

ORIGINAL ARTICLE

Factors associated with early non-response within an Internet-based behavioural weight loss program

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Summary

Objective

While behavioural weight loss interventions are effective overall, many individuals fail to achieve a clinically significant weight loss. Given that 4-week weight loss has been shown to predict longer term outcomes, one potential strategy for improving rates of success is to provide additional support to early non-responders. To inform these early rescue efforts, it is important to first identify how they may differ from their more successful peers.

Methods

At week 4 of a 12-week Internet-delivered weight loss program, 130 adults (age: 49.8 ± 9.8 years, body mass index: $31.2 \pm 4.6 \text{ kg m}^{-2}$) were asked to complete an 11-item survey assessing mood and weight-related cognitions and behaviours. Participants were then categorized as early non-responders (4-week weight loss $<2\%$) or initial responders (4-week weight loss $\geq 2\%$), and groups were compared on intervention adherence during weeks 1–4 and week 4 survey question responses.

Results

Early non-responders and initial responders did not differ on any intervention adherence variables (p s > 0.05). Compared to initial responders, early non-responders reported less positive mood ($p = 0.011$), greater boredom with weight loss efforts ($p = 0.036$), greater temptation to eat foods not consistent with their goals ($p = 0.023$), and that their eating choices were less consistent with their goals ($p < 0.001$).

Conclusions

These findings identify important differences between early non-responders and initial responders, offering potential intervention targets for rescuing early non-responders (i.e. making it easier for individuals to choose healthier foods, reducing boredom in Internet-delivered weight loss programs and providing strategies to limit exposure to dietary temptations).

Keywords: Behaviour modification, obesity, weight loss.

Introduction

The population-level scope of the current obesity epidemic (1) highlights a need for effective, scalable and affordable weight loss interventions. Given that nearly 90% of U.S. adults report using the Internet (2), Internet-delivered weight loss (IDWL) programs have become increasingly popular. Research suggests that these low-intensity Internet-based programs vary in effectiveness,

with weight losses typically ranging from 2 to 4.5 kg (3,4) and are overall less effective at producing weight loss than traditional face-to-face programs (5–8). As IDWL programs have wide-scale dissemination potential (5), strategies for adapting and improving these interventions are needed.

One potential strategy for improving IDWL programs is to utilize a stepped-care intervention approach. In the stepped care model, individuals are provided with a low

cost, minimally intensive intervention (e.g. a standard, low-intensity IDWL program) and are only provided with a more intensive (and more costly) treatment if they fail to meet specific criteria at a predetermined time point (9,10).

Previous research indicates that 4-week weight loss consistently predicts short- and long-term outcomes (11–15); while one study demonstrated that weight loss observed at 8 weeks was a stronger predictor of long-term outcomes compared to 4-week weight losses (11), existing intervention evidence suggests that waiting too long to 'step-up' individuals to more intensive treatment approaches may lead to participant disengagement and suboptimal weight loss outcomes (7,16).

To date, only one study has attempted to randomize early non-responders to receive additional support as early as 4 weeks. This study defined non-responders as participants achieving $<2.3\%$ weight loss at 4 weeks and randomized these individuals to receive either 3 weeks of extra support (provided via a weekly coaching call) or no extra support (14). Compared to early non-responders who received no extra support, those randomized to receive extra support demonstrated significant improvements in program adherence (e.g. self-monitoring and website usage) and greater weight loss at 12 weeks. These preliminary findings suggest that it may be possible to improve the weight change trajectory of early non-responders by supplementing an IDWL program with more intensive support.

The next step in this area of research is to begin to understand what types of interventions may be most effective for 'rescuing' early non-responders. Little is known, however, about how early non-responders and initial responders differ from one another early within an intervention period. Thus, it is important to first conduct research aimed at identifying potential differences between these two subgroups. Knowledge of these differences can subsequently be used to develop and test stepped-care intervention approaches for rescuing early non-responders. If effective, such interventions could ultimately improve weight loss outcomes for a greater proportion of IDWL participants.

