

Association between Self-Weighing and Percent Weight Change: Mediation Effects of Adherence to Energy Intake and Expenditure Goals



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ABSTRACT

Background To date, no investigators have examined electronically recorded self-weighing behavior beyond 9 months or the underlying mechanisms of how self-weighing might impact weight change.

Objective Our aims were to examine electronically recorded self-weighing behavior in a weight-loss study and examine the possible mediating effects of adherence to energy intake and energy expenditure (EE) goals on the association between self-weighing and weight change.

Design This was a secondary analysis of the self-efficacy enhancement arm of the Self Efficacy Lifestyle Focus (SELF) trial, an 18-month randomized clinical trial.

Participants/setting The study was conducted at the University of Pittsburgh (2008–2013). Overweight or obese adults with at least one additional cardiovascular risk factor were eligible.

Intervention Participants in the self-efficacy enhancement arm were given a scale (Carematix, Inc) and instructed to weigh themselves at least 3 days per week or every other day. The scale date- and time-stamped each weighing episode, storing up to 100 readings.

Main outcome measures Weight was assessed every 6 months. Adherence to energy intake and EE goals was calculated on a weekly basis using paper diary data.

Statistical analyses performed Linear mixed modeling and mediation analyses were used.

Results The sample (n=55) was 80% female, 69% non-Hispanic white, mean (standard deviation) age was 55.0 (9.6) years and body mass index (calculated as kg/m²) was 33.1 (3.7). Adherence to self-weighing declined over time ($P<0.001$). From baseline to 6 months, there was a significant mediation effect of adherence to energy intake ($P=0.02$) and EE goals ($P=0.02$) on the association between adherence to self-weighing and percent weight change. Mediation effects were not significant during the second and third 6-month periods of the study.

Conclusions Objectively measured adherence to self-weighing declined over 18 months. During the first 6 months, self-weighing directly impacted weight change and indirectly impacted weight change through changes in energy intake and EE.
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SELF-MONITORING OF BODY WEIGHT HAS BEEN recommended as a component of standard behavioral treatment for weight loss,¹ a strategy also recommended by the Clinical Guidelines for Treatment of Overweight and Obesity of the National Heart, Lung, and Blood Institute.² Recent studies have demonstrated that frequent self-weighing is associated with greater weight loss,^{3–7} less weight regain,^{8,9} and better weight gain prevention.^{10–12}

A weakness of the reported studies was the method used to assess self-weighing. Most of the studies used self-report methods and queried the participants retrospectively about the frequency of self-weighing (eg, daily, weekly). For

example, some studies used a single question asking about frequency of self-weighing; response options were “never,” “about once a year or less,” “every other month,” “once a month,” “once a week,” “once a day,” or “more than once a day.”^{6,9–16} However, these self-report methods might not accurately reflect the actual weighing behavior because self-reporting tends to provide an overreporting^{17,18} or recall bias¹⁹ of self-weighing frequency. Thus, more objective measures of self-weighing frequency are needed to validate the association of a self-weighing intervention strategy with weight loss.

To the best of our knowledge, only three of the recent studies have used electronic scales to objectively measure

self-weighing behaviors.^{4,5,20} VanWormer and colleagues⁵ used a telemonitoring scale (Thin-Link; Cardiocom, LLC) that transmitted weight data automatically to the research center through a telephone landline. Gokee-LaRose and colleagues⁴ reported using a scale that stored weight data for 31 days. Steinberg and colleagues²⁰ used a smart scale that displayed current weight and sent the data directly to a website (www.bodytrace.com) via wireless cellular network. The limitations of these studies included small and homogeneous samples and short-term follow-up (eg, 6 months), which limited the generalizability of the findings.

In addition, a few studies reported adherence to self-weighing during a short period of time; for example, 6 months. Gokee-Larose and colleagues⁴ reported that at the end of a 10-week intervention, approximately 90% of the participants weighed themselves daily, a rate that decreased significantly at the 20-week follow-up. This pattern of initial high level of adherence to self-weighing followed by a gradual decrease after approximately 3 months has also been reported by others.^{14,20} In addition, previously published studies have provided evidence for a gradual decline in adherence to self-monitoring of diet and exercise, which becomes worse when treatment sessions and interventionist contact decrease.²¹ Although research related to self-monitoring of diet and exercise is extensive, it remains unclear whether the pattern of adherence to self-weighing, a component of self-monitoring, is similar to or differs from that of long-term self-monitoring of diet and exercise.

