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# Associations between effort, importance, and self-monitoring during and after a 12-week behavioural weight management program

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## Summary

**Objective:** Self-monitoring of weight and caloric intake has been associated with improved weight loss and weight loss maintenance in behavioural weight loss programs; however, participants' adherence to self-monitoring tends to decrease over time. To identify potential barriers to self-monitoring adherence, the current study examined week-to-week associations between ratings of perceived effort, relative importance of weight loss goals, and adherence to self-monitoring of weight and caloric intake during and after a behavioural weight loss programme.

**Method:** Participants were 74 adults with overweight and obesity enrolled in a 12-week, Internet-based weight loss programme followed by a 40-week "maintenance" period during which no additional intervention was provided. Participants self-reported adherence to self-monitoring and completed ratings of effort and importance on a study website weekly throughout the study period (1 year).

**Results:** Longitudinal multilevel models demonstrated that higher ratings of effort were associated with fewer days of self-monitoring of weight, $\beta = -0.100$, $p < .0001$, and caloric intake, $\beta = -0.300$, $p < .0001$. Conversely, higher ratings of importance were associated with more frequent self-monitoring of weight, $\beta = 0.360$, $p < .0001$, and caloric intake, $\beta = 0.742$, $p < .0001$. Moreover, the magnitude of these associations were stronger during the maintenance period than during initial intervention, $ps < .01$.

**Conclusions:** Perceptions of effort and importance are both independently associated with adherence to self-monitoring weight and caloric intake, and this effect appears to be stronger after the end of initial intervention. Future research should investigate whether tailoring intervention content based on these constructs can improve adherence to self-monitoring.

KEYWORDS

behavioural strategies, motivation, weight maintenance, weight management program

## 1 | INTRODUCTION

Regular self-monitoring is a core component of behavioural weight management programs.[1–3] According to self-regulation theory,[4] self-monitoring promotes behaviour change by providing individuals with important feedback regarding progress towards goals, which can serve as reinforcement when goals are met or highlight areas for additional change when goals are not met. Greater weight losses have been observed in participants who engage in more frequent self-monitoring of weight and caloric intake,[1,5] and continued adherence to this self-monitoring after the end of initial weight loss programs has been demonstrated to improve weight loss maintenance.[6,7]

Despite the key role that self-monitoring plays for both initial weight loss and long-term weight loss maintenance, participant adherence to self-monitoring tends to decline over time.[8,9] One reason for this decline may be the amount of effort required. While recent technological advances offer promise to reduce participant burden related to self-monitoring,[10–12] participants have traditionally been asked to record weight and dietary intake each day in paper records. For weight, this has involved stepping on a scale once per day and writing this weight down in a paper record. For caloric intake, participants have typically been asked to write down all foods/drinks consumed (including ingredients used in cooking and any condiments added) along with caloric content of each of these items (found by searching through printed calorie reference books). In postintervention interviews with weight management programme participants, Burke et al[13] noted that participants who were less adherent to self-monitoring described self-monitoring as "burdensome" and "time-consuming."

Burke et al[13] also noted that, for individuals who were less adherent to self-monitoring, competing life demands (e.g., responsibilities to family or employers) became higher priority than weight loss goals. Conversely, these researchers found that considering weight management goals to be important, relative to other life demands, may help individuals stay on track with self-monitoring despite the effort required. Even the highly adherent participants in this study reported that self-monitoring was tedious; however, these highly adherent participants noted that they were committed to staying on track as meeting weight loss goals remained important life priorities. Thus, there may be a potential interaction between the effort required to self-monitor and how important a participant perceives their weight loss goals as being, compared to other life demands.

The study by Burke et al[13] was limited by reliance on retrospective recall, preventing investigation into the directionality of effects. Using only retrospective interview data, these researchers were unable to examine whether individuals who reported certain barriers to self-monitoring were less likely to adhere to self-monitoring (which would be theoretically supported by the health belief model[14] and theory of planned behaviour[15]) or, conversely, if individuals who had poorer adherence to self-monitoring were more likely to retrospectively report experiencing these barriers (as would be posited by cognitive dissonance theory[16]). Establishing time precedence is necessary to examine whether perceived effort and importance predict or influence adherence to self-monitoring, especially given that two studies have demonstrated that participants in weight management interventions who experience poorer weight loss outcomes may be more likely to have a "negative" recall bias when asked to retrospectively recall experiences during a previous weight management programme (i.e., later remembering their mood, emotions, and behaviours during intervention as worse than they had reported at the time).[17,18]

