Changes in the Perceptions of Self-weighing Across Time in a Behavioral Weight Loss Intervention

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Objective: Changes in beliefs about self-weighing were examined across time in a behavioral weight loss intervention.

Methods: Active duty military personnel (n = 248) enrolled in a 12-month counselor-initiated or self-paced intervention based on the Look AHEAD (Action for Health in Diabetes) Intensive Lifestyle Intervention. Using an electronic scale, participants were asked to self-weigh daily. Self-weighing perceptions were compared from baseline to 4 months (weight loss phase), from 4 months to 12 months (weight maintenance phase), and from baseline to 12 months (full intervention), as well as across time by behavioral and demographic characteristics.

Results: Overall, participants perceived self-weighing as more helpful and positive, less frustrating, and making them less self-conscious after the weight loss phase. After weight maintenance, individuals believed self-weighing was less helpful and positive, more frustrating and anxiety provoking, and making them more self-conscious. However, after the intervention, participants still viewed self-weighing as more helpful and positive and less frustrating than at baseline. Weight change, self-weighing behavior prior to the intervention, and intervention condition were associated with perception change. Controlling for these influencing factors, differences in gender, BMI, age, ethnicity, and race were observed in how beliefs changed across time.

Conclusions: Results suggest engaging in a weight loss intervention promoting daily self-weighing increases positive and decreases negative beliefs about self-weighing.

Introduction

Frequent self-weighing is an effective tool for weight loss and weight gain prevention (1–7), and decreases in self-weighing are associated with subsequent weight gain (8). Extensive research refutes the common misperception that self-weighing increases long-term psychological distress and body dissatisfaction (5,9). In fact, some studies have suggested frequent self-weighing increases body satisfaction over time (10,11).

Several studies have measured perceptions of self-monitoring in adults after weight management interventions and found experiences are generally positive (3,12–14). Steinberg and colleagues (3) measured beliefs about self-weighing in adults who completed a 6-month weight loss intervention. On average, participants reported that daily self-weighing with electronic scales (e-scales) was easy to do, easy to remember, positive, helpful, and that they would likely continue (3). Participants did not report that they found this behavior highly frustrating or anxiety provoking or that it made them self-conscious. Using the same measure, consistently positive beliefs were found in African American female breast cancer survivors after a 6-month weight gain prevention program (13). Additionally, Gokee Larose and colleagues (14) measured the belief that self-weighing is positive twice within a weight gain prevention program and found scores remained positive and stable (14). However, these studies examined beliefs after engaging in an intervention (3,12–14). Thus, potential changes in self-weighing perceptions before, during, and after a behavioral weight loss intervention are unknown.

The study purpose is to examine changes in perceptions of self-weighing during the weight loss and weight maintenance phases of a weight loss...
intervention in active duty military personnel using e-scales. Based on previous studies of self-weighing beliefs, in the overall sample, we hypothesize that positive perceptions will increase during weight loss \(^{(3,12,13)}\). Furthermore, based on research, which has suggested a stable and positive perception of self-weighing during weight gain prevention \(^{(14)}\), we hypothesize that perceptions will remain stable during weight maintenance. Given that individual experiences are embedded within a weight loss intervention, our study will examine how weight loss success, intervention condition, and self-weighing behavior prior to the intervention are associated with perception change. Additionally, because of a lack of research on demographic differences in self-weighing perceptions, our study aims to explore potential differences in gender, BMI, age, ethnicity, and race in how experiences of self-weighing differ across the intervention phases.

### Methods

#### Participants

Active duty military personnel \((n = 248)\) were recruited from Joint Base San Antonio, Texas (Table 1). Participants \((\geq 18 \text{ years of age; BMI} \geq 25)\) had phone and email access and at least 1 year left in their position in San Antonio. They were required to self-monitor diet and physical activity for a week and obtain written clearance from a health care provider. Exclusion criteria included failing more than one military fitness test in the past 12 months as well as having a medical condition or taking medication that affects their weight or ability to change diet or physical activity.

#### Procedure

This study was primarily approved by the Institutional Review Board of the 59th Medical Wing in San Antonio and secondarily acknowledged by the Institutional Review Board at the University of Tennessee Health Science Center. After obtaining informed consent at screening, participants were randomized at the individual level using a computerized block design. Participants received either a counselor-initiated (CI) or self-paced (SP) weight loss intervention. With both conditions, weight loss goals (10% of baseline weight), personalized calorie, and exercise goals were the same. All participants were also provided the BodyTrace e-scale (BodyTrace, Inc., Palo Alto, California), in which measured weights were uploaded and graphed over time into a secure personalized website. Both conditions received a 12-month manualized behavioral weight loss program based on the Look AHEAD (Action for Health in Diabetes) Intensive Lifestyle Intervention. Those randomized to the CI condition received 28 individual telephone sessions with a trained interventionist over the 12-month period. Participants received interventionist feedback via email on weight, diet, and exercise self-monitoring at the same frequency as telephone sessions.

Individuals in the SP condition were given a handout of available resources (i.e., individual telephone sessions and self-monitoring feedback via email when requested, lesson materials). During telephone sessions, counselors encouraged daily self-weighing as one of the most effective tools for weight loss (1–7). Further details on the sample and study procedures are described elsewhere \((15)\).