The primary aim of the current study was to identify differences between early non-responders and initial responders on intervention adherence (e.g. self-monitoring, website logins and video lessons viewed), affective states (e.g. mood and stress) and weight-related cognitions and behaviours (e.g. temptations, hunger, importance of losing weight and effort required to stay on track) during the first 4 weeks of an IDWL program. Further, in addition to group-level differences, we proposed to assess individual variability in these associations to inform future intervention tailoring efforts.

Methods

Participants

The current study included a total of 130 participants who had previously enrolled in one of two studies that implemented the same 12-week, Internet-based weight loss program (Study 1: $n = 75$; Study 2: $n = 55$). To be eligible, participants needed to be overweight or obese ($BMI \geq 25 \text{ kg m}^{-2}$), between the ages of 18 and 70 (upper age limit 65 years in Study 2), and have regular Internet access. Individuals who previously enrolled in a weight loss study at our centre, those with recent weight loss, plans to move outside of the area during the study period, severe psychiatric conditions or medical conditions for which weight loss was contraindicated (e.g. history of a stroke, undergoing treatment for cancer, self-report of an eating disorder, inability to walk at least 2 blocks without stopping), were ineligible to participate. Moreover, participants in Study 1 (17) were employees or dependents of employees of a large health care corporation in Providence, RI.

Weight loss intervention

All participants received a 12-week IDWL program with demonstrated efficacy for weight loss (18,19). Prior to the start of the program, participants attended a 1-h, group-based meeting, during which they were provided with additional information about the study and taught how to count calories, self-monitor weight-related behaviours and use the study website. Participants were given initial goals for weight loss (to lose 1–2 lb week^{-1}), calorie and fat gram intake (to consume 1,200–1,500 kcal d^{-1} and 40–50 g of fat for participants with starting weights of <250 lb, or 1,500–1,800 kcal d^{-1} and 50 g of fat for participants with starting weights ≥ 250 lb), and physical activity (to gradually increase to 200 min of aerobic activity per week). In addition, participants were instructed to log into the study website each week to view a 10- to 15-min multimedia lesson which focused on standard behavioural WL strategies and was modelled after the intervention provided within the Look AHEAD trial (20). Participants were also instructed to log their weight, calorie intake, fat grams and physical activity minutes daily on this study website and were provided with weekly, automated and personalized feedback based upon their self-reported data. The intervention website also provided additional resources, such as information on meal plans, meal replacements products and healthy recipes.

Design differences between studies

Participants enrolled in Study 1 were given small financial incentives (\$1–10 per week in a pattern unknown to the participants; average was \$3.50 per week) during the 12-week intervention for providing self-monitoring data (17). Importantly, participants in this study were not incentivized for completing self-monitoring but only for reporting how much they self-monitored and could receive the incentive for reporting that they did not self-monitor during a week. Study 1 was also conducted within the context of an existing corporate health care rewards program, and participants were eligible to receive \$250 from this program if they lost either $\geq 5\%$ of starting weight or at least 17 lb. Finally, Study 1 identified early non-responders after week 4 of the intervention and provided these participants with brief counselling and meal replacement products; however, the identification of early non-response happened at the end of week 4 (after collection of weight and questionnaire data used in the current study), and participants were not alerted that early non-response was being assessed in that study. Participants in Study 2 did not receive any incentives, and early non-responders in Study 2 did not receive additional support.

Measures

Weight

Individuals were classified as early non-responders or initial responders at the start of week 5 (reflecting weight change over the first 4 weeks of the program). Self-reported data from the intervention website were used to assess 4-week weight change. Self-reported intervention weights have been shown to demonstrate strong agreement (intraclass correlation coefficient = 0.98) when compared to objectively measured smart scale weights (21). The weight entered by the participant on their first login was considered their baseline weight and their last reported weight during week 4 was considered their 4-week weight. If a participant did not report a weight at week 4 but reported a weight at weeks 3 and 5, the average of these two weights was considered their 4-week weight ($n = 6$). Percent weight loss at week 4 was calculated, and using previous criteria for classifying early non-response (11–13), individuals with weight losses of $< 2\%$ at week 4 were classified as early non-responders and those with 4-week weight losses of $\geq 2\%$ as initial responders. Individuals without a weight measurement at week 4 were unable to be classified and thus were excluded from the analyses ($n = 4$).