To address this gap, the current study investigated week-to-week associations between perceived effort, importance of staying on track with weight management goals compared to competing life priorities, and self-monitoring of weight and caloric intake during and after a 12-week, Internet-based behavioural weight loss programme. Participants were asked to complete a brief questionnaire and to self-report their adherence to self-monitoring weight and caloric intake via a study website each week during the weight loss programme and for an additional 40 weeks during an observational "maintenance" period (during which no additional intervention was provided). It was hypothesized that, across all study weeks (a full calendar year), greater perceived effort and lower ratings of importance would be associated with lower adherence to self-monitoring. It was also hypothesized that importance would moderate the association between effort and self-monitoring, such that the association between effort and self-monitoring would be attenuated in participants who also reported high ratings of importance of weight management goals. An exploratory analysis was conducted to examine whether the associations between perceived effort, importance, and self-monitoring were different during initial 12-week intervention versus the 40-week observational "maintenance" period.

## 2 | METHODS

The current study conducted secondary data analyses of data collected during and after the implementation of a 12-week Internet-based behavioural weight loss intervention in a worksite healthcare rewards programme. Full details regarding participant recruitment, inclusion/exclusion criteria, and baseline characteristics have been published previously.[19] In brief, participants in the parent study were 75 employees (or dependents of employees) of a large healthcare organization in Providence, RI, with overweight or obesity (BMI ≥ 25 kg/m$^2$, but weight less than <150 kg) and who reported access to a computer and internet access at home.

Participants in the parent study were eligible for the current study if they reported questionnaire and self-monitoring data on the study website for at least 1 week. Of the 75 participants who enrolled in the parent study, 74 met this additional criterion and were included in the current study. These 74 participants were, on average, 50.65 ± 10.41 years old, weighed an average of 86.65 ± 16.76 kg at baseline, and had an average body mass index (BMI) at baseline of 31.20 ± 4.51 kg/m$^2$.[20] Further, 68.9% reported identifying as female and, in terms of race/ethnicity, 86.5% of participants reported identifying as White, 9.5% as African American or Black, 2.7% as Asian, 2.7% as Hispanic or Latino, 1.4% as American Indian or Alaskan Native, and 5.4% selected "other" (participants could select more than one race/ethnicity category, thus totals may exceed 100%). The

parent study was approved by The Miriam Hospital Institutional Review Board, and the current analyses were approved by the University of Florida Institutional Review Board.

## 2.1 | Initial weight loss intervention and maintenance period

All enrolled participants were provided with a 12-week, Internet-based behavioural weight loss programme. Full details of the initial weight loss programme have been published previously.[19] Intervention content provided in 12 weekly multimedia lessons was adapted from the Diabetes Prevention Programme lifestyle intervention,[21] and participants were encouraged to self-monitor weight, caloric intake, and physical activity daily throughout the intervention. Prior to starting the online intervention, participants attended an hour-long in-person orientation visit. At this visit, participants received educational materials about weight management and were taught how to self-monitor weight (using a study-provided scale and paper records), caloric intake (using paper records and a printed Calorie King® reference book) and physical activity (using paper records to track minutes of moderate-intensity activity). Participants were given the option to use other self-monitoring tools (e.g., calorie tracking websites or smartphone applications, or commercial physical activity monitors); however, these tools were not provided by the study.

At the end of each week (by the end of Sunday night), participants were asked to log into a study website to report, for each day of the prior week, their weight, total calories consumed, and total minutes of physical activity. Given that a primary goal of the parent study was to investigate week-to-week predictors of weight loss and regain,[22] participants were also asked at this time to complete a brief, 11-item questionnaire assessing factors hypothesized to be associated with weight loss maintenance. At their next log in (starting the next Monday morning), participants were provided with automated, tailored feedback based on their progress toward weight loss goals and self-monitoring data (no feedback was provided regarding questionnaire responses).

After the end of the 12-week intervention, participants were encouraged to continue self-monitoring their weight, caloric intake, and physical activity daily. Participants were also asked to continue to log into the study website at the end of each week in order to complete the 11-item questionnaire and to report, for that week, (1) the number of days that they self-monitored weight and caloric intake and (2) total number of minutes of physical activity. Throughout this "maintenance" period, no additional intervention content was provided (e.g., participants did not receive new weight loss lessons and no longer received tailored feedback based on their progress/self-monitoring data) and participants could no longer access the intervention content previously available on the study website.

