Long and Short of It: Early Response Predicts Longer-Term Outcomes in Pediatric Weight Management

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Objective: This study aimed to examine whether 1-month BMI improvement is predictive of superior 6- and 12-month BMI changes in a national sample of youth in pediatric weight management treatment.

Methods: Participants were 4- to 18-year-olds from the Pediatric Obesity Weight Evaluation Registry, a prospective study collecting data from 31 pediatric weight management programs across the United States. Response at 1 month was defined as ≥ 3% BMI reduction; success at 6 and 12 months was defined as ≥ 5% BMI reduction from baseline. Analyses used linear and logistic regression with robust variance estimation.

Results: Primary analyses were completed with 687 participants (mean age 12.2 years). One-month responders demonstrated significant improvements in BMI compared with nonresponders at 6 months (BMI, −2.05 vs. 0.05; %BMI, −5.81 vs. 0.23; P < 0.001 for all) and 12 months (BMI, −1.87 vs. 0.30; %BMI, −5.04 vs. 1.06; P < 0.001 for all). The odds of success for 1-month responders were 9.64 (95% CI: 5.85-15.87; P < 0.001) times that of nonresponders at 6 months and 5.24 (95% CI: 2.49-11.02; P < 0.001) times that of nonresponders at 12 months.

Conclusions: In treatment-seeking youth with obesity, early BMI reduction was significantly associated with greater long-term BMI reduction. Nonresponders may benefit from early treatment redirection or intensification.

Introduction

Pediatric obesity is a significant public health concern that affects approximately 17% of children and adolescents in the United States (1). Current treatment guidelines for youth with obesity advise slow, gradual reductions in weight status using a staged approach, whereby a child may participate in an intervention for 3 to 6 months prior to changing course, even if unsuccessful (2). At present, there are limited pediatric data that can be used as evidence to support or refute the 3- to 6-month trial period before redirecting or intensifying interventions. This staged approach to delivery of more intensive therapy may limit the efficacy of anthropometric outcomes of youth in obesity treatment, particularly among those with severe obesity (3,4).

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In adults with obesity, weight loss early in treatment is associated with greater total weight loss and long-term weight loss maintenance (5). Furthermore, some studies have identified the benefit of providing “rescue” efforts (e.g., treatment change or intensification) to nonresponders early in the course of intervention. Delivery of early rescue interventions has resulted in better weight loss outcomes, particularly when nonresponders are identified within 3 months of treatment initiation (6). In adults, the timing and amount of weight loss that define “early response” vary across studies. There is a need to identify the optimal timeline for weight loss, as this would allow clinicians to make appropriate strategic alterations in treatment that could lead to increased early weight loss, thereby promoting greater and more sustained weight loss long term (6).

There is some evidence in the pediatric population to suggest that early BMI reduction and dietary changes predict greater future BMI reduction and maintenance (7-13). However, much of the available data have come from smaller sample sizes or from highly prescriptive treatment regimens, limiting the generalizability of the findings. The goal of the current study was to examine the extent to which early improvement in BMI at 1 month is predictive of superior 6- and 12-month BMI changes in a nationally representative sample of youth participating in multicomponent pediatric weight management (PWM) treatment.

Methods

Participants

This study was based on data from the Pediatric Obesity Weight Evaluation Registry (POWER) (ClinicalTrials.gov NCT02121132), a prospective study collecting longitudinal data from a network of 31 multicomponent PWM programs across the United States. The purpose of POWER is to identify participant and program characteristics associated with favorable outcomes (14). For inclusion in POWER, programs must provide multicomponent PWM treatment for youth with obesity and collect the required data elements. These data elements include demographic characteristics, such as race, ethnicity, and age, as well as height and weight from each visit. Sites were responsible for obtaining institution-specific Institutional Review Board approval as well as informed consent and assent. The inclusion and exclusion criteria for individual participant enrollment were previously described (14). The present study utilized data from POWER participants who were aged 4 to 18 years.