Intervention adherence

Participant adherence was assessed as (i) the number of times that the participant logged into the study website during the first 4 weeks, (ii) the number of unique video lessons viewed (out of a possible 4 d) and (iii) the number of days that weight and calorie intake were self-reported on the study website (out of a possible 28 d).

Survey questions

At the end of week 4, participants were instructed to complete an 11-item web-based survey which was developed by the investigative team to assess changes in weight-related constructs throughout a weight loss program. This questionnaire asked participants to rate their affective states (positive and negative mood and stress) and weight-related cognitions and behaviours over the previous week (i.e. week 4). All questions were asked using a 1–7 Likert scale (see Table 1 for a list of the questions), and early non-responders and initial responders were compared on mean values for each survey question.

Statistical analyses

Early non-responders and initial responders were compared on demographic variables, adherence metrics (assessed as number of video lessons viewed and proportion of participants adhering to program goals for self-monitoring of weight and caloric intake) and questionnaire measures using independent samples *t*-tests for continuous variables (with Cohen's *d* calculated to assess effect sizes) and chi-square analyses for categorical variables (with Fisher's exact *p* used for frequency table cell counts < 5). Analyses were conducted using SPSS for Windows (Version 24, Chicago, IL) and statistical significance was set at $p < 0.05$.

Results

Of the 130 participants enrolled in the two parent studies, 119 were included in the current analyses (six individuals never logged into the study website and therefore were excluded because they did not start the weight loss program, one participant was excluded because they did not enter a weight at baseline and four participants were excluded because they did not have a weight at week 4). On average, participants were 49.8 ± 9.8 years old and had a baseline BMI of $31.2 \pm 4.6 \text{ kg m}^{-2}$; further, 85.7% self-identified as white, non-Hispanic, and 83.2% self-identified as female. Participants in Study 1 did not differ from participants in Study 2 in terms of age ($p = 0.435$) or baseline BMI ($p = 0.844$). However, 71.4%

Table 1 Differences in survey responses at week 4 between early non-responders and initial responders

	Early non-responders (n = 37)	Initial responders (n = 74)	P-value for difference between groups	Effect size Cohen's <i>d</i>
1. How positive was your mood during the past week?	4.32 ± 1.65	5.11 ± 1.25	0.011*	0.566
2. How negative was your mood during the past week?	3.13 ± 1.55	2.77 ± 1.29	0.192	-0.261
3. How stressed were you during the past week?	3.95 ± 1.85	4.25 ± 1.58	0.370	0.179
4. How hungry were you during the past week?	4.29 ± 1.49	3.69 ± 1.59	0.056	-0.385
5. How bored with your weight control efforts were you during the past week?	3.71 ± 1.81	3.01 ± 1.55	0.036*	-0.427
6. How tempted were you to eat foods that were not consistent with your weight goals during the past week?	5.63 ± 1.32	4.93 ± 1.83	0.023*	-0.417
7. How tempted were you during the past week to skip your planned physical activity?	4.21 ± 2.08	3.58 ± 1.94	0.113	-0.317
8. To what degree were your eating choices during the past week consistent with your weight goals?	3.08 ± 1.42	4.39 ± 1.61	<0.001*	0.845
9. To what degree were your activity/exercise choices during the past week consistent with your weight loss goals?	4.24 ± 1.83	4.82 ± 1.57	0.085	0.349
10. How much effort did it take to stay on track this past week with your weight goals?	5.42 ± 1.55	4.86 ± 1.63	0.086	-0.349
11. Compared to the other demands in your life, how important was it to you to stay on track with your weight goals this week?	4.39 ± 1.52	4.97 ± 1.57	0.065	0.373

Mean ± standard deviation; all questions were asked on a 1–7 Likert scale where 1 = 'not at all' to 7 = 'very ____' (very important, very positive, etc.); the following is the *p*-value for independent samples *t*-tests comparing the two groups.