### Measures

#### Sociodemographic characteristics

Participants reported gender (i.e., male, female), age (i.e., \(< 30 \text{ years, 30-40 years, > 40 years}\), ethnicity (i.e., non-Hispanic/Latino, Hispanic/Latino), and race (i.e., Caucasian, African American, and other) at baseline. The category “other” included individuals who identified as American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, multiple races, and unknown race given infrequency of responses.

#### Body weight

Weight was measured on a calibrated scale (in kilograms) at the baseline, 4-month assessment, and 12-month assessment. Height (in centimeters) was measured using a wall-mounted stadiometer. BMI was calculated using the standard formula based on baseline measurements. Participant BMI was categorized as overweight (25.0-29.9 kg/m\(^2\)) or obesity (> 30 kg/m\(^2\)). If clinic weight was missing for 4- or 12-month assessments, BodyTrace weights closest to targeted time points were used to maximize completeness of weight data based on high consistency between BodyTrace weights and in-person weight assessments \((16)\). To define 4-month weight not collected in clinic \((n = 36)\), BodyTrace weight that was available ± 30 days around 120 days from randomization was used (range: 90-142 days). For 12-month weight not collected in clinic \((n = 34)\), BodyTrace weight that was available ± 30 days around 360 days from randomization was used (range: 335-385 days). After this imputation step, missing weights at 4 months \((n = 13)\) and 12 months \((n = 42)\) assumed no change from baseline as the most conservative estimate.

#### Weight change

To define weight change (i.e., gain, loss, stable), the difference in weight from baseline to 4 months and baseline to 12 months was used. Weight change was classified as the following: weight gain (> 2.3% of baseline weight), weight loss (< 2.3% of baseline weight), and weight stable (within 2.3% of baseline weight). Criterion was based on a previous study on weight maintenance \((17)\).

#### Perceptions of self-weighing

Perceptions were assessed with a questionnaire on attitudes associated with self weighing used in previous weight loss and weight gain prevention studies \((3,14)\). Using an 8-point scale, participants were asked whether they found daily self-weighing to be helpful (i.e., not at all helpful \([1]\) to very helpful \([8]\)) and positive.

### Table 1: Participant characteristics \((n = 248)\)

|                            | Randomized (%) |
|-----------------------------|----------------|
| Gender                      |                |
| Male                        | 122 (49%)      |
| Female                      | 126 (51%)      |
| Age                         |                |
| <30 y                       | 66 (27%)       |
| 30-40 y                     | 123 (50%)      |
| >40 y                       | 59 (24%)       |
| Race                        |                |
| African American            | 49 (20%)       |
| Caucasian                   | 163 (66%)      |
| Other                       | 36 (15%)       |
| Ethnicity                   |                |
| Non-Hispanic/Latino         | 192 (77%)      |
| Hispanic/Latino             | 56 (23%)       |
| BMI category                |                |
| Normal                      | 1              |
| Overweight                  | 139 (55%)      |
| Obesity                     | 107 (43%)      |

Numbers represent \(n\) values.
Changes in the Perceptions of Self-Weighing

(i.e., not at all positive [1] to very positive [8]). Additionally, using a reverse-scored 8-point scale, participants were asked whether they found self-weighing to be frustrating (i.e., not at all frustrating [1] to very frustrating [8]) or anxiety provoking (i.e., not at all anxiety provoking [1] to very anxiety provoking [8]) or whether it made them feel self-conscious (i.e., not at all self-conscious [1] to very self-conscious [8]). Thus, a higher score for these items indicates a more negative (i.e., frustrating, anxiety provoking, makes you self-conscious) perception of self-weighing.

Previous self-weighing frequency. A question from the Look AHEAD weight control practices questionnaire was administered at baseline to assess previous self-weighing behavior (i.e., “How often do you weigh yourself?”) (3,15). Answers were never, about once a year or less, every couple of months, every month, every week, every day, and more than once per day. This study categorized participants as those who weighed themselves weekly or more frequently versus less than weekly.

Self-weighing frequency. Self-weighing was measured continuously by measurements from the BodyTrace scale. Frequency was computed by adding the number of days each participant weighed during each phase of the intervention.

Analyses
Perceptions of self-weighing were compared from baseline to 4 months (weight loss), 4 months to 12 months (weight maintenance), and baseline to 12 months (full intervention). This change was observed in the overall sample and compared by intervention condition, relevant weight change (i.e., 4-month or 12-month outcome), and self-weighing frequency prior to the intervention using Wilcoxon signed rank and Kruskal-Wallis tests. To explore demographic differences, linear regression models examined change by gender, BMI category, age, ethnicity, and race, controlling for these influencing covariates (i.e., weight change, intervention condition, previous self-weighing). In additional analyses, models examined demographic differences, controlling for intervention condition, weight change, and frequency of e-scale self-weighing during the relevant intervention phase (Supporting Information Table S1). To observe longitudinal profiles across the full intervention, random coefficient models predicted change over time, controlling for baseline covariates (i.e., intervention, previous self-weighing frequency). Finally, a Spearman correlation coefficient was computed to assess the relationship between change in each belief and frequency of self-weighing during each intervention phase.