In order to promote weekly submission of self-report data via the study website, participants were provided with small financial incentives (ranging from $1–10 per week, delivered on a schedule unknown to participants). Notably, participants received these incentives for completing the questionnaire and reporting their self-monitoring habits, regardless of their adherence to self-monitoring (e.g., participants could receive the incentive if they reported that they did not self-monitor weight or caloric intake for any days during a week).

## 2.2 | Intervention outcomes

Intervention outcomes have been published previously.[22] Participants lost an average (mean ± SD) −5.78 ± 4.91 kg (−6.42 ± 4.81% of their baseline weight) during the 3-month intervention, and regained, on average, 2.42 ± 3.64 kg (a 2.98 ± 4.50% increase from Month 3) during the 40-week maintenance period (Weeks 13–52). Greater frequency of self-monitoring both weight and caloric intake were associated with greater weight loss during the initial weight loss programme, and less frequent self-monitoring of weight and caloric intake were associated with greater weight regain during the post-intervention maintenance period.[22]

## 2.3 | Measures

### 2.3.1 | Adherence to self-monitoring

Adherence to self-monitoring was operationalized as the frequency of self-monitoring weight and caloric intake during a given week (i.e., the number of days self-monitoring was completed, ranging from 0 to 7). During the initial 12-week intervention, participants were asked to log into the study website at the end of each week and to report their weight and caloric intake for each day of that week. Two count variables were created from these data in order to represent the number of days that participants reported values for weight and caloric intake, respectively, each week (missing data for weight or caloric intake was assumed to represent a day that self-monitoring did not occur). During the 40-week observational maintenance period, participants were no longer asked to report weight and caloric intake for each day but instead were asked to self-report the number of days that they self-monitored weight and caloric intake during the previous week; these counts were used to assess frequency of self-monitoring during the maintenance intervention (missing data for frequency of self-monitoring was assumed to represent a week when self-monitoring did not occur). Adherence to self-monitoring of physical activity was not included in the current analyses because participants were asked to report the total minutes of physical activity during the maintenance programme rather than the number of days physical activity was self-monitored.

### 2.3.2 | Perceived effort and importance

As part of the 11-item questionnaire that participants were asked to complete each week, participants were asked to rate, on 7-point

scales, "How much effort did it take to stay on track this week with your weight goals?" (1 = *No effort at all* and 7 = *A great deal of effort*) and "Compared to the other demands in your life, how important was it to you to stay on track with your weight goals this week?" (1 = *Not a priority* and 7 = *Essential priority*).

### 2.4 | Analyses

All analyses were conducted with SAS version 9.4.[23] Longitudinal multilevel models (SAS PROC MIXED) were used to examine the associations between effort, importance, and adherence to self-monitoring, and to investigate whether these associations changed over time (between the initial weight loss programme and the observational maintenance period). Models used all available data via restricted maximum likelihood estimation methods. Values for perceived effort and importance were mean centred within participants to allow for examination of interaction effects. Model fit and comparisons between models were made using Akaike information criterion (AIC).

## 3 | RESULTS

Across the full study year, participants self-monitored weight on an average (mean ± SE) of 4.30 ±0.22 days each week and caloric intake on an average of 3.24 ± 0.21 days each week. As expected, there were significant decreases over time in adherence to self-monitoring of weight, $\beta$ = −0.064, SE = 0.002, $t(3773)$ = −27.66, $p$ < .0001, and caloric intake, $\beta$ = −0.095, SE = .002, $t(3773)$ = −41.71, $p$ < .0001. Interpreting these effects, participants self-monitored weight, on average, on −0.06 fewer days each week and caloric intake on −0.10 fewer days each week as the study year progressed.

Across the full study year, participants reported effort on an average (mean ± SD) of 37.09 ± 14.26 weeks (71.34% ± 27.43% of 52 possible weeks) and reported importance on 37.07 ± 14.32 weeks (71.28% of 24.54% possible weeks). On average (mean ± SE), participants rated effort as 4.93 ± 0.12 across all study weeks; there was a significant increase in ratings over the full study year, $\beta$ = 0.004, SE = 0.002, $t(2703)$ = 2.12, $p$ = .034, such that ratings of effort increased, on average, 0.004 points each week as the study year progressed. Participants rated importance as 4.74 ± 0.14 across all study weeks; there was a significant decrease in ratings of importance over the course of the study year, $\beta$ = −0.018, SE = 0.002, $t(2692)$ = −11.35, $p$ < .0001, such that ratings of importance decreased, on average, −0.018 points each week as the study year progressed.

