Published in final edited form as:

Curr Diab Rep. 2017 September ; 17(9): 69. doi:10.1007/s11892-017-0904-1.

Initial Weight Loss Response as an Indicator for Providing Early Rescue Efforts to Improve Long-Term Treatment Outcomes

Jessica L. Unick, PhD¹, Christine A. Pellegrini, PhD², Kathryn E. Demos, PhD¹, and Leah Dorfman, MS, MPH¹

¹The Miriam Hospital's Weight Control and Diabetes Research Center, Warren Alpert Medical School at Brown University; Providence, RI

²Department of Exercise Science, Arnold School of Public Health, University of South Carolina, Columbia, SC

Abstract

Purpose of review—There is large variability in response to behavioral weight loss (WL) programs. Reducing rates of obesity and diabetes may require more individuals to achieve clinically significant WL post-treatment. Given that WL within the first 1–2 months of a WL program is associated with long-term WL, it may be possible to improve treatment outcomes by identifying and providing additional intervention to those with poor initial success (i.e., ‘early non-responders’). We review the current literature regarding early non-response to WL programs and discuss how adaptive interventions can be leveraged as a strategy to ‘rescue’ early non-responders.

Recent findings—Preliminary findings suggest that adaptive interventions, specifically stepped-care approaches, offer promise for improving outcomes among early non-responders.

Summary—Future studies need to determine the optimal time point and threshold for intervening and the type of early intervention to employ. Clinicians and researchers should consider the discussed factors when making treatment decisions.

Keywords

behavioral weight loss; stepped-care; adaptive intervention; non-responder; lifestyle intervention

---

Contact information for Corresponding Author: Jessica L. Unick, Ph.D., Warren Alpert Medical School at Brown University, The Miriam Hospital's Weight Control and Diabetes Research Center, 196 Richmond Street, Providence, RI 02903, Telephone: 401-793-8966, Fax: 401-793-8944, junick@lifespan.org.

Contact information for co-authors:

Christine Pellegrini – pellecca@mailbox.sc.edu; Technology Center to Promote Healthy Lifestyles; University of South Carolina; Discovery I Building, Suite 403d; 915 Greene Street; Columbia, SC 29208

Kathryn Demos – kathryn_demos@brown.edu; address same as corresponding author

Leah Dorfman – ldorfman@lifespan.org; address same as corresponding author

Compliance with Ethical Standards

Conflict of Interest

Jessica L. Unick, Christine A. Pellegrini, Kathryn E. Demos, and Leah Dorfman declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent

All reports studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

Introduction

Obesity and diabetes are comorbid conditions which are major contributors to mortality in both the United States and worldwide [1, 2]. It has been projected that from 2010 to 2030 there will be a 69% increase in the number of adults with diabetes in developing countries and a 20% increase in developed countries [3]. Given that obesity is associated with an increased risk of developing diabetes, reducing rates of obesity can serve as a primary prevention method for combating diabetes diagnoses. Behavioral weight loss (WL) programs can reduce the cumulative incidence of diabetes among those at risk for diabetes as well as lead to partial or complete remission among many individuals with diabetes [4, 5]. Thus, effective WL interventions are crucial to help slow the staggering growth rates of diabetes worldwide.

Standard behavioral WL interventions traditionally employ a variety of behavioral modification techniques to assist individuals with reducing caloric intake and increasing physical activity [6, 7]. These interventions consistently produce average weight losses of 8–10% of initial body weight [8]; however they are costly and often result in a large degree of variability in WL response [9, 10]. For example, individuals with type 2 diabetes who received a standard behavioral WL intervention in the Look AHEAD trial lost on average 8.6% of initial body weight at 1 year [9]. Despite this successful rate of WL averaged across participants, only approximately two-thirds of participants achieved a 5% WL which is considered clinically significant, which means that nearly one-third of participants failed to achieve a clinically meaningful WL [9]. Given this heterogeneity in response, one strategy for improving obesity treatment outcomes and preventing diabetes is to tailor interventions so that a greater proportion of individuals achieve a clinically significant WL.

In general, behavioral WL programs provide the same treatment to all individuals, and tend to be resource intensive, as evidenced by a cost of \$1800 per person in the first year of the Diabetes Prevention Program [10]. Implementing these costly treatment components, such as in-person sessions, to those who are responding well may unnecessarily increase costs and exhaust the resources available to those struggling to lose weight [11, 12]. Previous studies indicate that WL during the first few months of treatment is significantly associated with post-treatment or longer-term WL outcomes [13–22]. Therefore, it may be useful to adapt interventions based upon how a patient initially responds, allowing individuals to start with a less intensive and lower cost treatment, only providing additional intensive treatment to those who are non-responsive. This strategy would allow for additional intervention resources to be reserved for ‘early non-responders’ (i.e., individuals with lower than expected WL during the first 1–2 months of treatment) and could potentially increase the proportion of individuals achieving a clinically significant WL.