### TABLE 2 Frequency of self-weighing

|                      | Weight loss phase |                                     | Weight maintenance phase |                                     | Full intervention |                                     |
|----------------------|-------------------|--------------------------------------|--------------------------|--------------------------------------|-------------------|--------------------------------------|
|                      | \(n\) | M (SD) | \(n\) | M (SD) | \(n\) | M (SD) | \(n\) | M (SD) | \(n\) | M (SD) |
| Overall sample       | 246  71.95 (34.47) | 246  78.03 (66.96) | 246  149.98 (94.31)     |                                     |                   |
| Gender               |                   |                                     |                          |                                     |                   |
| Male                 | 121   72.36 (36.52) | 121   77.55 (67.02) | 121   149.92 (95.64)     | 121   149.92 (95.64) | 121   149.92 (95.64) |
| Female               | 132   71.54 (32.52) | 125   78.49 (67.17) | 125   150.03 (93.39)     | 125   150.03 (93.39) | 125   150.03 (93.39) |
| Age                  |                   |                                     |                          |                                     |                   |
| <30 y                | 66   62.73 (35.34)  | 66   62.17 (62.53)   | 66   124.89 (90.24)     | 66   124.89 (90.24) | 66   124.89 (90.24) |
| 30-40 y              | 122   74.29 (34.03) | 122   80.11 (66.52) | 122   154.40 (92.99)     | 122   154.40 (92.99) | 122   154.40 (92.99) |
| >40 y                | 58    77.52 (32.92)  | 58    91.69 (70.20)  | 58    169.21 (97.18)     | 58    169.21 (97.18) | 58    169.21 (97.18) |
| Race                 |                   |                                     |                          |                                     |                   |
| Caucasian            | 161   70.01 (34.41) | 161   77.20 (64.71) | 161   147.22 (92.20)     | 161   147.22 (92.20) | 161   147.22 (92.20) |
| African American     | 49    77.61 (31.25)  | 49    77.90 (65.08)  | 49    155.51 (88.35)     | 49    155.51 (88.35) | 49    155.51 (88.35) |
| Other                | 36    72.89 (38.80)  | 36    81.89 (80.10)  | 36    154.78 (112.22)    | 36    154.78 (112.22) | 36    154.78 (112.22) |
| Ethnicity            |                   |                                     |                          |                                     |                   |
| Non-Hispanic/Latino  | 191   73.27 (34.84) | 191   81.10 (65.65) | 191   154.37 (93.57)     | 191   154.37 (93.57) | 191   154.37 (93.57) |
| Hispanic/Latino      | 55    67.36 (33.08)  | 55    67.35 (70.89)  | 55    134.71 (98.16)     | 55    134.71 (98.16) | 55    134.71 (98.16) |
| BMI category         |                   |                                     |                          |                                     |                   |
| Overweight           | 114   72.24 (33.76) | 114   78.30 (69.87) | 114   150.54 (95.95)     | 114   150.54 (95.95) | 114   150.54 (95.95) |
| Obesity              | 132   71.70 (35.21) | 132   77.80 (64.61) | 132   149.49 (93.24)     | 132   149.49 (93.24) | 132   149.49 (93.24) |
| Weight change        |                   |                                     |                          |                                     |                   |
| Weight loss          | 90    85.71 (29.43) | 90    113.11 (67.43) | 90    198.82 (90.60)     | 90    198.82 (90.60) | 90    198.82 (90.60) |
| Weight stable        | 100   66.47 (34.98) | 100   57.12 (59.79) | 100   123.59 (85.66)     | 100   123.59 (85.66) | 100   123.59 (85.66) |
| Weight gain          | 56    59.61 (34.21) | 56    58.98 (54.78) | 56    115.89 (83.42)     | 56    115.89 (83.42) | 56    115.89 (83.42) |
| Intervention         |                   |                                     |                          |                                     |                   |
| Counselor-initiated  | 114   88.15 (27.97) | 114   97.11 (68.13) | 114   185.27 (89.31)     | 114   185.27 (89.31) | 114   185.27 (89.31) |
| Self-paced           | 132   55.74 (32.78) | 132   58.94 (60.23) | 132   114.68 (85.88)     | 132   114.68 (85.88) | 132   114.68 (85.88) |
| Previous self-weighing |                   |                                     |                          |                                     |                   |
| At least weekly      | 143   73.67 (33.3)  | 143   82.20 (69.92) | 143   155.87 (96.1)      | 143   155.87 (96.1) | 143   155.87 (96.1) |
| Less than weekly     | 102   69.25 (36.12) | 102   72.15 (62.79) | 102   141.40 (91.98)     | 102   141.40 (91.98) | 102   141.40 (91.98) |
Results
Participants
Randomized participants were diverse in gender, BMI category, race, ethnicity, and age (Table 1). Frequency of self-weighing behavior across behavioral and demographic characteristics is provided (Table 2).

Change in self-weighing perceptions in overall sample
Weight loss phase (0-4 months). Participants reported self-weighing as more helpful (mean $M = 1.56; P < 0.0001$) and more positive ($M = 1.66; P < 0.0001$) as well as less frustrating ($M = -1.02; P < 0.0001$) and making them less self-conscious ($M = -0.76; P < 0.0001$) after the weight loss phase (Table 3). Belief that self-weighing was anxiety provoking did not significantly change (baseline score $M = 3.33$).