Across all weeks, there was a significant association between effort and self-monitoring of weight, $\beta$ = −0.100, $SE$ = 0.020, $t(2739)$ = −4.98, $p$ < .0001, and self-monitoring of caloric intake, $\beta$ = −0.300, $SE$ = 0.034, $t(2731)$ = −8.75, $p$ < .0001, such that a 1 point higher rating of effort was associated with 0.10 fewer days of self-monitoring weight and 0.30 fewer days of self-monitoring caloric intake during the same week. A significant association was also observed between importance and self-monitoring weight, $\beta$ = 0.360, $SE$ = 0.019, $t(2686)$ = 18.45, $p$ < .0001, and self-monitoring caloric intake, $\beta$ = 0.742, $SE$ = 0.033, $t(2651)$ = 22.73, $p$ < .0001, such that 1 point higher rating of importance was associated with 0.36 additional days of self-monitoring weight and 0.74 additional days of self-monitoring caloric intake. There was not a significant interaction between effort and importance for self-monitoring of either weight or caloric intake, $p$s > .05, suggesting that importance did not moderate the association between effort and self-monitoring.

Given that ratings of effort and importance were both collected at the end of each week (thus introducing similar recall biases to those discussed in the introduction), post hoc analyses were conducted to investigate whether effort and importance predicted adherence to self-monitoring the following week. The same pattern of results were found, such that effort and importance on 1 week both predicted self-monitoring of weight and caloric intake during the following week, all $p$s < .05, with effects in the same direction as reported above.

Finally, an exploratory analysis was conducted to examine whether associations between effort, importance, and self-monitoring differed between the initial weight loss period and the subsequent maintenance period. There was a significant interaction between effort and intervention period (maintenance vs. the initial weight loss programme) and frequency of self-monitoring weight, $\beta$ = −0.111, $SE$ = 0.034, $t(2696)$ = −3.26, $p$ = .001, and caloric intake, $\beta$ = −0.172, $SE$ = 0.050, $t(2698)$ = −3.42, $p$ < .001, such that magnitude of associations were larger during the maintenance period compared to the initial intervention period for both self-monitoring of weight and caloric intake (see Figure 1A,B). A similar pattern was observed for importance and frequency of self-monitoring weight, $\beta$ = 0.178, $SE$ = 0.034, $t(2716)$ = 5.31, $p$ < .0001, and caloric intake, $\beta$ = 0.539, $SE$ = 0.048, $t(2717)$ = 11.25, $p$ < .0001, such that the associations between higher ratings of importance and greater adherence to self-monitoring weight and caloric intake were stronger during the maintenance period compared to the initial intervention period (see Figure 2A,B).

## 4 | DISCUSSION

The current study investigated proximal associations between perceived effort and importance of staying on track with weight management goals and adherence to self-monitoring of weight and caloric intake. As expected, adherence to self-monitoring of both weight and caloric intake decreased over time. This decrease had important clinical implications, as previous results from the parent study found that lower adherence to self-monitoring of weight and caloric intake was associated with less weight loss during the initial intervention and greater weight regain during the maintenance period.[22] Ratings of effort increased over time; however, the magnitude of these decreases was small (averaging an increase of less than 0.01 points each week) and thus may not be clinically meaningful. Ratings of importance decreased over time; on average, ratings decreased about −0.02 points each week, equating to almost a full point decrease over the course of the study year.

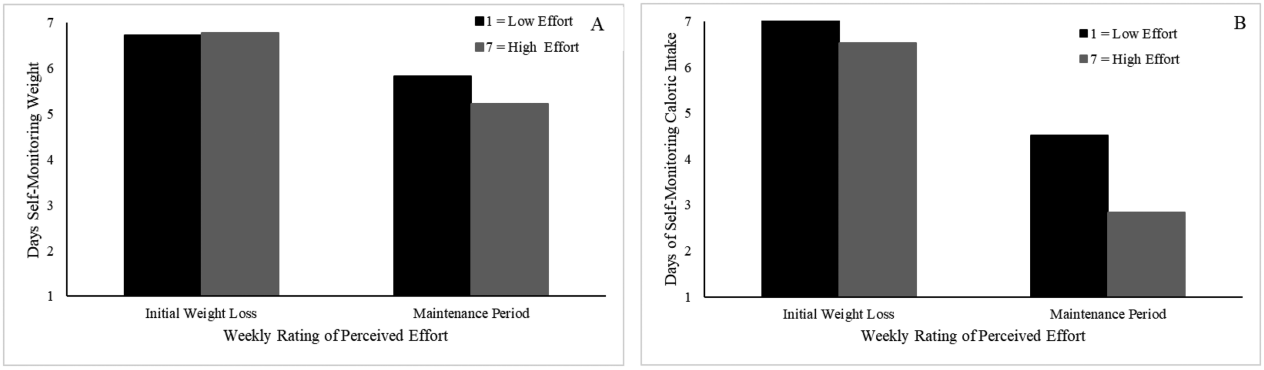


**FIGURE 1** Associations between ratings of effort and self-monitoring of weight (A) and caloric intake (B) during the initial intervention and follow-up maintenance period

