HHS Public Access
Author manuscript
Obesity (Silver Spring). Author manuscript; available in PMC 2020 October 20.

Published in final edited form as:
Obesity (Silver Spring). 2019 July ; 27(7): 1107–1114. doi:10.1002/oby.22512.

Measurement Equivalence of E-Scale and In-Person Clinic Weights

Kinsey Pebley[a], **Robert C. Klesges**[b,c], **G. Wayne Talcott**[b,c], **Mehmet Kocak**[c], **Rebecca A. Krukowski**[c]

[a]Department of Psychology, University of Memphis, Memphis, TN, USA;

[b]Department of Public Health Sciences, University of Virginia School of Medicine, Charlottesville, VA, USA;

[c]Department of Preventive Medicine, University of Tennessee Health Science Center, Memphis, TN, USA

Abstract

Objectives.—The current study aimed to determine if e-scale weight measurements are concordant with in-person clinic weights.

Methods.—E-scale and in-person clinic weight measurements from 248 active duty military personnel enrolled in a weight loss intervention study were used. E-scale and clinic measurements were matched and tested to determine if measurements were significantly different from each other. Equivalence between the two measurements were tested among the cohort and when stratifying by gender, BMI, race, and age. We also examined if matching the times of clinic and e-scale measurements or averaging multiple measurements was optimal, and if using e-scale and clinic measurements from the same day or if using measurements across a specified amount of time is acceptable.

Results.—Overall, e-scale and clinic measurements were significantly different from each other, but did not differ from equality. Additionally, using e-scale and clinic weight measurements that were taken on the same day may be a preferable method compared to using measurements within a week of each other, which leads to weight underprediction among e-scale measurements.

Conclusions.—E-scales display good measurement concordance. E-scales may be helpful when studying highly mobile populations, such as military personnel, and could potentially eliminate the need for in-person visits.

Keywords

e-scale; measurement concordance; weight measurements

---

66 Pauline St, Memphis, TN 38105; rkrukows@uthsc.edu.

The authors declare no conflict of interest.

Dissemination of the Look Ahead Weight Management Treatment in the Military (NCT02063178)

The opinions expressed on this document are solely those of the authors and do not represent an endorsement by or the views of the United States Air Force, the Department of Defense, the United States Government or the National Institutes of Health. The views or materials of BodyTrace™ are not necessarily the official views of, or endorsed by the United States Air Force, the Department of Defense, or the United States Government. No Federal endorsement of BodyTrace™ is intended.

Introduction

In recent years, the use of e-scales in weight management research has become more prevalent[1,2,3,4]. These portable scales allow for data to be transferred directly from the scale to the research center via cellular networks or Bluetooth connections. This capability has the potential to allow for implementation of weight loss interventions and data collection without requiring participants to attend frequent appointments, and thus may help to lower attrition rates, alleviate participant burden, and reduce the amount of missing data in weight-related studies. The use of these e-scales may also help to increase study sample sizes, as fewer individuals will be deemed ineligible due to the fact that they may not be able to attend follow-up appointments (e.g., based on distance from the data collection site or moves out of the area). This is especially important for mobile populations, such as military personnel, who may have to move or travel for extended periods of time with little prior notice, or rural populations.

Despite the positive potential that the e-scales may have, it is unclear if they provide valid measurements compared to scales used during in-person clinic visits with trained staff members. To date, only one study, to our knowledge, has assessed the agreement between the two measures[5], which found evidence of measurement concordance. However, the sample size was small (n = 58), and it is unclear if there would be measurement discrepancies across diverse groups. Thus, it is clear that more research pertaining to the validity of e-scales is needed to determine if this is a viable method of weight measurement.

The current study aimed to further examine the feasibility of using e-scales that transmit data via cellular network for weight outcomes in clinical trials by assessing whether the e-scale measurements were significantly different than measurements taken during clinic visits by trained staff members. Additionally, we aimed to determine if using the e-scale weight measurement closest to the scheduled clinic visit time (i.e., time matching) or methods of averaging together multiple weight measurements within a given amount of time were most useful in determining measurement concordance.