*Indicates statistically significant at *p* < 0.05.

of participants in Study 1 were female, whereas 100% participants in Study 2 were female (*p* < 0.001).

Intervention weight losses

The primary endpoint for both interventions was 12 weeks. Across both studies, 89.1% of participants attended a follow-up assessment visit, and average weight losses (including all participants, using a baseline-carried-forward approach to handling missing assessment data) from baseline assessment visit to the follow-up assessment visit were 5.0 ± 4.8%. There was a difference in weight loss by study, such that participants in Study 1 lost more weight than participants in Study 2 (6.4 ± 4.9% vs. 2.9 ± 3.8%, respectively, *t*(117) = 4.11, *p* < 0.001).

Differences between early non-responders and initial responders

Forty participants (33.6%) were classified as early non-responders and 79 (66.4%) as initial responders. Early non-responders were younger (47.1 ± 10.3 vs. 50.9 ± 9.2 years; *t*(117) = 2.05, *p* = 0.043) and more likely to be female (95.0% vs. 77.2%; Fisher's exact *p* = 0.018) compared to initial responders; however, they did not differ in ethnicity or BMI at baseline (*ps* > 0.05). By definition, early non-responders lost significantly less weight at

4 weeks compared to initial responders (-0.8 ± 1.0% vs. -3.8 ± 1.5%; *t*(117) = -11.97, *p* < 0.0001). A greater percentage of participants were classified as early non-responders in Study 2 compared to Study 1 (44.9% vs. 25.7%, respectively, χ^2 (1) = 4.75, *p* = 0.029).

Intervention adherence was high at week 4 across all participants. Compared to initial responders, early non-responders viewed a similar number of video lessons (out of the first four lessons, early non-responders viewed 3.6 ± 0.8 and initial responders viewed 3.7 ± 0.9, *t*(117) = 0.35, *p* = 0.729, Cohen's *d* = 0.117), had a similar number of website logins (15.5 ± 12.4 vs. 18.5 ± 10.5, *t*(117) = 1.44, *p* = 0.153, *d* = 0.261) and self-monitored their weight (26.8 ± 2.5 vs. 27.2 ± 2.2 d, *t*(117) = 0.87, *p* = 0.385 *d* = 0.170) and calorie intake (26.4 ± 3.2 vs. 27.3 ± 2.4, *t*(60.7) = 1.52, *p* = 0.133, *d* = 0.318) on a similar number of days. Further, there was no significant differences between initial responders and early non-responders in the percentage of individuals with perfect adherence for self-monitoring of body weight (i.e. self-monitored on all 28 d; 83.5% vs. 75.0%, χ^2 (1) = 1.24, *p* = 0.265), self-monitoring of calorie intake (86.1% vs. 72.5%, χ^2 (1) = 3.25, *p* = 0.072) and viewing of video lessons (i.e. all four lessons viewed; 82.3% vs. 75.0%, χ^2 (1) = 0.87, *p* = 0.350). Given that the percentage of participants classified as early non-responders differed between Study 1 and Study 2, we repeated these adherence analyses using analysis of covariance models that

controlled for 'study'; the same pattern of results was observed for all adherence metrics.