Weight maintenance phase (4-12 months). Compared with scores after the weight loss phase, participants reported self-weighing as less helpful and less positive after weight maintenance ($P = 0.036$ and $P = 0.0024$, respectively) (Table 3). Furthermore, they found that self-weighing was more frustrating ($P = 0.035$) and making them more self-conscious ($P 0.003C 0.0001$). Belief that self-weighing was anxiety provoking remained unchanged.

Full intervention (0-12 months). Participants believed self-weighing was more helpful ($M = 1.31; P < 0.003C 0.0001$) and more positive ($M = 1.18; P < 0.0001$) as well as less frustrating ($M = -0.35; P < 0.0001$) and making them more self-conscious ($P 0.003C 0.0001$). Belief that self-weighing was anxiety provoking remained unchanged.

Perceptions by behavioral characteristics
Weight change. At baseline, there were no differences in self-weighing perceptions by weight change outcomes at 4 months (data not shown) or 12 months (Table 3).

| TABLE 3 Description of self-weighing perception scores across intervention phases by behavioral characteristics |
|---------------------------------------------------------------|
| Perception change, M (SD) | Overall sample | Weight change | Intervention group | Previous self-weighing |
|-----------------------------|----------------|---------------|--------------------|------------------------|
|                             | Baseline       | Weight loss   | Weight maintenance | Full intervention      |
|                             | $5.15 (1.93)$  | $1.56 (2.09)^a$ | $-0.28 (1.52)^c$  | $1.31 (2.27)^a$        |
| Helping                     | $4.82 (1.93)$  | $1.94 (2.05)^b$ | $0.15 (1.19)^b$   | $2.15 (1.94)^a$        |
|                             | $5.32 (1.94)$  | $1.17 (2.09)^b$ | $-0.72 (1.60)^b$  | $0.49 (1.97)^b$        |
|                             | $5.31 (1.88)$  | $1.13 (2.00)^b$ | $-0.55 (1.84)^b$  | $0.85 (2.67)^a$        |
|                             | $4.91 (2.04)$  | $2.07 (2.05)^a$ | $-0.26 (1.47)$    | $1.85 (2.17)^a$        |
|                             | $5.39 (1.79)$  | $0.93 (1.98)^a$ | $-0.30 (1.61)$    | $0.62 (2.21)^a$        |
|                             | $4.68 (2.01)^b$| $1.97 (2.02)^c$ | $0.00 (1.30)^c$   | $2.03 (2.24)^a$        |
|                             | $5.49 (1.81)^b$| $1.28 (2.10)^c$ | $-0.50 (1.66)^c$  | $0.81 (2.16)^a$        |
| Positive                    | $4.12 (1.98)$  | $2.44 (1.84)^a$ | $0.83 (1.91)^b$   | $2.01 (2.02)^a$        |
|                             | $4.77 (1.96)$  | $1.03 (2.15)^a$ | $-0.55 (1.76)$    | $0.92 (2.02)^a$        |
|                             | $4.23 (2.00)$  | $-0.13 (2.53)^a$ | $-0.38 (1.30)$    | $0.03 (1.86)^a$        |
|                             | $4.44 (1.92)$  | $2.17 (2.12)^a$ | $-0.39 (1.72)$    | $1.78 (2.26)^a$        |
|                             | $4.00 (2.06)$  | $1.03 (2.13)^a$ | $-0.33 (1.49)$    | $0.41 (1.68)^a$        |
|                             | $4.24 (1.89)$  | $1.23 (2.15)^b$ | $-0.41 (1.47)$    | $1.69 (2.30)^c$        |
|                             | $3.80 (1.99)^c$| $1.27 (2.15)^b$ | $-0.41 (1.47)$    | $0.83 (1.94)^c$        |
| Frustrating                 | $4.62 (2.12)$  | $4.51 (2.10)$  | $4.59 (2.05)$     | $4.58 (2.13)$          |
|                             | $-1.02 (2.26)^a$| $-1.38 (2.26) | $-0.68 (2.07)$    | $-0.44 (2.87)$        |
|                             | $0.36 (2.01)^b$| $0.83 (1.91)^a$ | $0.93 (2.55)^b$   | $-0.11 (2.43)$        |
|                             | $-0.61 (2.25)^b$| $-1.36 (2.02)^a$| $-0.35 (2.09)^a$  | $-0.83 (2.45)$        |
| Anxiety provoking           | $3.33 (2.10)$  | $3.47 (2.04)$  | $3.22 (2.15)$     | $3.33 (2.08)$          |
|                             | $-0.22 (1.99)$ | $-0.40 (1.96)$ | $0.19 (2.61)$     | $-0.30 (1.92)$        |
|                             | $0.31 (1.99)^b$| $-0.16 (1.91)^c$| $0.89 (1.97)^b$   | $-0.21 (1.84)$        |
|                             | $-0.06 (2.28)$ | $-0.74 (2.06)^b$| $0.25 (2.46)^b$   | $-0.18 (2.22)$        |
| Self-Conscious              | $4.58 (2.36)$  | $4.71 (2.19)$  | $4.58 (2.51)$     | $4.37 (2.31)$          |
|                             | $-0.76 (2.22)^a$| $-1.20 (2.25)^b$| $-0.39 (1.87)^a$  | $0.25 (3.02)^b$        |
|                             | $0.62 (1.80)^a$| $0.26 (1.57)$  | $0.77 (2.06)$     | $1.21 (1.72)$          |
|                             | $-0.15 (2.24)$ | $-0.72 (1.76)^a$| $-0.20 (2.65)^a$  | $0.95 (2.06)^a$        |

Weight change based on relevant intervention phase outcome. Wilcoxon signed rank and Kruskal-Wallis tests measured mean change differences overall and between behavioral factors.