The purpose of this review is to: 1) summarize the existing literature regarding the association between early and long-term WL, 2) describe stepped-care or adaptive interventions and discuss how they can be leveraged to improve WL outcomes for early non-responders in obesity treatment programs, 3) discuss approaches for determining the WL threshold and optimal time point for identifying and intervening upon early non-responders,

and 4) discuss several ‘early rescue’ adaptive intervention approaches and offer suggestions for future research in this area.

Early weight loss or program adherence as a marker of success

Over the past two decades, secondary analyses have shown that WL achieved within the first few months of a WL program is positively associated with post-treatment and longer-term WL outcomes [13–22]. These findings have been observed among individuals with and without diabetes as well as across various types of WL programs. For example, WL programs that have been delivered individually [23, 17, 24], in a group-based setting, and via the Internet [20] have all found that early WL is related to post-treatment WL outcomes. Similarly, WL programs that included low-calorie or very low-calorie diets [24, 18] also demonstrate the importance of early WL for long-term WL success.

Although the evidence linking early WL with both short- and long-term WL is consistent, challenges remain in trying to define early WL response due to the variability in the criteria used across the literature. ‘Early non-response’ is most commonly referred to as WL below a specific threshold, typically ranging between 0.5%–3% of initial body weight during the first 1–2 months of a WL program [22, 15, 20, 25, 13]. On average, approximately one-quarter to one-third of participants enrolled in a WL program are classified as early non-responders, depending upon the criteria utilized [15, 13, 20]. Individuals whose WL falls below the 0.5%–3% range in the first 2 months generally have lower post-treatment or long-term WL success. In fact, individuals who fail to reach these early WL thresholds are between 3 to 11 times less likely to achieve a clinically significant WL compared to individuals with greater WL initially [15, 21, 25, 13, 14].

As illustrated in Figure 1, WL within the first 1 month of treatment in the Look AHEAD trial was predictive of WL at 1, 4, and 8 years [14]. These data suggest that many individuals remain on the same weight change trajectory established early on in a WL program. However, it is unclear exactly how soon after starting a WL program a response trajectory predictive of long-term WL outcomes can be determined. ‘Very early WL’, defined as WL within the first 1–3 weeks of treatment, is also predictive of post-treatment WL, yet the predictive power of ‘very early’ WL is not as strong as ‘early’ WL achieved in the first 1–2 months [25, 21]. Although the optimal time point for identifying early non-responders remains unclear, these preliminary findings suggest that WL at months 1 or 2 may be a slightly better predictor of long-term WL rather than WL achieved during the first 1–3 weeks of treatment.

In addition to early WL response, examining adherence to WL program recommendations within the first few months of a program may be another potential method for identifying individuals with a reduced likelihood of WL success. Some evidence suggests that early non-responders have poorer adherence to intervention recommendations (e.g., lower session attendance, fewer days of self-monitoring) during the first 1–2 months of an intervention [20, 14, 15]. However because most participants, including early non-responders, tend to have high adherence during the initial stages of a WL program, it is challenging to define early non-adherence in a clinically meaningful way, as there tends to be little variability

between individuals early in a WL program [14]. Until additional research is conducted to identify concrete adherence thresholds, weight change may be a more appropriate measure for identifying early non-responders for several reasons. First, the evidence linking early and long-term WL outcomes is stronger than the associations observed between early adherence and long-term WL. Second, similar WL thresholds for identifying early non-responders could be utilized across studies, whereas adherence metrics vary based upon the intervention components (i.e., in-person sessions vs. telephone sessions). Finally, weight is an easy measure to obtain within clinical practice or a home-based setting, whereas measuring and defining adherence can often be challenging. For example, there is not a clear way to measure adherence to dietary self-monitoring, which makes identifying an adherence threshold to define non-response even more difficult [26].

Tailoring treatment for early non-responders

Given the association between early WL response and post-treatment or long-term WL, it is important to explore strategies to assist early non-responders in achieving a clinically significant WL. Pharmacotherapy guidelines from the Food and Drug Administration suggest that if a patient does not lose 3% of initial body weight while taking the recommended dose of a WL drug at 12 weeks, then either the pharmacotherapy regimen be discontinued, or for certain drugs, that the treatment be continued for an additional 12 weeks at a higher dose. If after an additional 12 weeks the patient does not achieve a 5% WL, it is recommended that the drug be discontinued [27]. Further, current Medicare guidelines state that individuals losing <3kg after 6 months of intensive WL treatment are required to have their readiness to change assessed prior to further treatment [28]. While these obesity treatment guidelines imply that there may not be an additional therapeutic or cost advantage of continuing with the same treatment if an individual is initially unsuccessful, data discussed above indicate that these non-responders may be able to be identified even earlier than 3 months. Thus, early in a WL program may be an opportune time to identify 'high risk' individuals and to provide additional intervention or 'rescue' efforts in an attempt to jump start WL among these initially non-responsive individuals. One method for testing the efficacy of early intervention for early non-responders is through the use of adaptive interventions.