No study has reported the underlying mechanisms of how self-weighing impacts weight change. Mediation analysis can determine the impact of each link in a hypothetical chain of events and define the contribution of different program components, which provides an explicit check on an intervention's theoretical underpinnings, and determine whether the proposed change process was achieved.²² Exploring these mechanisms will provide data to inform interventions to better counsel participants on the use of self-weighing for weight management.

According to self-regulation theory, motivation for behavioral change results from the interplay among awareness, self-observation, recording, and self-evaluation.²³ Regular self-weighing may permit an individual to increase his or her awareness of eating and exercise behaviors, which can result in changes in balance of energy intake and expenditure and impact weight loss.²⁴ Therefore, we conducted mediation analysis to examine whether self-weighing impacted weight loss through changes in eating and exercise behaviors.

The aims of our study were to examine electronically recorded self-weighing behavior in a long-term weight-loss study and examine the potential mediating effects of adherence to energy intake/expenditure goals on the association between self-weighing and percent weight change. Mediation analysis may identify the underlying process or mechanisms for the impact of self-weighing on weight change.

METHODS

Study Design

This was a secondary analysis of data ($n=58$) from the self-efficacy enhancement (standard behavioral treatment plus self-efficacy enhancement) arm of the Self-Efficacy Lifestyle Focus (SELF) trial. Because only the participants in standard

behavioral treatment plus self-efficacy enhancement group were provided an electronic scale to weigh themselves at home, only the data from the standard behavioral treatment plus self-efficacy enhancement arm were used for data analysis. The SELF trial was a two-group, single-center, 18-month randomized clinical trial of a behavioral weight-loss intervention for obese/overweight adults (Figure 1).²⁵ The study was conducted at the University of Pittsburgh (2008-2013). The primary outcome of the SELF trial was weight-loss maintenance. Both groups received a standard behavior treatment intervention to promote weight loss, which included a calorie- and fat-restricted diet.²⁶ Standard behavioral treatment is composed of group-based cognitive-behavioral intervention strategies, daily dietary goals, weekly physical activity goals, as well as self-monitoring of dietary intake and physical activity. Group meetings were held in person at the research center weekly for the first month, every 2 weeks in the second month, and monthly for the remainder of the first year; then every 6 weeks for months.¹³⁻¹⁸ In addition to the group sessions, participants in the standard behavioral treatment plus self-efficacy enhancement group met in person with their interventionist on a one-to-one basis. The interventionists for the trial were master-level registered dietitian nutritionists and exercise physiologists. They implemented the self-efficacy-based strategies and worked with the participant to develop jointly tailored, incremental goals for diet and physical activity to facilitate weight loss. During the first 12 months, the one-to-one sessions were held every 2 weeks; thereafter, sessions were held at least monthly. Telephone sessions were available in place of face-to-face sessions at participant's request. Individuals in the standard behavioral treatment plus self-efficacy enhancement group were also provided with a scale (Carematix, Inc) to weigh themselves at home at least three times per week or every other day. The University of Pittsburgh Institutional Review Board approved the study protocol and all participants provided written informed consent.

Sample

Overweight or obese adults with at least one additional risk factor for cardiovascular disease (eg, dyslipidemia, hypertension, cigarette smoking) were eligible. During screening for eligibility, participants were asked to reasonably assess whether or not they would be able to commit to an 18-month intervention. They were excluded if they were planning a pregnancy or relocation that would prevent them from attending the group sessions. To minimize attrition, individuals who participated in weight-loss treatment within the last 6 months were not eligible. Assessments were conducted every 6 months throughout the study as described here.

Measures

Sociodemographic Questionnaire. Baseline sociodemographic factors were assessed with The Sociodemographic and Lifestyle Questionnaire, a self-administered, standardized questionnaire developed by the Center for Chronic Disorders at the University of Pittsburgh.

Weight. A digital scale (Tanita Corporation of America, Inc) was used to measure weight in pounds at baseline, 6, 12, and

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