$^aP < .0001; ^bP < .01; ^cP < .05.$
Across the weight loss phase, those who lost weight (i.e., at 4 months) viewed self-weighing as more helpful \((P = 0.013)\), more positive \((P < 0.0001)\), and making them less self-conscious \((P = 0.008)\) compared with those who gained weight or remained weight stable (Table 3). Across weight maintenance, individuals who lost weight (i.e., at 12 months) perceived self-weighing as more helpful \((P < 0.0001)\), more positive \((P < 0.0001)\), less frustrating \((P = 0.0004)\), less anxiety provoking \((P = 0.007)\), and making them less self-conscious \((P = 0.0006)\) than those who gained or remained weight stable. Over the full intervention, those who lost weight (i.e., 12 months) developed views that self-weighing was more helpful \((P < 0.0001)\) and positive \((P < 0.0001)\), less frustrating \((P = 0.0004)\) and anxiety provoking \((P = 0.007)\), and making them less self-conscious \((P = 0.0006)\). No other differences were observed.

**Intervention group.** Participants in both interventions had similar baseline perceptions (Table 3). Across the weight loss phase, the CI group believed self-weighing was more helpful \((P = 0.0001)\) and more positive \((P = 0.0004)\) than the SP group (Table 3). Over the full intervention, the CI group perceived self-weighing as more helpful \((P = 0.0003)\) and positive \((P < 0.0001)\) and making them less self-conscious \((P = 0.004)\) than the SP group. No other differences in beliefs were observed.

**Previous self-weighing.** At baseline, individuals who weighed weekly or more frequently prior to the intervention indicated that self-weighing was more helpful \((P = 0.002)\) and positive \((P = 0.03)\) than those who weighed less often (Table 3). Across the weight loss phase, those who weighed less than weekly prior to the intervention believed self-weighing was more helpful \((P = 0.046)\) and more positive \((P = 0.004)\) than those who weighed more frequently (Table 3). Across weight maintenance, those who weighed less than weekly prior to the intervention believed self-weighing was more helpful \((P = 0.014)\) than those who weighed more frequently (Table 3). Across the full intervention, those who weighed less than weekly prior to the intervention developed views of self-weighing as more helpful \((P = 0.0003)\) and positive \((P = 0.033)\) than those who weighed more frequently.

**Perceptions by demographic characteristics**

**BMI.** At baseline, participants with overweight believed self-weighing was more positive \((P = 0.027)\) and less frustrating \((P = 0.029)\) than participants with obesity (Table 4). Controlling for covariates, across the weight loss phase, individuals with obesity believed self-weighing was more helpful \((P = 0.027)\) and more positive \((P = 0.006)\) than those with overweight (Table 4). Across weight maintenance, however, those with obesity believed self-weighing was less positive \((P = 0.02)\) and more anxiety provoking \((P = 0.022)\). There were no BMI differences for other beliefs at baseline or across time (Table 4).

**Gender.** At baseline, men reported self-weighing was more positive \((P = 0.001)\), less frustrating \((P = 0.002)\), less anxiety provoking \((P = 0.005)\), and made them less self-conscious \((P < 0.0001)\) than women (Table 4). There were no other differences at baseline or across the weight loss or maintenance phases (Table 4). Adjusting for covariates, across the full intervention, women developed the view of self-weighing as more positive \((P = 0.03)\). No other differences were found across the full intervention.

**Age.** Baseline scores showed similar beliefs of self-weighing across age groups, and no differences were observed for beliefs over time (Table 4).

**Ethnicity.** At baseline, scores showed similar perceptions regardless of ethnicity (Table 4). Adjusting for covariates, individuals who identified as Hispanic/Latino believed self-weighing was more anxiety provoking \((P = 0.013)\) than those who identified as non-Hispanic/Latino after the full intervention (Table 4). No other differences were found.

**Race.** At baseline, participants who identified as Caucasian reported self-weighing was less positive \((P < 0.0001)\) compared with other racial identities (Table 4). Furthermore, participants classified as Other perceived self-weighing as less frustrating \((P = 0.009)\) and less anxiety provoking \((P = 0.017)\) at baseline than other racial identities. There were no other baseline differences. Adjusting for covariates, those classified as Other believed self-weighing was less helpful across weight maintenance \((P = 0.03)\) and the full intervention \((P = 0.022)\) compared with those with other racial identities. Across the full intervention, those identified as Caucasian developed self-weighing beliefs of being more positive \((P = 0.044)\) than those with other racial identities.

**Longitudinal profiles**

In random coefficient models, interactions of time and behavioral characteristics were consistent with linear regression models (Figure 1). To differentiate between intervention and weight loss success, models explored the effects of intervention group and time for all beliefs, controlling for weight change (i.e., 12 months). Interactions of time and intervention condition remained for beliefs that self-weighing is helpful \((P = 0.0041)\) and positive \((P = 0.0054)\), such that those in the CI group exhibited a steeper increase in the beliefs that self-weighing is helpful and positive compared with the SP group over the full intervention. No significant interactions were found for other beliefs.