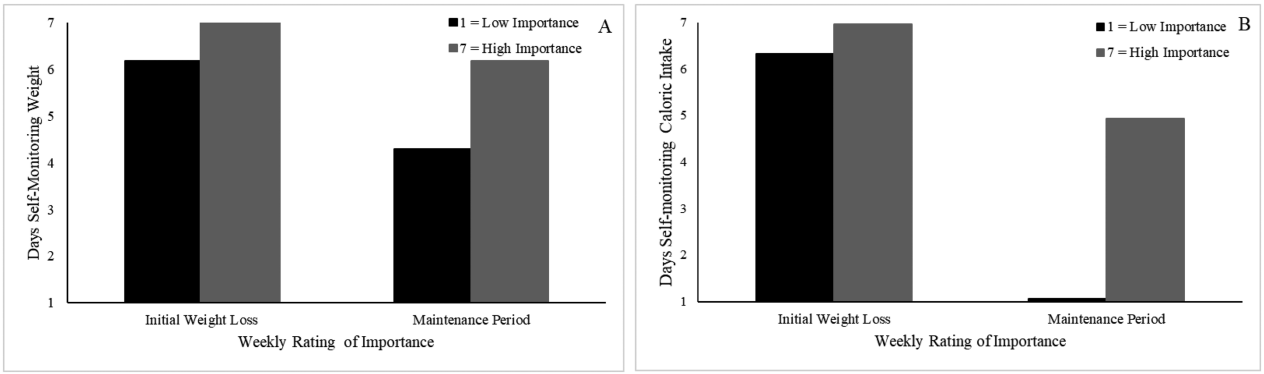


**FIGURE 2** Associations between ratings of importance and self-monitoring of weight (A) and caloric intake (B) during the initial intervention and follow-up maintenance period

Consistent with hypotheses and the results of the qualitative study conducted by Burke et al,[13] greater perceived effort during a given week was significantly associated with lower adherence to self-monitoring, and higher ratings of importance were associated with greater adherence. Given the proximal nature of the associations assessed, the constructs of effort and importance might serve as important "early warning" signs of suboptimal adherence. The widespread adoption of smartphones[24] has made it possible to track constructs such as these in a relatively low-burden manner (e.g., through delivery of brief questionnaires via text-message or smartphone prompt). Future studies should investigate whether tracking these constructs and providing additional intervention when participants report high effort and/or low importance can improve self-monitoring adherence. Supporting adherence to self-monitoring during initial intervention can improve initial weight losses,[25] which may be particularly important given that early weight loss success has been demonstrated to predict longer-term outcomes.[26] Longer-term, continued adherence to self-monitoring of weight and caloric intake may play a key role in weight loss maintenance, allowing individuals to observe and quickly recover from small slips before experiencing larger weight regain.[27,28]

In addition to monitoring these constructs to provide additional intervention/support, there may be potential for developing tailored intervention components focused on goal prioritization (which should influence ratings of importance). One study found that a simple written intervention increased ratings of relative goal importance and led to higher success rates for health behaviour change.[29] Moreover, acceptance-based weight management approaches, developed from strategies employed in Acceptance and Commitment Therapy,[30] include intervention components that help individuals connect weight loss goals and weight-related behaviour changes to larger life values,[31] theoretically increasing prioritization of these goals and behaviours. Although studies have demonstrated that acceptance-based interventions can lead to clinically significant weight losses,[31–33] little attention has been paid to whether these interventions or these specific value-related components can impact self-monitoring behaviour.