Procedures

Data for this study were not collected systematically at specific time points because intervals of data collection were dependent on each POWER site’s own clinical protocols. Therefore, measurements at 1, 6, and 12 months (30, 182, and 365 days) were derived algorithmically from the longitudinal records within 14-, 60-, and 90-day windows, respectively, or via interpolation. At 1 month, the closest visit within a 14-day window was used, or, if two visits were equidistant within the window for a given participant (e.g., 26 and 34 days), the average of the two measurements was used. For the 6- and 12-month visits, participant measurements were determined in a two-step algorithm. First, if visits were recorded within 6 months before and after the 182- and 365-day time points, measurements were interpolated for their predicted value at 6 and 12 months (e.g., for the 6-month visit, if there were visits at 95 and 250 days, the measurement at 182 was interpolated from these two visits). If a visit did not meet the criteria for interpolation but the participant had at least one record within the 60- or 90-day window (i.e., 122 to 241 days for 6 months or 275 to 455 days for 12 months), that record was used for the 6- or 12-month visit.

In the primary analyses, early response at 1 month was defined as ≥ 3% BMI reduction, which was a cutoff selected by the investigators as a clinically reasonable BMI reduction in the time frame. Success at 6 and 12 months was defined as ≥ 5% BMI reduction from baseline. This definition of success was based on the Food and Drug Administration suggestions for end points of efficacy in clinical trials (15). Any participant with a 1-month absolute change in BMI greater than 15% was excluded, as this was considered implausible and could not be verified with the available data.

Statistical analyses

Summary characteristics were tabulated with respect to 1-month responder status using mean (SD) for continuous variables and frequency (percent) for categorical variables. Analyses were based on linear and logistic regression with robust variance estimation, adjusting for age, sex, race (white vs. other), ethnicity, and baseline BMI. An exploratory analysis determined whether increasing or decreasing the definition of response at 1 month affected the prediction of success at 6 and 12 months. Classification criteria, such as sensitivity and specificity, were calculated using the epiR package (epiR: Tools for the Analysis of Epidemiological Data. R package Version 0.9-93; The R Foundation for Statistical Computing, Vienna, Austria) with exact binomial confidence limits to determine the 95% CI. Similar methods were applied in an additional analysis to determine whether 1-month response influenced rate of return for follow-up since attrition was observed in the cohort. All analyses were conducted in R version 3.4.3 (The R Foundation for Statistical Computing).

Results

Participant characteristics

Data from 687 participants were included in the primary analyses. These participants came from an initial sample of 6,183 unique participants with at least one visit recorded in the POWER data set. Of those, 1,506 were in the appropriate age range and had data entered at baseline and 1 month (±14 days). From the 1,506 participants, 687 had data entered at 6 months, 12 months, or both. There were 401 participants with 6-month but not 12-month data, 7 participants with 12-month but not 6-month data, and 279 participants with both 6- and 12-month data. For the additional analysis to examine the influence of 1-month response on the rate of return, the 1,506 participants with baseline and 1-month data were included.

For the study cohort of 687 participants used in the primary analyses, the mean age was 12.2 (SD=3.2) years, and 45.1% were male. Table 1 provides additional demographic data.

BMI change at 1 month

At 1 month, 109 (15.9%) participants achieved an early response to weight management services of ≥ 3% BMI reduction. Responders had a mean absolute change in BMI of −1.62 (SD=0.73) kg/m² compared with 0.03 (SD=0.63) among nonresponders at 1 month (Table 2).
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BMI change at 6 months and 12 months

Figure 1 shows scatterplots of the change in BMI at 6 months based on categories of BMI change at 1 month. In each category of 1-month BMI change, there was a wide distribution of values for 6-month BMI change. Increasing and maintaining BMI at 1 month corresponded to an approximate mean increase and maintenance of BMI at 6 months, respectively. That is, if BMI increased by 1% or more at 1 month, the mean increase at 6 months was 2.7% (SD = 4.2%); if maintained at 1 month, the mean change at 6 months was 0% (SD = 4.1%). The mean decrease in BMI at 6 months was increasingly more pronounced in groups with increasingly greater BMI decrease at 1 month, with 5% or more BMI reduction at 1 month corresponding with 8.0% (SD = 5.8%) mean reduction at 6 months.