Adjusting for baseline covariates, coefficient models predicted profile differences by BMI, gender, ethnicity, and race similar to differences found in linear regression models (Figure 1). However, inconsistent with null findings in regression models, time and age interacted in the belief that self-weighing is anxiety provoking \((P = 0.027)\) (Figure 1). Specifically, those between the ages of 30 and 40 years exhibited a steeper increase in the belief that self-weighing is anxiety provoking compared with other ages over the full intervention.

**Self-weighing perceptions and self-weighing behavior**

**Weight loss phase.** There was a positive relationship between the increased belief that self-weighing is helpful and the number of days participants self-weighed during the weight loss phase \((r = 0.35; P < 0.0001)\) (Table 5), such that developing stronger beliefs that self-weighing is helpful correlated with more frequent self-weighing. There was a negative relationship between the increased belief that self-weighing is positive and the days weighed \((r = -0.19; P = 0.007)\), such that developing stronger beliefs that self-weighing is positive correlated with less frequent self-weighing. Furthermore, there was a negative relationship between the increased belief that self-weighing is frustrating and days participants weighed \((r = -0.15; P = 0.020)\), such that developing stronger views that self-weighing is frustrating correlated with less frequent weighing. There were no correlations between change in other beliefs and self-weighing frequency.

**Weight maintenance phase.** There were no associations between change in perceptions and self-weighing frequency during weight maintenance (Table 5).
| Perception change, M (SD) | BMI | Gender | Age | Ethnicity | Race |
|---------------------------|-----|--------|-----|-----------|------|
|                           | ≥30 | >25    | <30 y | 30-40 y | >40 y |
| Helpfulness                |     |        |      |          |      |
| Baseline                  | 5.00 (1.93) | 5.32 (1.93) | 5.10 (1.94) | 4.97 (1.94) | 5.31 (1.86) |
| Weight loss               | 1.84 (0.24) | 1.20 (0.25) | 1.56 (0.24) | 1.49 (0.33) | 1.46 (0.25) |
| Maintenance               | −0.38 (0.18) | −0.26 (0.19) | −0.31 (0.18) | −0.39 (0.28) | −0.26 (0.18) |
| Full intervention         | 1.44 (0.23) | 1.00 (0.25) | 1.02 (0.23) | 1.04 (0.36) | 1.39 (0.24) |
| Positive                  |     |        |      |          |      |
| Baseline                  | 3.87 (1.96) | 4.41 (1.97) | 3.74 (2.07) | 3.97 (1.95) | 4.29 (1.99) |
| Weight loss               | 1.61 (0.24) | 0.81 (0.25) | 1.08 (0.24) | 1.33 (0.32) | 0.93 (0.25) |
| Maintenance               | −0.69 (0.17) | −0.11 (0.19) | −0.48 (0.18) | −0.38 (0.28) | −0.46 (0.25) |
| Full intervention         | 1.11 (0.21) | 0.91 (0.23) | 0.70 (0.21) | 1.13 (0.33) | 0.71 (0.22) |
| Frustrating               |     |        |      |          |      |
| Baseline                  | 4.89 (2.17) | 4.30 (2.02) | 4.20 (2.03) | 5.00 (2.03) | 4.43 (2.09) |
| Weight loss               | −0.93 (0.27) | 0.81 (0.27) | −0.82 (0.28) | −1.09 (0.37) | −0.67 (0.28) |
| Maintenance               | 0.54 (0.23) | 0.40 (0.26) | 0.41 (0.24) | 0.55 (0.25) | 0.55 (0.38) |
| Full intervention         | −0.48 (0.24) | −0.42 (0.26) | −0.44 (0.24) | −0.55 (0.25) | −0.32 (0.25) |
| Anxiety provoking         |     |        |      |          |      |
| Baseline                  | 3.46 (2.12) | 3.18 (2.07) | 2.94 (1.97) | 3.41 (2.04) | 3.11 (2.07) |
| Weight loss               | −0.17 (0.24) | 0.01 (0.25) | −0.11 (0.24) | −0.56 (0.33) | 0.26 (0.25) |
| Maintenance               | 0.72 (0.23) | 0.04 (0.25) | 0.44 (0.24) | 0.02 (0.37) | 0.18 (0.33) |
| Full intervention         | 0.26 (0.24) | −0.19 (0.27) | 0.06 (0.25) | 0.05 (0.26) | −0.38 (0.38) |
| Self-conscious            |     |        |      |          |      |
| Baseline                  | 4.71 (2.38) | 4.42 (2.34) | 3.93 (2.18) | 4.82 (2.35) | 4.38 (2.36) |
| Weight loss               | −0.47 (0.26) | −0.41 (0.28) | −0.28 (0.27) | −0.55 (0.36) | −0.40 (0.27) |
| Maintenance               | 0.83 (0.21) | 0.59 (0.23) | 0.81 (0.22) | 0.54 (0.33) | 1.05 (0.21) |
| Full intervention         | 0.04 (0.24) | −0.06 (0.26) | 0.20 (0.24) | −0.22 (0.25) | −0.12 (0.37) |

Means adjusted for intervention condition, baseline self-weighing frequency, and weight change at end of relevant intervention phase (i.e., 4-month outcome, 12-month outcome). Wilcoxon signed rank and Kruskal-Wallis tests measured mean change differences at baseline between demographic factors; linear regression models observed demographic differences in change across each intervention phase controlling for covariates.