Method

Participants

Participants were 248 active duty military personnel at Joint Base San Antonio who were at least 18 years of age, had a body mass index (BMI) of 25 or higher, and expected to have at least one year left of their duty assignment in San Antonio to avoid excessive attrition. Exclusion criteria included a history of significant medical or psychiatric conditions, use of medication known to impact weight, pregnancy, significant recent weight loss, medical conditions that would impact the individual’s ability to make alterations to exercise and/or dietary habits, and multiple fitness test failures (due to risk of discharge in this situation). Participants gave written consent prior to starting the study. The Institutional Review Boards at the 59th Medical Wing in San Antonio, TX and the University of Tennessee Health Science Center reviewed and approved all materials and procedures before the initiation of the study.

Procedures

Data for the current study was collected in the Fit Blue study, a randomized controlled trial assessing a weight loss intervention among active duty military personnel. Participants received either a counselor-initiated or self-initiated version of the Look AHEAD Lifestyle Program, and they were also given a BodyTrace e-scale (model number BT003) and encouraged to weigh themselves daily, preferably in the morning before eating and after voiding their bladder. Only one e-scale was given to each participant, and thus the same e-scale was used for all of their measurements. At their clinic visits at baseline, four months, and twelve months, weight was measured using a calibrated Tanita Professional Digital Scale with Remote Display (in kilograms; model number BWB-800S) while the participant was wearing street clothes without shoes on a calibrated scale. While the same model of scale was used for each study visit, it is possible that a different scale was used at each appointment. Study details have been published previously (Krukowski et al., 2015).

Data Analysis

E-scale and clinic weights were first matched by determining which measurements for each method occurred on the same day (i.e., exact day matching). The e-scale measurement that was closest to the scheduled time of the participant’s baseline clinic visit was used (i.e., time matching) in one analysis. In a separate analysis, multiple e-scale measurements, although infrequent, from the same day as the clinic visit were averaged. Additionally, e-scale and clinic measurements were also matched by determining which measurements for each method occurred within seven days of each other (i.e., seven day matching) in order to increase the sample size. Participants without e-scale or clinic weight data were not included in the analyses. The e-scale measurement was time matched in one analysis, while the averaging of multiple measurements within the seven days was used for a separate analysis. This is important given that individuals may not be able to weigh themselves at certain time points. Thus, knowing if averaging methods are acceptable may help to reduce missingness of data in future weight-related studies.

Spearman correlations between the clinic and e-scale weights were then computed and Bland-Altman agreement plots were created. The means of each data subset were tested to determine if the difference between the paired means was significantly different from zero using a paired t-test. Additionally, we tested if the fit of the slope of the linear regression between e-scale and clinic weights was significantly different from equality (i.e., a “slope test) using a z-test. This was accomplished by predicting the clinic weights by the e-scale weights, and testing whether or not the fit of the slope of this regression was significantly different than 1.0, which represents perfect prediction of clinic weights by the e-scale weight. In addition, we used and presented R^2 to describe the prediction accuracy. We have also longitudinally assessed the prediction accuracy through random coefficients model utilizing the entire data from all three time points to increase the statistical power.

The analyses were performed using the overall cohort with the time matched and averaged exact day matching data subsets and the time matched and averaged seven day matching data subsets. The four data subsets were then stratified by gender (i.e., male and female) and BMI category (i.e., overweight and obese), race (i.e., African American and Caucasian), and age (i.e., under age 30, 30–40, over age 40). The number of participants in each stratification group can be found in Table 1. In determining significance, considering that multiple tests at each cross-sectional time points and by various factors of interest, we used a conservative Bonferroni multiplicity correction approach using a Type-1 error rate of 4.1667E-04 for significance. To emphasize the departure from the slope of 1.0 in the regression models, we used a Type-1 error rate of 0.01 to indicate potential significance, since a significant value in this instance would suggest a departure from equality between e-scale and clinic measurements.

Results

Correlations

All correlations between e-scale and clinic measurements were highly positive ($p < .0001$). Thus, tests of equality were carried out.

Matching

The baseline exact day matching yielded a sample size of 164 participants, while the baseline seven day matching yielded 237 participants. At four months, exact day matching yielded 140 participants, while seven day matching yielded 179 participants. At twelve months, exact day matching yielded 62 participants, while seven day matching yielded 114 participants. Results for seven day matching can be found in Table 1.