Using adaptive and stepped care interventions to intervene upon early non-responders

Adaptive interventions have the ability to adjust the sequence of treatment over time based upon one's needs, characteristics, or response, resulting in an individualized program for each participant. Stepped care is one such approach that adapts treatment based on individual response [12]. Often, stepped care consists of starting with less costly interventions first and then providing additional, more costly and aggressive treatment to those who do not meet a specific criterion at a predetermined time point. A stepped care intervention approach has been utilized within a number of WL trials and the findings have been mixed. However as detailed below, these studies have varied greatly in terms of the intervention employed and criteria for early non-response.

Table 1 highlights several of these stepped care studies. Study durations ranged from 12 weeks to 18 months and most had small sample sizes ($n \leq 50$). Some studies used only one time point and WL threshold for identifying early non-responders [29–31], while others assessed WL at various time points and intervened if an individual fell below a specific WL criteria at any one of these time points [11, 32, 33]. Intervention modifications for early non-responders included weekly individual therapy focused on problem solving [11] or motivational interviewing [32], group-based stimulus control lessons [30] or standard behavioral WL [29], or a combination of individual sessions, telephone calls, and meal replacement products [33, 31]. While discrepant findings were observed across studies, most demonstrated a favorable effect of additional intervention for early non-responders [31, 11, 32]. For the studies in which a stepped care approach did not improve WL, early non-responders were not identified until 3 months, suggesting that this may be too late to intervene [33, 29]. This highlights the importance for determining appropriate decision points and the critical window of opportunity in which to rescue these early non-responders.

When building an adaptive intervention to treat early non-responders in a WL program, it is necessary to determine *whom* to intervene upon, *how* to intervene, and *when* to intervene. This includes determining the optimal time point and threshold for defining early non-response, the type of ‘rescue’ strategy to employ while considering the cost and burden of additional intervention, and whether to re-assess WL following initial rescue efforts. Currently, there are no uniform thresholds for identifying early non-responders, nor are there standardized early intervention approaches for non-responders. These decisions can vary based upon the type or intensity of the initial intervention and the goals of the researcher or clinician. Future trials are clearly needed to assist clinicians and researchers in making empirically-based decisions. Some factors that should be considered when designing such a study are discussed below.

Whom to intervene upon: Choosing an appropriate WL threshold for identifying early non-responders

In order to identify who is an early non-responder, a WL threshold or criteria must be determined. When choosing this WL threshold, many factors need to be considered including the clinician, researcher, and/or patient goals, as well as the cost of the treatment being provided. For instance, the cost of providing supplemental treatment to early non-responders may need to be weighed against the number of individuals that would receive this supplemental treatment who actually need it (i.e., true positives) versus those who would receive, but did not need it and would have achieved a clinically significant WL without early intervention (i.e., false positives). If the cost of the ‘rescue’ efforts are high, choosing a WL threshold with the lowest rate of false positives may be ideal (i.e., a low percentage of individuals incorrectly identified as needing additional intervention, when they would have been able to achieve a clinically significant WL without the ‘rescue’ efforts). However, this also means that a large number of individuals who may need supplemental intervention would not receive it (i.e., high false negative rate). If on the other hand, the cost of the supplemental intervention is low, the goal may be to maximize the number of individuals receiving supplemental treatment who need it (true positives) and minimize the number of

individuals not receiving supplemental treatment, but who may have benefited from it (false negatives) [13].

To date, studies have examined early WL thresholds ranging from 0.5% to 7%, but only a few have reported sensitivity and specificity rates [13, 19, 21, 17]. For example, one study [13] evaluated several early WL thresholds for predicting achievement of a 10% WL and suggested that a 3% WL threshold at month 2 minimizes false positives (i.e., only 5.9% of individuals who actually need additional intervention would not have received it if this threshold was used). This WL threshold and timing may be optimal if a high cost intervention is provided. Conversely, if the cost of the intervention was low, a 5% WL threshold at month 2 might be considered because it maximizes the number of individuals receiving additional support when it is actually needed (74%). Investigators and clinicians should consider this potential trade-off when making treatment decisions and consult previous studies which have examined the sensitivity and specificity of different WL thresholds.

