Research Article

The Use of Telehealth Technology in Assessing the Accuracy of Self-Reported Weight and the Impact of a Daily Immediate-Feedback Intervention among Obese Employees

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Objective. To determine the accuracy of self-reported body weight prior to and following a weight loss intervention including daily self-weighing among obese employees.

Methods. As part of a 6-month randomized controlled trial including a no-treatment control group, an intervention group received a series of coaching calls, daily self-weighing, and interactive telemonitoring. The primary outcome variable was the absolute discrepancy between self-reported and measured body weight at baseline and at 6 months. We used general linear mixed model regression to estimate changes and differences between study groups over time.

Results. At baseline, study participants underreported their weight by an average of 2.06 (SE = 0.33) lbs. The intervention group self-reported a smaller absolute body weight discrepancy at followup than the control group.

Conclusions. The discrepancy between self-reported and measured body weight appears to be relatively small, may be improved through daily self-monitoring using immediate-feedback telehealth technology, and negligibly impacts change in body weight.

1. Introduction

Assessment of self-reported body weight is widely regarded as being more practical than obtaining a measured weight [1]. In both community samples and employed populations, self-reported weight has been shown to be fairly accurate [2–5]. On the other hand, among certain populations such as younger women [6, 7], a greater tendency to underestimate body weight has been observed. Likewise, substantial underestimates have been reported among people who are obese or are otherwise attempting to lose weight [8–10] or restrain their eating [8, 11]. Generally speaking, the heavier the individual, the greater the self-reported bias toward an underestimate of body weight [8, 10]. In the workplace setting, this bias phenomenon can be especially problematic because self-reported body weight may call into question the utility of employee self-assessments in estimations of program impact. In addition, recruitment and screening efforts are complicated when seemingly eligible participants are misclassified based on inaccurate self-reported weight [12].

Relatively little is known about what can improve the accuracy of self-reported body weight in obese populations. Experimental evidence suggests that a (clinically) measured body weight taken prior to completing a self-report questionnaire improves the accuracy of self-reported body weight [9, 13]. A cross-sectional survey by Flood and colleagues [14] found that women who self-weighed at least weekly were
more likely to report their body weight correctly as compared to those who self-weighed less frequently. Taken together, this evidence seems to suggest that if a person “weighs-in” before self-reporting their body weight, especially if weigh-ins occur frequently, the more accurate their self-reported body weight will be. Unfortunately, none of these studies focused specifically on obese populations, where the concern over self-reported body weight accuracy seems especially relevant in the context of interventions. Furthermore, recent advances in telehealth technologies can be used to obtain unbiased measured body weight using electronic scales that, using visual and audio options, can provide immediate feedback. Hence, the purpose of this study was to test the effect of frequent self-weighing, a key behavioral weight loss strategy [15, 16], on the accuracy of self-reported body weight among employed, obese adults participating in a randomized-controlled trial.

2. Methods

2.1. Participants. Participants were enrollees in the Weigh-By-Day study, a randomized controlled weight management trial among obese employees. Although the main results of this study have been described elsewhere [17], the research presented in the current paper specifically refers to the use of telehealth technology in assessing the accuracy of self-reported body weight prior to and following weight loss. The number of participants recruited into the study was reported body weight before and following weight loss. The main outcome of interest was the discrepancy between self-reported and measured weight. It is a useful analytical measure because it provides a precise estimate of the magnitude of the weight discrepancy (i.e., how far are the self-reported and measured weights away from each other?). Relative weight discrepancy, on the other

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randomly assigned to the intervention (confirmed ineligible, and, as a result, 100 participants were
of those invited, 38 did not attend, cancelled, or were
study, 138 individuals were invited to the study orientation.
Following recruitment and screening for eligibility in the
3. Results
2.4. Analysis. t-tests and χ² tests were used to com-
pare differences in baseline characteristics. General linear
mixed model regression models were estimated using SAS
PROC MIXED (time within participant, random participant
intercepts, unspecified covariance structure, and restricted
maximum likelihood estimation) to test whether relative
or absolute weight discrepancy was different across study
groups, between baseline and followup, or differentially
over time by study group. Absolute and relative weight
discrepancies were predicted separately from measurement
time (baseline, followup), which varied within participants,
and randomized treatment group (Intervention, Control),
which varied across participants. The mixed model approach
was chosen because, relative to a general linear model
approach (e.g., repeated measures ANOVA or ANCOVA), it
readily accommodates variation in the number of repeated
observations per participant and accurately estimates stan-
dard errors of parameters without reliance on imputation to
replace missing observations. All analytical procedures were
computed using SAS 9.1 (SAS Institute, Cary, NC, USA),
and an α-level of 0.05 was used as the criterion for statistical
significance.

