NIH workshop. Int J Obes. 2018;42(11):1834–1844.
17. Boutelle KN, Rhee KE, Liang J, et al. Effect of Attendance of the Child on Body Weight, Energy Intake, and Physical Activity in Childhood Obesity Treatment: A Randomized Clinical TrialEffect of Attendance of the Child in Childhood Obesity TreatmentEffect of Attendance of the Child in Childhood Obesity Treatment. JAMA Pediatrics. 2017;171(7):622–628. [PubMed: 28558104]
18. Kuczmarski RJ. 2000 CDC growth charts for the United States; methods and development. 2002.
19. Freedman DS, Woo JG, Ogden CL, Xu JH, Cole TJ. Distance and percentage distance from median BMI as alternatives to BMI z score. Br J Nutr. 2019:1–8.
20. Gulati AK, Kaplan DW, Daniels SR. Clinical tracking of severely obese children: a new growth chart. Pediatrics. 2012;130(6):1136–1140. [PubMed: 23129082]

Table 1.

Child Participant Demographics by Rapid Response to Treatment

	Overall (N=137), mean (SD) or *n* (%)	Rapid Responder (*n*=45), mean (SD) or *n* (%)	Non-Rapid Responder (*n*=92), mean (SD) or *n* (%)	Test Statistic; p-value
Sex (female)	**90 (66%)**	**23 (51%)**	**67 (73%)**	**5.40; 0.02** *
Age (years)	10.48 (1.28)	10.64 (1.35)	10.4 (1.24)	−1.00; 0.32
Race/Ethnicity				**8.85; 0.01** *
Hispanic	**40 (29%)**	**12 (27%)**	**28 (30%)**	
Non-Hispanic White	**61 (45%)**	**27 (60%)**	**34 (37%)**	
Non-Hispanic, Non-White	**34 (25%)**	**5 (11%)**	**29 (32%)**	
Treatment (FBT)	69 (50%)	19 (42%)	50 (54%)	1.33; 0.25
Income (< $60,000)	37 (27%)	11 (24%)	26 (28%)	0.11; 0.73
Child BMI (kg/m^2)	26.35 (3.58)	26.26 (3.4)	26.39 (3.69)	0.19; 0.85
Child BMIz	2.0 (.33)	1.99 (.33)	2.0 (.33)	0.29; 0.77
Child %of95th	113.71 (13.44)	113.22 (13.19)	113.94 (13.63)	0.29; 0.77
Child %distmed	54.13 (18.54)	53.15 (17.69)	54.61 (19.01)	0.44; 0.66
Parent BMI (kg/m^2)	32.05 (6.37)	31.38 (5.76)	32.38 (6.66)	0.90; 0.37
Parent weight change at week 4 (lbs**)**	**−2.26 (6.41)**	**−3.92 (3.41)**	**−1.43 (7.34)**	**2.70; 0.007** **
Child percent of BMIz change at post-treatment	**−14% (14)**	**−21% (15)**	**−10% (12)**	**4.20; <0.001** ***
Child percent of %of95th change at post-treatment	**−7% (6)**	**−11% (6)**	**−5% (5)**	**5.26; <0.001** ***
Child percent of %distmed change at post treatment	**−19% (19)**	**−31% (19)**	**−14% (17)**	**5.02; <0.001** ***
Child percent of BMIz change at 6-month follow-up	**−10% (17)**	**−17% (17)**	**−7% (15)**	**2.96; 0.004** **
Child percent of %of95th change at 6-month follow-up	**−5% (7)**	**−8% (7)**	**−3% (7)**	**3.60; p<0.001** ***
Child percent of %distmed change at 6-month follow-up	**−12% (24)**	**−22% (23)**	**−6% (24)**	**3.63; <0.001** ***
Child percent of BMIz change at 18-month follow-up	−9% (16)	−12% (16)	−8% (16)	1.04; 0.30
Child percent of %of95th change at 18-month follow-up	−4% (8)	−5% (8)	−4% (8)	1.13; 0.26
Child percent of %distmed change at 18-month follow-up	−8% (26)	−12% (24)	−5 (27)	1.36; 0.18

Note: FBT = Family-Based Treatment; %of95th = percentage above the 95th percentile; %distmed % distance of a child's BMI from the median BMI for sex and age;

* p<0.05;

** p<0.01;

*** p<.001

Table 2:

Estimates of Predictors of Achieving Rapid Response of 2.4% Weight Loss at Week 4

	Estimate	SE	Z	P	Odd's Ratio (95% CI)
Sex[a]	**1.01**	**0.44**	**2.3**	**0.02** *	**2.75 (1.16–6.70)**
Age (years)	.01	0.01	0.75	0.45	1.01 (0.98–1.04)
White vs Hispanic	0.22	0.49	−0.45	0.65	1.25 (0.48–3.26)
White vs Non-Hispanic, Non-White	**1.5**	**0.60**	**−2.52**	**0.01** *	**4.58 (1.40–14.99)**
Income[b]	0.14	0.47	0.31	0.75	1.16 (0.46–2.98)
Treatment[c] **Condition**	−0.55	0.42	−1.33	0.18	0.57 (0.25–1.29)
Baseline BMIz	−0.58	0.64	−0.92	0.36	0.56 (0.16–1.93)
Parent Week 4 Weight Change	**0.15**	**0.06**	**2.61**	**0.009** **	**1.16 (1.05–1.31)**

Note:

[a] Female was reference category;

[b] below median income of $60,000 was reference category;

[c] Parent Based Treatment (PBT) was reference category;

* p<0.05;

** p<0.01;