To date, only a handful of stepped care trials have been conducted and all have utilized slightly different early WL thresholds for identifying and intervening upon early non-responders (see Table 1). These have included <1% WL at week 3 [11, 32], <2.3% at week 4 [31], and <5% at week 12 [33, 29]. Further, several of these studies sought to identify early non-responders at several time points versus a single time point, thus the threshold varied depending upon the time point assessed (e.g., <1% at week 3 or <2% at week 12; [11, 32]). Therefore, it is difficult to make empirically-based recommendations for choosing the appropriate threshold for intervening upon early non-responders, as too few intervention studies have examined the effectiveness of a stepped-care approach and inconsistent thresholds have been utilized. Further, there is likely no single ideal threshold for identifying early non-responders - this decision will likely be dependent upon the goals of the investigator or clinician.

How to Intervene: Choosing an appropriate intervention for early non-responders

Determining how to best to intervene upon early non-responders is crucial for improving the efficacy of adaptive interventions for obesity treatment. Many options exist for how to alter the existing intervention for non-responders, whether this includes adjusting the intensity of the intervention (e.g., providing additional in-person coaching sessions) or adding new intervention components (e.g., adding text messages or meal replacements to initial treatment). The decision of how to adapt treatment for non-responders will also be highly dependent upon the type of initial intervention delivered. For example, if the initial intervention was an Internet-based program, it may be advantageous to offer individual, face-to-face counseling as a strategy to 'jump start' WL. Conversely, if the program is an intensive face-to-face intervention delivered twice per week, it may not be advantageous to offer more contact time as a potential 'rescue' strategy. Instead, altering the intervention prescription may be a better alternative. Further, early intervention components should be chosen based upon their empirical efficacy when included within standard behavioral WL trials and should address WL barriers common to non-responders. For example, food-specific and general self-regulation difficulties, not knowledge, are associated with

suboptimal WL outcomes. Thus one approach would be to examine whether strategies to improve self-regulation can effectively ‘rescue’ early non-responders. To date, studies which have utilized problem solving [11], motivational interviewing [32], and a combination of goal setting and meal planning [31] as an early intervention for non-responders have proven to be successful (see Table 1); however much more work is needed to determine the most effective approaches for early non-responders.

When to intervene upon early non-responders

In addition to determining an appropriate WL threshold and treatment modification, it is equally important to consider the optimal time point(s) for assessing early non-response. There is a fine line between choosing to intervene too early and waiting to intervene until it is too late. If participants are identified too early in treatment as needing additional support, they may feel frustrated or alienated from others in the program if they are removed from the program to receive extra support; thus this may limit the effectiveness of the early intervention [19]. Conversely, if participants are identified too late, they may already feel discouraged or they may have already begun to disengage in the program, thereby reducing the effectiveness of the early intervention. Moreover, patients may have less time to ‘catch up’ to those who were initially successful if supplemental treatment is provided too late in the intervention. For example, one study provided early non-responders with additional intervention support between weeks 6 and 8 and then allowed these participants to continue on with regular treatment [31]. While this additional intervention positively altered the WL trajectory among early non-responders, 12-week weight losses were still significantly lower than initial responders, possibly because this design only allowed these individuals 4 additional weeks to ‘catch up’ to the initial responders. Thus, when designing studies with early intervention, it is important that early non-responders are given ample time to absorb the content of the early intervention and change their behaviors, prior to evaluating the effectiveness of these rescue efforts.

Another factor to consider when determining the timing for intervening on early non-responders is whether WL response should be assessed at multiple time points. Thus far, the focus has been on choosing an early WL threshold and using this threshold to identify and intervene upon early non-responders. However, using a single WL threshold at one time point fails to provide additional intervention to individuals originally classified as initial responders, but never go on to achieve a clinically significant WL (i.e., false negatives). Generally, lower initial WL thresholds for identifying early non-responders result in higher rates of false negatives (i.e., a higher number of individuals not receiving early intervention who need it); thus in these instances it may be advantageous to assess WL at several time points. For example, Waring and colleagues [19] found that 16–42% of women who achieved the target WL at week 3 (>1 lb/week), were no longer achieving the targeted WL during weeks 4–8. Evaluating WL progress at week 3 and again at week 8 improved sensitivity rates significantly compared to when assessed only at 3 weeks. Given that some individuals may achieve an early WL threshold but then drop below WL standards at another time point, reassessment of WL at multiple time points may be appropriate; however much more work in this area is needed to say definitively.