Similar to the 6-month data, increasing and maintaining BMI at 1 month appeared to correspond to an analogous mean increase and maintenance of BMI, respectively, at 12 months (Figure 2). Reducing 2% to 4% of BMI at 1 month resulted in BMI reduction at 12 months, while losing 4% or more resulted in an apparently greater 12-month BMI reduction. (Table 2 provides additional information about changes in BMI from baseline to 6 months or 12 months.)

The mean change in BMI at 6 and 12 months for responders (≥ 3% BMI reduction at 1 month) was higher than that of nonresponders (< 3% BMI reduction at 1 month) (Table 3). Results were significant with and without adjustment for age, sex, race (white vs. other), ethnicity, and baseline BMI. The change in BMI was evaluated as change in absolute mean BMI (BMI), percent BMI (%BMI), percent of the BMI 95th percentile (%BMIp95), and BMI z score (zBMI). Responders at 1 month demonstrated significant improvements in BMI compared with nonresponders at 6 months (BMI, −2.05 vs. 0.05; %BMI, −5.81 vs. 0.23; %BMIp95, −10.34 vs. −2.11; zBMI, −0.18 vs. −0.05; P < 0.001 for all) and 12 months (BMI, −1.87 vs. 0.30; %BMI, −5.04 vs. 1.06; %BMIp95, −10.97 vs. −2.67; zBMI, −0.21 vs. −0.08; P < 0.001 for all).

Likelihood of success at 6 and 12 months based on response of ≥ 3% BMI reduction

Odds ratios were calculated to represent likelihood of success at 6 and 12 months in responders versus nonresponders, with adjustment for age, sex, race (white vs. other), ethnicity, and baseline BMI. At 6 months, the odds of success for responders were 9.64 times that of nonresponders while holding all other variables in the model constant.
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TABLE 2 Change in BMI values for the study cohort at 1, 6, and 12 months

|                                      | Overall cohort (N=687) | Lost ≥ 3% BMI at 1-month window (n=109) | Lost < 3% BMI at 1-month window (n=578) |
|--------------------------------------|------------------------|----------------------------------------|----------------------------------------|
| Absolute BMI (kg/m²)                 |                        |                                        |                                        |
| Baseline to 1 month                  | −0.23 (0.88)           | −1.62 (0.73)                           | 0.03 (0.63)                            |
| Baseline to 6 months                 | −0.28 (1.77)           | −2.05 (2.02)                           | 0.05 (1.51)                            |
| Baseline to 12 months                | −0.06 (2.49)           | −1.87 (3.06)                           | 0.3 (2.21)                             |
| Percent of BMI (%)                   |                        |                                        |                                        |
| Baseline to 1 month                  | −0.65 (2.62)           | −4.78 (1.82)                           | 0.13 (1.92)                            |
| Baseline to 6 months                 | −0.73 (5.18)           | −5.81 (5.17)                           | 0.23 (4.59)                            |
| Baseline to 12 months                | 0.06 (7.11)            | −5.04 (7.42)                           | 1.06 (6.61)                            |
| Percent of 95th BMI percentile (%)   |                        |                                        |                                        |
| Baseline to 1 month                  | −1.37 (3.55)           | −6.92 (2.7)                            | −0.32 (2.58)                           |
| Baseline to 6 months                 | −3.42 (6.97)           | −10.3 (7.81)                           | −2.11 (6.96)                           |
| Baseline to 12 months                | −4.03 (9.37)           | −11.0 (11.1)                           | −2.67 (8.37)                           |
| BMI z score change                   |                        |                                        |                                        |
| Baseline to 1 month                  | −1.0 (2.61)            | −5.13 (1.81)                           | −0.22 (1.92)                           |
| Baseline to 6 months                 | −0.07 (0.14)           | −0.18 (0.15)                           | −0.05 (0.13)                           |
| Baseline to 12 months                | −0.1 (0.21)            | −0.21 (0.22)                           | −0.08 (0.2)                            |

*N = 680 in overall cohort at 6 months.