Table 1 provides differences between early non-responders and initial responders on average self-report questionnaire responses at week 4. Compared to initial responders, early non-responders reported having less positive mood, greater boredom with their weight control efforts, greater temptation to eat foods not consistent with their weight loss goals, and that they made fewer eating choices which were consistent with their weight goals; the largest effects (as assessed by Cohen's *d*) were observed for how consistent eating choices were with participant weight loss goals and positive mood. Follow-up analyses controlling for 'study' demonstrated the same pattern of mean differences; however, while significant differences remained between early non-responders and initial responders for positive mood (study-adjusted mean \pm SE = 4.31 \pm 0.023 vs. 5.12 \pm 0.17, respectively, $F(1, 109) = 8.06, p = 0.005$), and consistency between eating choices and weight loss goals (3.11 \pm 0.24 vs. 4.22 \pm 0.17, $F(1, 109) = 14.33, p < 0.001$), there were no longer significant differences observed between groups in ratings of boredom (3.70 \pm 0.27 vs. 3.07 \pm 0.20, $F(1, 109) = 3.58, p = 0.061$) or temptation to eat foods not consistent with weight loss goals (5.60 \pm 0.26 vs. 5.10 \pm 0.19) $F(1, 109) = 2.45, p = 0.120$).

To aid in interpretation of the current results, post hoc analyses were conducted to examine variability in questionnaire ratings across early non-responders and initial responders for the four questionnaire items that demonstrated significant mean differences between groups. The distribution of participants who reported 'high' (≥ 5 on a 7-point scale), 'low' (≤ 3 out of 7) or 'neutral' (4 out of 7) ratings were significantly different between initial

responders and early non-responders for positive mood, temptations to eat foods not consistent with goals, and making eating choices not consistent with goals, but not for boredom (Figure 1). Specifically, 73% of initial responders reported 'high' levels of positive mood during week 4, whereas only 45% of early non-responders fell within that category. Similarly, 79% of early non-responders reported 'high' scores when asked to rate whether they were tempted to eat foods not consistent with their goals, while 60.5% of initial responders reported 'high' scores. Finally, a larger proportion of early non-responders reported 'low' consistency between eating choices and weight goals (60.5% vs. 28.4% for initial responders).

Discussion

The current study investigated differences in intervention adherence, mood and weight-related cognitions and behaviours between early non-responders and initial responders at week 4 of an IDWL program. Results demonstrated that approximately one-third of participants were categorized as early non-responders, a proportion similar to that reported in previous trials (both face-to-face and IDWL) (11,12). No significant differences were observed in program adherence during weeks 1–4 between early non-responders and initial responders; however, compared to initial responders, at week 4, early non-responders reported less positive mood, greater boredom with weight control efforts, being more tempted to eat foods not consistent with their weight loss goals, and that eating choices were less consistent with their weight goals.

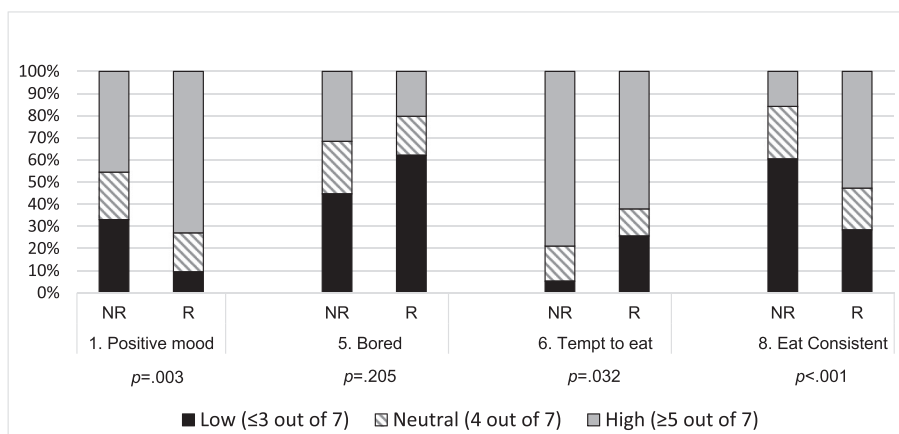


Figure 1 Distribution of early non-responders and initial responders reporting low, neutral, or high ratings on survey measures of positive mood, boredom, temptation to eat foods not consistent with weight loss goals, and consistency between eating choices and weight loss goals. NR, early non-responder; R, initial responder. Number refers to the survey question in Table 1. *P*-value from chi-square analyses examining whether the distribution of participants in low, neutral and high categories differs between early non-responders and initial responders.