As summarized in Table 1, only a few studies have examined stepped-care approaches for intervening upon early non-responders and the time point when early response was assessed varied between studies. Two of the studies waited until 12 weeks to identify and intervene upon early non-responders and in these instances, the stepped care approach was not effective [33, 29]. However, early intervention was found to be effective when individuals received additional intervention as early as week 3 [34, 32] or week 4 [31]. Although the data is limited, together these findings suggest that intervening sooner rather than later, may be optimal for improving WL outcomes.

Future Directions

As highlighted above, when designing a stepped care or adaptive intervention, it is challenging to determine the optimal treatment approach, the appropriate decision points and WL thresholds, and the criteria associated with evaluating response. One way to work towards answering these critical questions is to use a Sequential Multiple Assignment Randomized Trial (SMART). A SMART is a multi-stage randomized trial that allows participants to move through different stages of treatment by evaluating progress using individually tailored decision rules [35, 36]. Based on pre-determined decision rules, participants may be re-randomized at specific time points to receive varying levels of treatments, allowing for the examination of these adaptations. Over the years, SMART has gained increasing attention as many researchers and clinicians see this experimental design as an efficient way to build towards individually tailored treatment. For example, the BestFIT study by Sherwood and colleagues [37] is the first to use SMART to compare early intervention approaches for non-responders. In this study, the researchers are examining whether sub-optimal responders to the standard WL treatment can achieve a greater WL when treatment is adjusted to include either portion-controlled meals or acceptance-based behavior treatment. Further, they are simultaneously examining whether it is optimal to provide additional intervention at 1 or 2 months. Ongoing and future trials utilizing the SMART experimental design can help inform future adaptive interventions aimed at providing the most effective and timely rescue strategies to early non-responders, thereby increasing the number of individuals achieving success within a WL program.

Conclusion

As the prevalence of type 2 diabetes is expected to rise, WL interventions must be improved so that a greater proportion of patients achieve a clinically significant WL, thereby preventing or delaying future diabetes diagnoses. Early WL is a feasible and reliable indicator of treatment success and is easy to assess within a clinic or WL program. Preliminary studies show promise for improving WL outcomes by intervening upon early non-responders in the first 1–2 months of treatment. Additional research is needed to better understand the optimal time point(s) for intervening upon early non-responders and the type of early intervention or support that is most effective for ‘rescuing’ these individuals. While many of these decisions are dependent upon the goals of the researcher or clinician, the SMART experimental design provides an opportunity for systematically assessing the efficacy of a variety of interventions and early intervention timing. Moreover, the use of

SMART can help facilitate the use of more empirically-supported decisions when designing adaptive interventions.

Acknowledgments

Dr. Unick is supported by the National Institutes of Health grant K01DK100498.

References

Papers of particular interest, published recently, have been highlighted as:

• Of importance

•• Of major importance

1. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA*. 2003; 289(1):76–9. [PubMed: 12503980]
2. Morgan CL, Currie CJ, Peters JR. Relationship between diabetes and mortality: a population study using record linkage. *Diabetes Care*. 2000; 23(8):1103–7. [PubMed: 10937505]
3. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract*. 2010; 87(1):4–14. DOI: 10.1016/j.diabres.2009.10.007 [PubMed: 19896746]
4. Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, et al. Diabetes Prevention Program Research G. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *Lancet*. 2009; 374(9702):1677–86. DOI: 10.1016/S0140-6736(09)61457-4 [PubMed: 19878986]
5. Gregg EW, Chen H, Wagenknecht LE, Clark JM, Delahanty LM, Bantle J, et al. Association of an intensive lifestyle intervention with remission of type 2 diabetes. *JAMA*. 2012; 308(23):2489–96. DOI: 10.1001/jama.2012.67929 [PubMed: 23288372]
6. Wadden TA, West DS, Delahanty L, Jakicic J, Rejeski J, Williamson D, et al. The Look AHEAD study: a description of the lifestyle intervention and the evidence supporting it. *Obesity (Silver Spring)*. 2006; 14(5):737–52. 14/5/737 [pii]. DOI: 10.1038/oby.2006.84 [PubMed: 16855180]
7. Butryn ML, Webb V, Wadden TA. Behavioral treatment of obesity. *Psychiatr Clin North Am*. 2011; 34(4):841–59. DOI: 10.1016/j.psc.2011.08.006 [PubMed: 22098808]
8. Wadden TA, Butryn ML, Wilson C. Lifestyle modification for the management of obesity. *Gastroenterology*. 2007; 132(6):2226–38. DOI: 10.1053/j.gastro.2007.03.051 [PubMed: 17498514]
9. Wadden TA, West DS, Neiberg RH, Wing RR, Ryan DH, Johnson KC, et al. One-year weight losses in the Look AHEAD study: factors associated with success. *Obesity (Silver Spring)*. 2009; 17(4): 713–22. oby2008637 [pii]. DOI: 10.1038/oby.2008.637 [PubMed: 19180071]
10. Diabetes Prevention Program Research G. The 10-year cost-effectiveness of lifestyle intervention or metformin for diabetes prevention: an intent-to-treat analysis of the DPP/DPPOS. *Diabetes Care*. 2012; 35(4):723–30. DOI: 10.2337/dc11-1468 [PubMed: 22442395]
11. Carels RA, Darby L, Cacciapaglia HM, Douglass OM, Harper J, Kaplar ME, et al. Applying a stepped-care approach to the treatment of obesity. *J Psychosom Res*. 2005; 59(6):375–83. DOI: 10.1016/j.jpsychores.2005.06.060 [PubMed: 16310019]
12. Haaga DA. Introduction to the special section on stepped care models in psychotherapy. *J Consult Clin Psychol*. 2000; 68(4):547–8. [PubMed: 10965628]
13. Unick JL, Hogan PE, Neiberg RH, Cheskin LJ, Dutton GR, Evans-Hudnall G, et al. Evaluation of early weight loss thresholds for identifying nonresponders to an intensive lifestyle intervention. *Obesity (Silver Spring)*. 2014; 22(7):1608–16. DOI: 10.1002/oby.20777 [PubMed: 24771618]
14. Unick JL, Neiberg RH, Hogan PE, Cheskin LJ, Dutton GR, Jeffery R, et al. Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. *Obesity (Silver*