Contrary to hypotheses, ratings of importance did not moderate the association between effort and adherence to self-monitoring. This suggests that intervention strategies aimed at improving ratings of importance may not help participants "overcome" barriers related to effort, as initially suggested by the study by Burke et al.[13] Thus, intervention developers may want to promote adherence to self-monitoring by also decreasing the amount of effort required. One approach may be to integrate newer technological developments that may decrease the burden of tracking weight and dietary intake. For

example, "smart" scales allow individuals to easily track weight via Bluetooth, Wi-Fi, or cellular networks, and a host of smartphone applications and websites allow individuals to track caloric intake without needing to carry around extra materials, look up foods/drinks in a reference book, or conduct mathematical calculations. To date, research investigating the integration of these tools into weight loss programs has supported their use for promoting greater self-monitoring adherence, with no adverse effects on intervention outcomes.[10,11,33]

Finally, exploratory analyses demonstrated that the effects of effort and importance and adherence to self-monitoring were stronger during the observational maintenance period compared with the initial intervention. Participation in the initial 12-week intervention may have provided a buffering effect, attenuating the influence of effort and importance of other competing life priorities. The parent study did not include a no-treatment control group, precluding investigation into this possibility. The parent study also did not include additional intervention support during the maintenance period, precluding investigation into whether additional support during this time could have also attenuated the association between ratings of effort and importance and adherence to self-monitoring. The broader weight management literature has established the importance of providing longer-term contact (e.g., through provision of "extended care" sessions after the end of initial intervention)[34]; future research should investigate whether ratings of effort and importance are affected by provision of extended care and whether perceptions of effort and importance mediate the effect of extended care on long-term weight loss maintenance.

The current study had several important strengths. Rather than relying on retrospective recall, data were collected concurrently (each week) during and after a behavioural weight management programme. In addition to overcoming barriers related to retrospective recall, these methods allowed us to capture week-to-week variation in self-report ratings of relative importance, perceived effort, and self-monitoring behaviour, allowing us to investigate the associations between these variables in a clinically relevant time frame (existing programs most frequently engage with participants on a weekly basis). Thus, results provide data necessary for future intervention developers or researchers to develop weekly thresholds for effort and importance (e.g., in order to inform decision rules for providing additional or tailored intervention).[35] Finally, several researchers have argued that different skills may be needed to support initial weight loss versus long-term weight loss maintenance[36,37]; assessing associations between these constructs both during and after a weight loss programme allowed us to investigate potential differences in associations between an active initial intervention and a longer-term follow-up period, when no additional intervention was provided.

The current study also had several limitations. First, self-reports of effort, importance, and self-monitoring were all collected at the same time (at the end of each week), limiting causal inference and potentially leading to some of the same issues with retrospective data collection that were mentioned previously (albeit on a much smaller time scale). Thus, post hoc analyses were conducted to investigate whether ratings of effort and importance 1 week predicted adherence to self-monitoring the following week. The same pattern of associations was observed, establishing temporal precedence; however, alternative interpretations of the associations reported cannot be fully ruled out. Second, both effort and importance were assessed using a single item Likert-style question rather than through use of existent validated measures. Future studies may benefit from the use of longer, validated measures; however, if these constructs are to be monitored regularly (e.g., weekly or more frequently), there is a required trade-off between measurement accuracy and participant burden. Thus, future studies should also investigate whether these brief, single-item measures provide valid and reliable estimates of effort and importance. Third, participants in the current study were asked to submit self-monitoring data weekly on a study website. The data requested were similar in scope to the weekly summaries that participants are typically asked to turn in during traditional, face-to-face interventions; however, this data entry may have still served as an additional burden (affecting perceptions of effort). Fourth, participants in the current study were predominantly White and female, limiting generalizability of the results. Moreover, the parent study was conceptualized as a pilot programme within the larger healthcare organization, and thus recruitment was limited[19] and the final sample may not be representative of participants in the healthcare rewards programme or the broader population of employees within the healthcare organization. Future studies should replicate these results in more diverse samples.

## 5 | CONCLUSION

The current study was the first to examine proximal (week-to-week) associations between effort, relative importance of weight loss goals, and adherence to self-monitoring of weight and caloric intake during and after a 12-week, Internet-based weight loss programme. Results demonstrated that lower ratings of effort and higher ratings of importance were associated with greater adherence to self-monitoring of weight and caloric intake within the same week and predicted greater adherence the following week. Moreover, effects were stronger in magnitude during the maintenance period versus the initial weight loss programme. Contrary to hypotheses, importance did not modify the association between effort and adherence to self-monitoring. Future studies should examine whether additional intervention components designed to bolster relative importance of weight loss goals and lower perceived effort can improve adherence to self-monitoring.

### CONFLICT OF INTEREST STATEMENT

No conflict of interest was declared.

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