*P < 0.0001, †P < 0.01, ‡P < 0.05.*
Changes in the Perceptions of Self-Weighing

Fahey et al.

Figure 1 Modeling change in self-weighing perceptions across the intervention. Random coefficient models observed change in self-weighing perceptions by behavioral and demographic factors. Self-weighing perceptions (x-axis) are in the following order: helpful, positive, frustrating, anxiety provoking, and makes you self-conscious. Factors of interest (y-axis) are in the following order: overall sample, previous self-weighing frequency (i.e., <weekly, ≥weekly), weight change (i.e., gain, loss, stable), intervention condition (i.e., counselor-initiated, self-paced), BMI category (i.e., overweight, obesity), gender, age (i.e., <30, 30-40, >40y), ethnicity (i.e., non-Hispanic/Latino, Hispanic/Latino), race (i.e., Caucasian, African American, other). Models of demographic differences (i.e., BMI, gender, age, ethnicity, race) were adjusted for baseline covariates (i.e., intervention condition, previous self-weighing frequency). A higher score indicates a more positive (i.e., helpful, positive) perception of self-weighing. Scores for negative beliefs were reverse scored, such that a higher score indicates a more negative (i.e., frustrating, anxiety provoking, makes you self-conscious) perception of self-weighing. [Colour figure can be viewed at wileyonlinelibrary.com]
Full intervention. Across both phases, there was a positive relationship between the increased belief that self-weighing is helpful and days participants self-weighed (\( r = 0.29; P = 0.0005 \)), such that developing stronger beliefs that self-weighing is helpful correlated with more frequent self-weighing (Table 5). There was a negative relationship between increased belief that self-weighing is positive and days participants self-weighed (\( r = -0.20; P = 0.0086 \)), such that developing stronger beliefs that self-weighing is positive correlated with less frequent self-weighing. There were no associations between change in other beliefs and self-weighing frequency.

Discussion

Current findings are the first, to our knowledge, to track the progress of beliefs specifically about self-weighing behavior across different phases of a weight loss intervention. Consistent with our hypothesis, overall, positive perceptions of self-weighing increased and negative perceptions decreased during the weight loss phase. However, positive perceptions decreased slightly and negative perceptions increased slightly, albeit significantly, during the weight maintenance phase. Yet, after intervention completion, active duty personnel still perceived self-weighing as more positive and less negative than they did at baseline. Results indicate that when observing the sample as a whole, participants in a weight loss intervention, especially the weight loss phase, increased positive beliefs and decreased negative beliefs about weight self-monitoring behavior, although this effect was stronger in the more intensive version of the intervention. Consistent with previous qualitative findings, results suggest that participants find that self-weighing is not as frustrating as expected, and that it can be helpful and positive in achieving goals after engaging in an intervention promoting daily self-weighing (19).

Ratings after the weight loss phase (i.e., 4 months) were similar to a previous study, which measured these perceptions at 6 months; specifically, overall mean scores in the beliefs that self-weighing is helpful, positive, anxiety provoking, and makes you self-conscious were similar to those reported by Steinberg and colleagues (3). However, the slight decrease over the maintenance period in the belief that self-weighing is positive was inconsistent with previous findings (14), in which this perception remained stable in a weight gain prevention program. Furthermore, compared with African American breast cancer survivors in a weight management program (13), this study sample’s perceptions about self-weighing were less positive and more negative. Perhaps current ratings were specific to those experienced in an intervention that included both weight loss and weight maintenance phases as well as within a primarily (66%) Caucasian sample.

Given the potential for different experiences of self-weighing throughout the intervention, our study aimed to disentangle behavioral characteristics associated with change in beliefs. Weight change, self-weighing behavior prior to the intervention, and the intensity of the intervention were associated with how self-weighing perceptions changed. Specifically, those who weighed less frequently at baseline perceived self-weighing as more helpful and positive over time than those who previously weighed more often. Participants who weighed infrequently prior to the intervention might have been unfamiliar with self-weighing as a weight loss tool, and perhaps these participants were more positively influenced by exposure to this behavior. Not surprisingly, those

### Table 5

|                          | Weight loss | Weight maintenance | Full intervention |
|--------------------------|-------------|---------------------|-------------------|
| **Weight loss**          |             |                     |                   |
| Helpful                  | 0.35^a      | 0.32^a              | 0.35^a            |
| Positive                 | -0.19^b     | -0.19^b             | -0.19^b           |
| Frustrating              | -0.15^c     | -0.20^b             | -0.19^b           |
| Anxiety provoking        | -0.08       | -0.09               | -0.09             |
| Self-conscious           | 0.08        | 0.06                | 0.07              |
| **Weight maintenance**   |             |                     |                   |
| Helpful                  | -0.01       | 0.02                | -0.01             |
| Positive                 | 0.00        | 0.00                | -0.00             |
| Frustrating              | -0.02       | -0.12               | -0.09             |
| Anxiety provoking        | -0.06       | -0.08               | -0.07             |
| Self-conscious           | -0.07       | -0.05               | -0.06             |
| **Full Intervention**    |             |                     |                   |
| Helpful                  | 0.29^a      | 0.28^b              | 0.29^a            |
| Positive                 | -0.20^c     | -0.20^c             | -0.22^a           |
| Frustrating              | -0.13       | -0.15               | -0.16             |
| Anxiety provoking        | -0.16       | -0.15               | -0.16             |
| Self-conscious           | 0.09        | 0.06                | 0.07              |

Spearman correlation coefficients measured associations; numbers represent R values.