- Spring). 2015; 23(7):1353–6. Demonstrates that 1-month weight loss predicts weight loss outcomes at 4 and 8 years. DOI: 10.1002/oby.21112 [PubMed: 26110890]
15. Nackers LM, Ross KM, Perri MG. The association between rate of initial weight loss and long-term success in obesity treatment: does slow and steady win the race? *Int J Behav Med*. 2010; 17(3):161–7. DOI: 10.1007/s12529-010-9092-y [PubMed: 20443094]
  16. 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):265–82. DOI: 10.1016/S1471-0153(03)00029-1 [PubMed: 15000970]
  17. Kong W, Langlois MF, Kamga-Ngande C, Gagnon C, Brown C, Baillargeon JP. Predictors of success to weight-loss intervention program in individuals at high risk for type 2 diabetes. *Diabetes Res Clin Pract*. 2010; 90(2):147–53. DOI: 10.1016/j.diabres.2010.06.031 [PubMed: 20655608]
  18. 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):361–6. S0738-3991(10)00039-X [pii]. DOI: 10.1016/j.pec.2010.02.006 [PubMed: 20223613]
  19. Waring ME, Schneider KL, Appelhans BM, Busch AM, Whited MC, Rodrigues S, et al. Early-treatment weight loss predicts 6-month weight loss in women with obesity and depression: implications for stepped care. *J Psychosom Res*. 2014; 76(5):394–9. DOI: 10.1016/j.jpsychores.2014.03.004 [PubMed: 24745781]
  20. Unick JL, Leahey T, Kent K, Wing RR. Examination of whether early weight loss predicts 1-year weight loss among those enrolled in an Internet-based weight loss program. *Int J Obes (Lond)*. 2015; 39(10):1558–60. DOI: 10.1038/ijo.2015.89 [PubMed: 25982792]
  21. Miller CK, Nagaraja HN, Weinhold KR. Early weight-loss success identifies nonresponders after a lifestyle intervention in a worksite diabetes prevention trial. *J Acad Nutr Diet*. 2015; 115(9):1464–71. DOI: 10.1016/j.jand.2015.04.022 [PubMed: 26095435]
  22. Batterham M, Tapsell L, Charlton K, O'Shea J, Thorne R. Using data mining to predict success in a weight loss trial. *J Hum Nutr Diet*. 2017; doi: 10.1111/jhn.12448
  23. Stotland SC, Larocque M. Early treatment response as a predictor of ongoing weight loss in obesity treatment. *Br J Health Psychol*. 2005; 10(Pt 4):601–14. DOI: 10.1348/135910705X43750 [PubMed: 16238868]
  24. Handjieva-Darlenska T, Handjiev S, Larsen TM, van Baak MA, Jebb S, Papadaki A, et al. Initial weight loss on an 800-kcal diet as a predictor of weight loss success after 8 weeks: the Diogenes study. *Eur J Clin Nutr*. 2010; 64(9):994–9. DOI: 10.1038/ejcn.2010.110 [PubMed: 20588292]
  25. Garvin JT, Hardy D, Xu H. Initial Response to Program, Program Participation, and Weight Reduction Among 375 MOVE! Participants, Augusta, Georgia, 2008–2010. *Prev Chronic Dis*. 2016; 13:E55.doi: 10.5888/pcd13.150598 [PubMed: 27103265]
  26. Burke LE, Wang J, Sevick MA. Self-monitoring in weight loss: a systematic review of the literature. *J Am Diet Assoc*. 2011; 111(1):92–102. DOI: 10.1016/j.jada.2010.10.008 [PubMed: 21185970]
  27. US Food and Drug Administration. Medications target long-term weight control: consumer health information. Silver Spring, MD: US Food and Drug Administration; 2012.
  28. Centers for Medicare and Medicaid Services. Final coverage decision memorandum for intensive behavioral therapy for obesity. 2011.
  29. Carels RA, Young KM, Coit CB, Darby LA, Clayton AM, Spencer AC, et al. The failure of therapist assistance and stepped-care to improve weight loss outcomes. *Obesity (Silver Spring)*. 2008; 16(6):1460–2. DOI: 10.1038/oby.2008.49 [PubMed: 18356835]
  30. Carels RA, Wott CB, Young KM, Gumble A, Darby LA, Oehlhof MW, et al. Successful weight loss with self-help: a stepped-care approach. *J Behav Med*. 2009; 32(6):503–9. DOI: 10.1007/s10865-009-9221-8 [PubMed: 19521759]
  - 31•. Unick JL, Dorfman L, Leahey TM, Wing RR. A preliminary investigation into whether early intervention can improve weight loss among those initially non-responsive to an internet-based behavioral program. *J Behav Med*. 2016; 39(2):254–61. Randomized trial examining early intervention for early non-responders within Internet-based program. DOI: 10.1007/s10865-015-9691-9 [PubMed: 26518207]