Results demonstrating no difference in program adherence at week 4 between early non-responders and initial responders were unexpected given previous research demonstrating that early non-responders had poorer intervention adherence (across the course of an entire weight loss program) than initial responders (12,14); however, few studies have examined whether differences in adherence are seen this early in the intervention period. In one previous investigation of 181 participants enrolled in an IDWL program, early non-responders and initial responders differed significantly in self-monitoring of weight and calorie intake during weeks 1–4, but not the number of video lessons viewed during this time (12). Further, findings from a face-to-face weight loss program indicated that, at week 8, early non-responders and initial responders differed in the number of treatment sessions attended and the number of meal replacement products consumed (4-week adherence data were not reported) (13). It is unclear, however, whether the statistically significant differences in early adherence observed in this previous study were clinically meaningful (e.g. initial responders attended 8.44 treatment sessions on average vs. 8.74 sessions among those with the greatest WL at week 8). Contrary to our hypotheses and prior literature, current results demonstrate that program adherence (operationalized as frequency of self-monitoring weight and caloric intake, website logins and viewing of intervention videos) may not be the driver of early differences in weight loss. These results further highlight the importance of identifying other factors that differentiate these participants early in treatment.

Results demonstrated several additional differences between early non-responders and initial responders that may be helpful for designing future interventions. First, the largest effect between groups was found for ratings of whether eating choices were consistent with weight loss goals. Given that dietary changes tend to drive initial weight loss (22,23), the current result demonstrates that early non-responders may have greater difficulty meeting weight loss goals due to challenges with dietary adherence.

Early non-responders further reported less positive mood, greater boredom with weight control efforts and greater temptation to eat foods not consistent with weight loss goals. These findings are consistent with previous literature which found that both less positive mood and greater temptation to eat 'forbidden' foods are proximally associated with dietary lapses (24). Further, boredom has been implicated as the top reason that participants abandon weight loss attempts (25). Interestingly, the smallest effect size for differences between early non-responders and initial responders in the current study was seen for stress. Previous research indicates that stress is associated with increased caloric consumption (26,27) and

consumption of high-fat/high-sugar foods (28,29). Therefore, the finding that stress was not higher in early non-responders, despite the fact that they reported being more tempted by (and that they ate more) foods not consistent with their weight loss goals, was surprising and contrary to our hypotheses. These results suggest that factors other than stress may have contributed to the observations of less positive mood and greater food temptations among early non-responders.

From a clinical or intervention perspective, these identified differences between early non-responders and initial responders may be used to inform future intervention development, given that previous research has demonstrated that some of the factors identified in the current study may be modifiable. Two randomized trials have demonstrated that modifying intervention content/timing in order to reduce boredom may improve long-term weight loss outcomes (30,31), and interventions that introduce stimulus control skills teach participants how to modify their environment to reduce temptation to eat foods not consistent with their goals (32). Finally, newer acceptance-based approaches to intervention focus on helping individuals adhere to dietary changes despite negative mood states and temptations (33). These may be useful intervention approaches to consider when testing the efficacy of approaches to intervene with early non-responders.

Improving initial treatment weight losses for early non-responders may be especially important given consistent evidence that initial weight loss predicts long term outcomes (11–15). Further, many institutions and payers are beginning to reimburse patients for costs associated with enrolling in weight loss treatment programs but may make later reimbursement of sessions contingent on early weight loss success. For example, the Centers for Medicare and Medicaid Services cover the costs of weekly face-to-face visits for 1 month of treatment and bi-monthly visits during months 2–6. To be eligible for an additional 6 months of treatment, however, patients must have achieved a specific weight loss threshold (≥ 3 kg) (34). Given that insurance companies tend to follow Centers for Medicare and Medicaid Services policies (35), it is likely that models such as this will be used more broadly. Thus, it is particularly important to optimize the efficacy of 'rescue' interventions for early non-responders in order to justify reimbursement for these additional counselling sessions.