*N = 286 in overall cohort at 12 months.

Similarly, for 12-month data, sensitivity of response at 1 month decreased and specificity increased as the cutoff criteria involved greater %BMI decrease. The maximum overall accuracy was observed at 82.2% with ≥ 4% BMI decrease at 1 month.

Prediction models

The results presented here are based on using a cutoff of ≥ 3% reduction in BMI at 1 month, which was chosen as a clinically reasonable BMI reduction. However, as observed in Figures 1 and 2, there were participants who were successful at 6 and 12 months despite being nonresponders based on a ≥ 3% cutoff. Therefore, we explored how cutoff values above or below 3% may affect the prediction of success (Table 5). Prevalence of success was defined as the percentage of individuals with ≥ 5% reduction in BMI from baseline at the 6- and 12-month time points. Sensitivity and specificity, as well as positive and negative predictive values, were calculated. Sensitivity and specificity provide the probability of a test (e.g., 3% loss at 1 month) being positive or negative when the condition (i.e., ≥ 5% later weight reduction) is present or absent, respectively. Positive and negative predictive values indicate the probability of achieving ≥ 5% BMI reduction when there is at least X% (i.e., 2, 3, 4, or 5) reduction at 1 month or not, respectively. Overall accuracy is the proportion of all tests that give a “correct” result.

For 6-month data, as the cutoff criteria increased from ≥ 2% to ≥ 5%, sensitivity of response at 1 month decreased and specificity increased. The maximum overall accuracy observed was 84.6% with ≥ 4% BMI decrease at 1 month.

Return rates for visits after 1 month in responders and nonresponders

We also explored whether response at 1 month might influence the rate of return for future visits. Table 6 shows the rates of return any time after a 1-month visit for responders (73%, n=211) and nonresponders (67.3%, n=1,295). The odds ratio based on response at 1 month for returning for at least one visit after that time was determined and adjusted for age, sex, race (white vs. other), ethnicity, and baseline BMI. There was no significant difference in return rates between responders and nonresponders.

Discussion

The findings from this study support that early (1 month) treatment response is significantly and strongly associated with greater long-term (6- and 12-month) BMI improvement among a large national sample of youth treated in PWM. In particular, participants who achieved ≥ 3% BMI reduction at 1 month, compared with those who did not achieve this benchmark, had more than 9 times greater odds of achieving ≥ 5% BMI reduction at 6 months and more than 5 times greater odds of achieving ≥ 5% BMI reduction at 12 months. These data are consistent with findings from adult samples and raise questions about current
pediatric obesity guidelines that recommend waiting 3 to 6 months to assess response to initial interventions before considering redirecting or intensifying treatment.

In the current study, only 16% of the sample met the responder status of ≥ 3% BMI reduction at 1 month. When compared with several other studies examining outcomes of lifestyle modification therapy for youth with severe obesity, mean BMI reduction in this group was similar (3,16). It is unclear what combination of individual (e.g., bio-psycho-social) or treatment factors contributed to the early success of the small subset of early responders. Given the retrospective nature of this analysis and the limited availability of individual-level information in this registry, in-depth analyses regarding these factors was not possible. Future studies of contributors to early response are indicated, as these may elucidate individual or treatment factors that are important for early response and could promote longer-term BMI reduction.

Unfortunately, there is no consensus on a standard time frame or amount of BMI reduction that clinicians should use to make treatment-altering decisions. In the current study, an a priori decision was made to define early response as ≥ 3% BMI reduction at 1 month. Ideally, pediatric obesity providers would have clearer guidance on when to make intervention changes and with whom. As a step toward identifying these standards for the treatment of pediatric obesity, predictive assessments using various 1-month weight loss cut points were evaluated with the current data. From these results, specificity and negative prediction were higher than sensitivity or positive prediction, suggesting that nonresponse at 1 month was highly predictive of later nonresponse. This negative predictive value may be due to the high prevalence of nonresponders. Practically, this indicates that nonresponders generally do not change course and, instead, continue to struggle with BMI reduction. This suggests that the nonresponders may require either an increase in treatment intensity or a change in modality (e.g., pharmacotherapy, alteration of macronutrient content of dietary regimen, adjunctive behavioral health intervention) to achieve meaningful BMI reduction.