32. Carels RA, Darby L, Cacciapaglia HM, Konrad K, Coit C, Harper J, et al. Using motivational interviewing as a supplement to obesity treatment: a stepped-care approach. *Health Psychol.* 2007; 26(3):369–74. DOI: 10.1037/0278-6133.26.3.369 [PubMed: 17500624]
33. Jakicic JM, Tate DF, Lang W, Davis KK, Polzien K, Rickman AD, et al. Effect of a stepped-care intervention approach on weight loss in adults: a randomized clinical trial. *JAMA.* 2012; 307(24): 2617–26. DOI: 10.1001/jama.2012.6866 [PubMed: 22735431]
34. Carpeggiani C, Emdin M, Bonaguidi F, Landi P, Michelassi C, Trivella MG, et al. Personality traits and heart rate variability predict long-term cardiac mortality after myocardial infarction. *Eur Heart J.* 2005; 26(16):1612–7. ehi252 [pii]. DOI: 10.1093/eurheartj/ehi252 [PubMed: 15827060]
35. Lei H, Nahum-Shani I, Lynch K, Oslin D, Murphy SA. A “SMART” design for building individualized treatment sequences. *Annu Rev Clin Psychol.* 2012; 8:21–48. DOI: 10.1146/annurev-clinpsy-032511-143152 [PubMed: 22224838]
36. Almirall D, Nahum-Shani I, Sherwood NE, Murphy SA. Introduction to SMART designs for the development of adaptive interventions: with application to weight loss research. *Transl Behav Med.* 2014; 4(3):260–74. DOI: 10.1007/s13142-014-0265-0 [PubMed: 25264466]
37. Sherwood NE, Butryn ML, Forman EM, Almirall D, Seburg EM, Lauren Crain A, et al. The BestFIT trial: A SMART approach to developing individualized weight loss treatments. *Contemp Clin Trials.* 2016; 47:209–16. First SMART weight loss trial comparing early intervention approaches. DOI: 10.1016/j.cct.2016.01.011 [PubMed: 26825020]

Figure 1.

Weight change over an 8-year period, stratifying participants based upon 1-month weight change. Data collected from participants in the Look AHEAD trial who received a standard behavioral weight loss intervention. (Reprinted from [14•]. Copyright © 2015 John Wiley & Sons. Used with permission).

Randomized trials which utilized a stepped care intervention approach for early non-responders in a weight loss program