3. Results
Following recruitment and screening for eligibility in the
study, 138 individuals were invited to the study orientation.
Of those invited, 38 did not attend, cancelled, or were
confirmed ineligible, and, as a result, 100 participants were
randomly assigned to the intervention (n = 45) or control
group (n = 55). At 6-month followup, 87% (n = 39) and
84% (n = 46) of participants in the intervention and control
groups, respectively, completed the in-person assessments.
Table 1 presents descriptive characteristics of the study
population by study groups. Randomization was successful
in that there were no significant differences between groups
on any of the baseline measures as reported elsewhere [17].
Table 2 presents the absolute and relative mean weight
discrepancies by study group at baseline and at followup.
The top portion of Table 2 displays the means and standard
errors that were calculated using all available data points at
baseline and followup. The lower portion of Table 2 displays
the model predicted means and standard errors from the
separate mixed models in which weight discrepancy (either
absolute or relative) was predicted from study group and
measurement time. The absolute weight discrepancy variable
indicates that participants tended to self-report a weight
value that was on average 3.46 (se = 0.25) pounds different
from what was measured (average discrepancy calculated
across all subjects at baseline and followup). The relative
weight discrepancy variable shows that participants tended
to self-report a weight value that was on average 2.06
(se = 0.33) pounds less than what was measured (average
discrepancy calculated across all subjects at baseline and
followup). There were no baseline differences between the
intervention and control groups with respect to absolute
weight discrepancy, P = .35. The absolute discrepancy
between measured and self-reported weight did not change
over time (P = .32), nor did the rate of change over
time differ across the study groups, P = .31. However, the
simple effect of intervention versus control was significantly
different at the 6-month follow-up measurement (P = .036).
A similar pattern of results emerged for relative weight
discrepancy. The relative weight discrepancy was similar
across study groups at baseline (P = .49) and did not change
over time (P = .84), and the rate of change was similar across
study groups (P = .41). For the relative weight discrepancy
data, none of the simple effect comparisons were statistically
significant.

4. Discussion
The results of this study indicate that, in relative terms,
the discrepancy between self-reported and measured body
weights among obese employees is small, consistent over
time, and not influenced by a self-monitoring intervention,
thereby supporting the contention that self-reported body
weight may be considered a reasonable estimate of measured
body weight and body weight change among obese employ-
es. In addition, participants who received a regular self-
weighing intervention with immediate feedback and daily
monitoring were significantly more accurate in their self-
reported weight at followup.
Cash and colleagues [13] observed considerable improve-
ment in the accuracy of self-reported weight following just
a single weigh-in. Flood et al. [14] observed more accurate
self-reports among participants who practiced self-weighing
just weekly. In the Cash et al. study, however, measured body
weights were taken immediately before self-reported body
weight was recorded. This may suggest that the delay between
measured body weights relative to subsequent self-report of
body weight heavily influences recall bias. In other words,
it may be that the closer a measured body weight is taken
relative to self-reported weight, the more accurate that self-
reported body weight will be. This phenomenon may operate
largely independent of self-weighing frequency, although this
notion was not studied explicitly.
Consistent with previous research, participants in our
study reported that they weighed less than what was observed
on the scale. The magnitude of underreporting in our study
was about 30 percent less than that observed in some
weight loss programs [9, 19] and slightly higher compared
to other more recent data [5]. As in the Dekkers et al.
study [5], participants in this study self-reported their body
weight relatively accurately from the start, thereby leaving
less room for improvement. It may also be that participating
in a research trial versus a workplace program alters the
expectation that weights will be formally measured in the
presence of others (i.e., researchers), which tempers the
body image-related self-presentation bias that is suspected to
underlie weight underreporting [13, 20].
## Table 1: Descriptive characteristics of all participants at baseline.

|                                      | Intervention | Control | P    |
|--------------------------------------|--------------|---------|------|
| n                                    | 45           | 55      |      |
| Age (years)                          | 44.5 (1.4)   | 47.7 (1.1) | .065 |
| Female                               | 93.3%        | 89.1%   | .461 |
| Hispanic ethnicity                   | 2.2%         | 0%      | .266 |
| Race                                 |              |         |      |
| American/Alaskan native              | 0.0%         | 5.5%    |      |
| Black/African American               | 8.9%         | 5.5%    |      |
| Native Hawaiian/Pacific Islander     | 2.2%         | 0.0%    | .373 |
| White                                | 84.4%        | 87.3%   |      |
| Multiracial                          | 2.2%         | 1.8%    |      |
| Unknown or unspecified               | 2.2%         | 0.0%    |      |
| Non-Hispanic White                   | 84.4%        | 87.3%   | .685 |
| Marital status                       |              |         |      |
| Never married                        | 15.6%        | 12.7%   |      |
| Married, living with partner         | 71.1%        | 67.3%   | .576 |
| Divorced                             | 13.3%        | 16.4%   |      |
| Widowed                              | 0.0%         | 3.6%    |      |
| Education level                      |              |         |      |
| High school diploma or GED           | 4.4%         | 3.6%    |      |
| Technical or associate’s             | 28.9%        | 25.5%   |      |
| Some college                         | 26.7%        | 18.2%   | .688 |
| Bachelor’s degree                    | 26.7%        | 40.0%   |      |
| Graduate degree                      | 13.3%        | 12.7%   |      |
| Annual household income              |              |         |      |
| 15,000–29,999                        | 0.0%         | 1.9%    |      |
| 30,000–44,999                        | 20.0%        | 13.0%   |      |
| 45,000–59,999                        | 13.3%        | 13.0%   | .873 |
| 60,000–74,999                        | 13.3%        | 16.7%   |      |
| 75,000–89,999                        | 20.0%        | 22.2%   |      |
| 90,000+                              | 33.3%        | 33.3%   |      |
| Measured weight (lbs)                | 238.7 (5.7)  | 227.0 (4.4) | .102 |
| Body mass index (kg/m²)              | 39.2 (0.9)   | 37.6 (0.6) | .152 |
| Self-reported weight (lbs)           | 237.3 (5.7)  | 224.7 (4.3) | .078 |
| Ideal weight (lbs)                   | 154.3 (3.1)  | 154.0 (2.7) | .943 |
| Ever dieted to lose weight (yes)     | 100%         | 94.6%   | .112 |
| Weight loss program participation in last 2 years (yes) | 37.8% | 56.4% | .064 |