Existing literature (10,14) supports the provision of additional targeted treatment for early non-responders (and for the provision of reimbursement for these additional counselling sessions); the current results have identified potential areas for targeting or tailoring intervention content delivered at these sessions to the barriers

reported by early non-responders. Future research should investigate whether weight loss outcomes can be improved by providing targeted intervention to early non-responders focused on improving dietary adherence, reducing boredom and temptation to eat foods not consistent with weight loss goals and/or helping participants maintain dietary adherence despite less positive mood states/temptations.

Given the variability in responses observed even within the group of early non-responders, however, future research should also investigate whether individually tailoring interventions may also improve outcomes. While introducing additional stimulus control strategies designed to help participants modify their environment may be helpful for the 79% of early non-responders who reported 'high' levels of temptation to eat foods not consistent with their goals, these strategies may not be as effective for the 21% who reported low levels of temptation. Newer treatment models, such as just-in-time adaptive intervention designs (36), may be particularly helpful in guiding the development of these individually tailored programs.

The current study has several key strengths. First, the current study represents the first attempt to identify key differences between early non-responders and initial responders enrolled in IDWL treatment. Second, the current study collected data regarding intervention adherence, mood and weight-related cognitions and behaviours concurrently during intervention versus relying on retrospective recall measures. Two previous studies have demonstrated that retrospective recall measures of mood, cognitions and behaviour during weight loss programs are affected by biases related to weight loss outcomes (37). Finally, our analyses combined samples from two separate studies. Both studies utilized the same weight loss program but differed in implementation and study population: one was included as part of a corporate wellness program that offered financial incentives, ending up with a gender balance typical of weight loss programs (70% female participants), while the other enrolled only females participants within the general population. Given the wide range of weight loss programs available to patients, it is important to collapse data across studies, thereby improving generalizability of current results.

The current study also has several limitations. Primarily, the questionnaire used to assess mood and weight-related cognitions and behaviours only asked participants to rate these constructs during the past week. It is unknown whether 4-week responses are representative of participant moods and weight-related behaviours and conditions during other study weeks. Since all questions were asked at the same time, we are also unable to assess temporal precedence between questionnaire items and weight loss; that is, we are unable to determine

whether individuals are less likely to be successful with weight loss if they experience greater temptation, or if the experience of losing less weight influenced self-report ratings for temptation.

A second limitation of this study is that the differences in study designs precludes us from examining the association between 4-week and 12-week weight loss in this sample. Specifically, early non-responders in Study 1 were provided with in-person coaching starting at week 5. Given that a previous study (14) found that the provision of extra support to early non-responders diminished the association between 4-week and 12-week weight loss, the provision of this extra support in Study 1 limits our ability to investigate the association between 4-week and 12-week weight losses. Nonetheless, prior work in this area indicates that 4-week weight change consistently predicts weight change at 12 weeks and later time points when no extra support is provided (11–15). This design difference likely influenced the differences in 12-week weight losses observed between studies and also prevented us from being able to examine the association between 4-week survey questions and 12-week weight loss across studies. Finally, there was a difference between studies in proportion of participants classified as early non-responders (this proportion was lower Study 1 vs. Study 2). After including 'study' as a covariate, there were no longer significant differences observed between early non-responders and initial responders for ratings of boredom or temptation to eat foods not consistent with weight loss goals. Given that mean differences were similar after adjusting for study and that even after combining samples across studies, the sample size was still relatively small, and this may have been an issue of statistical power. Future studies should replicate these results with larger samples of participants.

In conclusion, this study contributes to the existing literature through the identification of key differences between early non-responders and initial responders within the first 4 weeks of IDWL treatment. These data can be used to inform future intervention efforts for early non-responders and suggest the use of strategies which specifically target methods of managing mood, boredom, dietary temptations and decision-making related to healthy eating choices. Future studies should investigate whether novel intervention approaches using stepped care and/or adaptive intervention designs to provide targeted and timely support for early non-responders can improve longer term WL outcomes.

Conflict of Interest Statement

The authors declare no conflict of interest.

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