Table 1

Reference	Subjects	Study Design and Length	Criteria for identifying non-responders	Intervention for non-responders	Results	Effect of stepped care
Carels et al. [11]	44 adults with a BMI > 30 kg/m ² (M age 47.0 ± 9.3 years; 88.6% female)	RCT: BWL vs. BWL+SC BWL = 6-mo LEARN [‡] program; 6-mo maintenance phase; no intervention from 12–18 mo. BWL+SC received problem solving therapy	Any one of the following: <1% WL at week 3 <1% between weeks 3–6 <2% WL between weeks 6–12 <2% WL between weeks 12–18	Weekly (45–60 min), individual problem solving therapy with clinical psychologist	Non-responders BWL: 14/20 (70%)* Non-responders BWL+SC: 7/20 (35%) BWL vs. BWL+SC comparison (sig): BWL: 6-mo WL: -14.6 lbs BWL+SC: 6-mo WL: -21.1 lbs BWL vs. BWL+SC non-responders only: 6-months (NS): BWL: -9.1 lbs BWL+SC: -14.7 lbs 6–12 months (Sig): BWL: +11.5 lbs BWL+SC: +5.1 lbs	Positive
Carels et al. [29]	54 adults with a BMI 27 kg/m ² (M age 48.2 ± 8.9 years; 78.0% female)	RCT: 14-wk self-help (SH) or therapist-assisted SH (TASH). TASH received 2, 45-min face-to-face sessions and weekly phone calls.	<5% WL at month 3	Weekly group-based BWL sessions (75 min) with weekly weigh-ins for additional 12 weeks	Non-responders SH: 10/21 (48%) Non-responders TASH: 9/23 (39%) Effect of stepped care (NS): Receiving SC: 6-mo WL: -0.2 lbs Not receiving SC: 6-mo WL: -20 lbs	No effect
Carels et al. [32]	55 adults with a BMI 30 kg/m ² (M age 48.3 ± 11.0 years; 86.8% female)	RCT: BWL vs. BWL+SC BWL = 20-session LEARN program over 6 months BWL+SC received motivational interviewing (MI)	Any one of the following: <1% WL at week 3 <1% between weeks 3–6 <2% WL between weeks 6–12 <2% WL between weeks 12–18	Weekly MI individual session (45–60 min); MI was discontinued when ppts met WL goal	Non-responders BWL: 16/22 (73%) Non-responders BWL+SC: 19/24 (79%) BWL vs. BWL+SC comparison (NS) BWL: 6-mo WL: -3.8 kg BWL+SC: 6-mo WL: -5.8 kg BWL vs. BWL+SC non-responders only (Sig): BWL: 6-mo: -2.1 kg BWL+SC: 6-mo: -4.5 kg	Positive
Jakicic et al. [33]	363 adults (M age 42.2 ± 9.0 years; 82.6% female; BMI = 33.0 ± 3.6 kg/m ²)	RCT: BWL vs. STEP BWL: group-based, 18-mo BWL (weekly mo. 1–6, bi-monthly, mo. 7–12, monthly mo. 13–18) STEP = ppts start at 'Step 1' which was monthly group session with behavioral lesson delivered by mail	Any one of the following: <5% at 3 mo <7% at 6 mo <10% at 9 mo <10% at 12 mo <10% at 15 mo	Steps: 2=BWL lesson + 1 phone call 3=BWL lesson + 2 phone calls 4 = BWL lesson + 2 phone calls and 1 individual session 5=Step 4 + meal replacements 6 = Step 5 +1 additional individual session Ppts continue progressing to next step if WL goal was not achieved at subsequent step	Non-responders: 154/198 (77.8%) progressed beyond initial step of intervention. 85% of STEP ppts who progressed to Step 2 at month 3, continued to increase 1 additional step every 3 months (i.e., few early non-responders were 'rescued'). Effect of stepped care: 18-mo WL (NS): - BWL: -8.1% - STEP: -6.9%	No Effect
Unick et al. [31]	100 adults (M age 51.7 ± 10.3 years; 92.0% female;	RCT: IBWL vs. IBWL+SC 12-wk internet-based WL program with weekly	<2.3% WL at end of week 4	30-min individual session, followed by 2, 10-min follow-up phone calls. Customized meal plans and goal setting were used.	Non-responders IBWL: 21/49 (43%) Non-responders IBWL+SC: 13/46 (28%) IBWL vs. IBWL+SC comparison (NS):	Positive

Reference	Subjects	Study Design and Length	Criteria for identifying non-responders	Intervention for non-responders	Results	Effect of stepped care
	BMI = 33.4 ± 6.6 kg/m ²	video lessons and self-monitoring			IBWL: 12-wks: -4.9% IBWL+SC: 12-wks: -5.0% IBWL vs IBWL+SC non-responders only (Sig) 12-week WL: - IBWL early non-responders: -3.9% - IBWL+SC early non-responders -1.8%	

WL = weight loss; RCT = randomized control trial; BWL = behavioral weight loss; SC = stepped care; mo=months; ppts = participants; PA = physical activity; IBWL = internet behavioral weight loss; wks = weeks; NS = no significant difference between groups reported; sig = significant difference between groups reported.

* When calculating percentage of participants failing to meet early weight loss threshold, drop outs were excluded from the total n.

[‡]LEARN program = Lifestyle, Exercise, Attitudes, Relationships, Nutrition; A comprehensive weight management program with standardized manuals.