^aP < 0.001; ^bP < 0.01; ^cP < 0.05.
who lost weight perceived self-weighing as more positive and less negative across the intervention. Additionally, those in the more intensive CI intervention group believed self-weighing was more positive and helpful than the SP group, regardless of weight loss success. Counselor encouragement and feedback about self-weighing might have facilitated a more positive experience when engaging in this behavior, even within individuals who were unsuccessful with weight loss.

Adjusting for all covariates, no age differences were found in beliefs across intervention phases. Yet, longitudinal profiles, adjusting for baseline covariates, suggested that those between the ages of 30 and 40 experienced self-weighing as more anxiety provoking compared with other ages. These findings might be unique to the military population, in which individuals between the ages of 30 and 40 are closer to retirement than in other professions (20). Failure to pass annual fitness tests increases an individual’s risk of being discharged from their job and losing medical and pension benefits (21). Therefore, perhaps these active duty personnel between 30 and 40 years experienced increased anxiety with self-weighing as the weight loss intervention neared completion in anticipation of a fitness test.

Participants with obesity, despite perceiving self-weighing as more helpful and positive during the weight loss phase, experienced this behavior as less positive and more anxiety provoking over weight maintenance compared with those with overweight. These findings indicate that participants with obesity might benefit from increased support in regard to self-weighing during weight maintenance periods. This BMI difference might explain why the mean rating of self-weighing as frustrating in the present study (i.e., M = 3.48) was higher compared with the mean reported by Steinberg and colleagues (3) (i.e., M = 2.4). Steinberg and colleagues (3) measured perceptions in only adults with overweight. Perhaps those with obesity, though believing self-weighing is helpful, perceive more negative experiences with this behavior. Furthermore, women developed a more positive view of self-weighing across the intervention compared with men. Women initially believed self-weighing was less positive and more negative prior to the intervention; therefore, they experienced a greater change in their perception of this behavior over time.

Despite similar beliefs at baseline, those who identified as Hispanic/ Latino perceived self-weighing as more anxiety provoking compared with those who identified as non-Hispanic/Latino. Additionally, individuals classified as Other believed self-weighing was less helpful across intervention phases compared with other racial identities. Though participants who identified as Caucasian reported less positive beliefs prior to the intervention, they were more likely to report a positive experience of self-weighing over time compared with other racial identities. Findings suggest adults identified as ethnic or racial minorities experience self-weighing more negatively across a behavioral trial. Future interventions might provide additional support and resources, specifically in regard to self-weighing, for individuals identifying as racial or ethnic minorities. However, because of the combined different racial identities, interpretation of results related to the Other race is difficult. Future research should utilize larger samples of individuals who identify as American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, multiple races, and unknown race in order to draw conclusions.

With regard to the correlations between perception change and actual self-weighing behavior, participants who weighed more frequently during the intervention were more likely to perceive self-weighing as helpful, yet they also felt that this behavior was less positive and more frustrating. Interestingly, other perceptions were not associated with self-weighing behavior. Although these correlations were weak, results suggest that an increased belief that self-weighing is helpful might facilitate more frequent self-weighing behaviors more so than other beliefs.

The current study was conducted in a military population, which might limit generalizability to the civilian sector. Personnel are generally younger and have access to additional resources to assist in weight loss that are not accessible to the general public (e.g., free fitness centers, health care). Furthermore, results might not be representative of adults with severe health and mental health conditions who are excluded from enlistment. In the military, fitness is perceived as a critical factor for employment and is assessed regularly in annual evaluations. Despite these unique characteristics of the military, the prevalence of overweight and obesity in the U.S. military is similar to the civilian population. Approximately 60% of active duty personnel are affected by overweight and obesity, which is a critical concern for the U.S. military (22). This diverse population of military personnel provided a unique opportunity to examine race differences as well as gender differences dissimilarly from previous studies, which have examined primarily female samples (3,13,14,19).

Missing in-clinic weight for some participants was a limitation. Although minimized by utilizing BodyTrace weight, there were cases in which weights were not available. The current study used a criterion of 2.3% to define weight change based on previous research (18). However, other studies have suggested alternative definitions (e.g., 3%) (23). Importantly, although the protocol clearly encouraged daily weighing, information on how frequently self-weighing was discussed during the telephone sessions was not collected. In addition, those in the CI condition more frequently received encouragement to self-weigh. Finally, although the questionnaire of self-weighing perceptions has been used in previous research, it was not previously validated. Future research should assess the reliability and validity of this measure.

Conclusion

Despite the weight loss benefits of self-monitoring, there is often a reluctance to engage in self-weighing behaviors. Current results suggest completing a weight loss intervention, which promotes daily self-weighing, overall increased positive perceptions and decreased negative perceptions of self-weighing. Importantly, weight loss success, prior lack of experience with self-weighing, and increased intervention intensity were associated with a more positive experience of self-weighing over time. Controlling for these influencing factors, differences in BMI, gender, age, ethnicity, and race were also observed in how these experiences changed across the intervention.

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