Thus, waiting 3 to 6 months as recommended by current pediatric obesity guidelines may contribute to suboptimal outcomes, particularly among youth with severe obesity.

Attrition is often a concern with PWM, and it is reasonable to consider treatment response as a possible factor contributing to PWM adherence. However, the data from the present study suggest that early response to intervention is not associated with attrition from weight management intervention. More than two-thirds of each group, responders and nonresponders, returned at least once following the 1-month time point.
This study has many strengths, including a large sample size that was diverse with respect to gender, race, and ethnicity. Furthermore, there was participation from numerous PWM centers across the United States, enhancing the generalizability of the findings. However, the lack of standardized data collection methods in POWER, as well as of the PWM interventions themselves, limits the reproducibility of this study’s outcomes. Furthermore, it is unclear whether the methods by which some participants lost significant amounts of weight were a result of intervention guidelines or unhealthy weight loss behaviors. Additional limitations include the challenge in defining success
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in weight management. This study focused on the outcome of BMI reduction, which is just one aspect of change. Individuals may experience metabolic benefits without attaining the definitions of response and success used in this paper, and therefore, further studies are needed to define criteria for early response and longer-term success. Finally, there is no consensus on how to report BMI metrics in children (17). This study displayed results using multiple BMI metrics to increase interpretability and ability to compare outcomes with other studies.

### Conclusion

The current study shows that early (1-month) BMI reduction of ≥ 3% within the context of PWM programs is significantly associated with greater long-term (6- and 12-month) BMI reduction of ≥ 5%. Early nonresponders may be ideal candidates for early redirection or intensifications of treatment, contrary to current pediatric obesity treatment guidelines.

### TABLE 4

| Outcome                        | Responder at 1 month | Nonresponder at 1 month | OR (responders = 1) | P     |
|-------------------------------|----------------------|-------------------------|---------------------|-------|
| Successful at 6 months        | 56.5%                | 11.4%                   | 9.64 (5.85-15.87)   | <0.001|
| Successful at 12 months       | 48.9%                | 15.5%                   | 5.24 (2.49-11.02)   | <0.001|

### TABLE 5

| Cutoff values for losing X% BMI at 1 month | Prevalence (%) of 5% reduction | Sensitivity (%) for 5% reduction | Specificity (%) for 5% reduction | Positive predictive value (%) for X% reduction at 1 month | Negative predictive value (%) for X% reduction at 1 month | Overall accuracy of test (%) |
|--------------------------------------------|---------------------------------|----------------------------------|---------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------------------|
| ≥2%                                        | 18.5 (15.7-21.7)                | 65.1 (56.1-73.4)                 | 80.1 (76.6-83.4)                | 42.7 (35.6-50.0)                                          | 91.0 (88.1-93.4)                                          | 77.4 (74.0-80.4)            |
| ≥3%                                        | 48.4 (39.4-57.5)                | 91.5 (88.9-93.7)                 | 56.5 (46.6-66.0)                | 88.6 (85.7-91.1)                                          | 83.5 (80.5-86.2)                                          | 83.5 (80.5-86.2)            |
| ≥4%                                        | 31.7 (23.7-40.6)                | 96.6 (94.7-97.9)                 | 67.8 (54.4-79.4)                | 86.2 (83.2-88.8)                                          | 84.6 (81.6-87.2)                                          | 84.6 (81.6-87.2)            |
| ≥5%                                        | 23.0 (16.0-31.4)                | 98.2 (96.7-99.1)                 | 74.4 (57.9-87.0)                | 84.9 (81.9-87.6)                                          | 84.3 (81.3-86.9)                                          | 84.3 (81.3-86.9)            |