Values are reported as mean ± standard error or frequency (% of column total).

## Table 2: Change in absolute and relative weight discrepancy by study group over time.

|                                      | Intervention | Control |         |         |         |         |         |
|--------------------------------------|--------------|---------|---------|---------|---------|---------|---------|
|                                      | Baseline     | Followup| Baseline| Followup|         |         |         |
| Observed                             |              |         |         |         |         |         |         |
| Absolute weight discrepancy (lbs)    | 3.01 (0.37)  | 2.69 (0.37) | 3.66 (0.44) | 4.37 (0.76) |         |         |         |
| Relative weight discrepancy (lbs)    | 1.41 (0.55)  | 2.59 (0.39) | 2.02 (0.61) | 2.28 (0.94) |         |         |         |
| Model predicted                      |              |         |         |         |         |         |         |
| Absolute weight discrepancy (lbs)    | 3.01 (0.52)  | 2.69 (0.56) | 3.67 (0.47) | 4.31 (0.52)* |         |         |         |
| Relative weight discrepancy (lbs)    | 1.41 (0.67)  | 2.54 (0.72) | 2.05 (0.61) | 2.21 (0.67) |         |         |         |

Values are reported as mean ± standard error.

*Intervention versus control is P < .05 at followup.
Convenience and low cost make the use self-reported body weight an attractive solution for ongoing program administration. Self-reported weight may be questionable because it may result in underclassification of people into overweight and obese categories [5, 12]. In a weight loss intervention, however, where the primary outcome of interest is usually a relative variable (i.e., weight change), it seems to be more acceptable, at least in the short-term or during the active treatment phase [18, 19]. The relative discrepancy across intervention group participants in our study moved from about 3 lbs underreported at baseline to about 2.7 lbs underreported at followup. This relatively small change of about 0.3 lbs is due in part to the relatively small baseline discrepancy between self-reported and measured body weight. Furthermore, the comparison between baseline and followup involves self-reported body weights at both measurement points. As such, a consistent error may be biased toward a lower body weight cross-sectionally but allows for a relatively stable change estimate. Consider the following application of the data generated from the current analysis of the Weigh-By-Day trial data: participants in an employer-sponsored weight loss program have an average measured body weight of 200 lbs and an average self-reported body weight of 197 lbs at baseline. After six months of treatment (with or without regular self-weighing), the average measured body weight is 190 lbs and the average self-reported body weight is 188 lbs. Thus, the average measured body weight loss was 10 lbs while the average self-reported body weight loss was 9 lbs. Although the precise amount of weight loss would be slightly biased, it seems to be a reasonable estimate if resource constraints make it difficult to obtain measured weight.

A unique aspect of this study involved the novel use of a telehealth device that allowed for a direct observation of self-weighing behavior as well as the direct measurement of body weight itself. The participants were fully aware that the health coaches had knowledge of their behavior (self-weighing) as well as their body weight itself. Measured and self-reported body weights were completed prior to and following the weight loss intervention. These study components allowed us to measure the accuracy of self-reported body weight in a cross-sectional manner as well as following a self-weighing program intervention.

The results of this study indicate that the accuracy of self-reported body weight, among obese employees appears to be relatively close to measured body weight, may be improved through daily self-monitoring, and negligibly impacts change in body weight. Despite the fact that directly measured weights will always be considered more accurate, the results of this study indicate that self-reported weights among obese employees may be considered acceptable for program effectiveness monitoring in real world applications which will greatly enhance program efficiency and affordability. Strategies to promote self-weighing may support improvements in accuracy of self-reported body weight and such efforts may be especially relevant since self-weighing has shown to be an evidence-supported recommendation for successful body weight loss, weight regain prevention, and prevention of weight gain among adults [16, 21].

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