### TABLE 6

| Model       | Outcome                  | 1-month responder return | 1-month nonresponder return | OR (responders = 1) | P     |
|-------------|--------------------------|--------------------------|------------------------------|---------------------|-------|
| Unadjusted  | Return after 1-month visit | 73.0%                    | 67.3%                        | 1.31 (0.95-1.81)    | 0.103 |
| Adjusted    | Return after 1-month visit | 73.0%                    | 67.3%                        | 1.28 (0.90-1.83)    | 0.167 |

Models for unadjusted and adjusted for age, sex, race (Caucasian vs. other), ethnicity, and baseline BMI analyses presented with robust variance estimation. Responders \( n = 211 \), nonresponders \( n = 1295 \) (total \( n = 1506 \)). There was no significant difference in return rates between responders and nonresponders.
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References

1. Skinnan AC; Ravanbakti SN, Skelton JA, Perrin EM, Armstrong SC. Prevalence of obesity and severe obesity in US children, 1999–2016. Pediatrics 2018;141:e20173459. doi:10.1542/peds.2017-3459
2. Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics 2007;120(suppl1):S164-S192.
3. Danielsson P, Kowalski J, Ekbloom O, Marcus C. Response of obese children and adolescents to behavioral treatment. Arch Pediatr Adolesc Med 2012;166:1103-1108.
4. Knop C, Singer V, Uysal Y, Schaefer A, Wolters B, Reinehr T. Extremely obese children respond better than extremely obese adolescents to lifestyle interventions. Pediatr Obes 2015;10:7-14.
5. 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 (Silver Spring) 2015;23:1353-1356.
6. Unick J, Pellegrini C, Demos K, Dorfman L. Initial weight loss response as an indicator for providing early rescue efforts to improve long-term treatment outcomes. Curr Diab Rep 2017;17:69. doi:10.1007/s11892-017-0904-1
7. Braet C. Patient characteristics as predictors of weight loss after an obesity treatment for children. Obesity (Silver Spring) 2006;14:148-155.
8. Epstein LH, Wing RR, Koese R, Valoski A. A comparison of lifestyle exercise, aerobic exercise, and calisthenics on weight loss in obese children. Behav Ther 1985;16:345-356.
9. Goldschmidt AB, Stein RI, Saelens BE, Theim KR, Epstein LH, Wilfley DE. Importance of early weight change in a pediatric weight management trial. (Clinical report). Pediatrics 2011;128:E33-E39.
10. Hart CN, Jelalian E, Raynor HA, et al. Early patterns of food intake in an adolescent weight loss trial as predictors of BMI change. Eat Behav 2010;11:217-222.
11. Jelalian E, Hart CN, Mehlenbeck RS, et al. Predictors of attrition and weight loss in an adolescent weight control program. Obesity (Silver Spring) 2008;16:1318-1323.
12. 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? (Report). Int J Behav Nutr Phys Act 2016;13:43. doi:10.1186/s12966-016-0367-9
13. Wiegand S, Keller K-M, Lomb-Corizius T, et al. Predicting weight loss and maintenance in overweight/obese pediatric patients. Horm Res Paediatr 2015;82:380-387.
14. Kirk S, Armstrong S, King E, et al. Establishment of the Pediatric Obesity Weight Evaluation Registry: a national research collaborative for identifying the optimal assessment and treatment of pediatric obesity. Child Obes 2017;13:9-17.
15. Colman E. Food and drug administration’s obesity drug guidance document: a short history. Circulation 2012;125:2156-2164.
16. Johnston CA, Tyler C, Palcic JL, Stansberry SA, Gallagher MR, Foreyt JP. Smaller weight changes in standardized body mass index in response to treatment as weight classification increases. J Pediatr 2011;158:624-627.
17. Kelly A, Fox C, Rudser K, Gross A, Ryder JR. Pediatric obesity pharmacotherapy: current state of the field, review of the literature and clinical trial considerations. Int J Obes (Lond) 2016;40:1043-1050.