Baseline Measurements

E-scale measurements were significantly higher than the clinic measurements at baseline for the exact day matching (median difference = 1.4 kg, $p < .0001$) and seven day matching (median difference = 0.4, $p < .0001$) when time matching methods were used. Similar results were found for exact day matching (median difference = 0.6 kg, $p < .0001$) and the seven day matching (median difference = −0.6, $p < .0001$) when averaging methods were used. Results were also similar when the data were stratified by gender, BMI category, race, and age ($p < .0001$). Values for each stratification category can be found in Table 2. At this time point, all clinic measurements were taken before the e-scale measurements, since the participants received their scale at the clinic visit. Thus, the e-scale measurements were taken later in the day, when weight tends to increase due to food and beverage consumption.

When testing if the e-scale and clinic measurements differed from equality, results indicated that both measurements for the overall sample were significantly predictive of each other for both exact day matching ($R^2 = 0.99$) and seven day matching ($R^2 = 0.99$) methods with time matching. The same was true for the measurements for both exact day matching ($R^2 = 1.00$) and seven day matching ($R^2 = 0.99$) methods using averaging. Similar results were found for gender, BMI, race, and age stratification categories. Results from the slope tests are displayed in Table 5.

Four Month Measurements

Clinic measurements were significantly higher than e-scale measurements for both exact day matching (median difference = −1.0 kg, $p < .0001$) and seven day matching (median difference = −1.0, $p < .001$) when time matching methods were used. The same results were found for exact day matching (median difference = −1.0 kg, $p < .0001$) and seven day matching (median difference = −1.0, $p < .0001$) when averaging methods were used. Similar results were found when the data were stratified by BMI categories, race, and age, and gender ($p < .0001$). Values for each stratification category can be found in Table 3. Most participants weighed themselves on their e-scale in the morning, with a median time of 6:20 am for the exact day match sample and 6:45 for the seven day match sample. Clinic measurements were typically taken later in the day than the e-scale measurements, with a median appointment time of 12:00 pm.

For equivalence testing, the e-scale and clinic measurements were significantly predictive of each other for both exact day matching (R^2 = 0.99) and seven day matching (R^2 = 0.99) methods with time matching. These results were also found for exact day matching (R^2 = 0.99) and seven day matching (R^2 = 0.99) when averaging methods were used, with the exception of males. Results indicated that the e-scale underpredicted the clinic weight for males when using seven day matching with averaging methods. Results from the slope tests are displayed in Table 5.

12 Month Measurements

Clinic measurements were significantly higher than e-scale measurements for both exact day matching (median difference = −1.0 kg, $p < .0001$) and seven day matching (median difference = −0.9, $p < .0001$) when time matching methods were used. The same results were found for exact day matching (median difference = −1.0 kg, $p < .0001$) and seven day matching (median difference = −0.8, $p < .0001$) when averaging methods were used. Similar results were found when the data were stratified by BMI, race, age, and gender categories ($p < .0001$). Values for each stratification category can be found in Table 4. Most participants weighed themselves in the morning, with a median time of 6:30 am for the exact day match sample and 6:50 am for the seven day match sample. Clinic measurements were typically taken later in the day than the e-scale measurements, with a median appointment time of 1:00 pm.

For equivalence testing, the e-scale and clinic measurements were significantly predictive of each other for both exact day matching (R^2 = 1.00) and seven day matching (R^2 = 0.99) methods with time matching. These results were also found for exact day matching exact day matching (R^2 = 1.00) and seven day matching (R^2 = 0.99) when averaging methods were used, with the exception of females. Results indicated that the e-scale weights underpredicted the clinic weights for females when using time matching and averaging methods with seven day matching. Results from the slope tests are displayed in Table 5.

Longitudinal Analysis

The longitudinal modeling approach confirms the results from the cross-sectional analyses. These results are displayed in Table 5.

Discussion

Results indicate that the measurements from clinic visits and e-scales were significantly different at all time points. However, the measurements were predictive of each other. The e-scale measurements at baseline were significantly higher than the clinic measurements, and this may be because the participants were weighed at their initial in-person clinic visit during the 8am-5pm clinic hours, then took their e-scale home and used it afterwards to try it out. The four and twelve month e-scale measurements were lower than the clinic measurements, and were typically taken earlier than the clinic visits. This is in accordance with the recommendation that participants received when given their e-scale (i.e., weigh themselves in the morning before eating and after voiding their bladders). Participants may have also been wearing less clothing for e-scale measurements in the privacy of their own home compared to clinic-based weights, where they were weighed in light clothing without shoes.

Additionally, women's e-scale weights underpredicted clinic weights at 12 months when using seven day matching methods. This may have been due to weight fluctuations attributable to later clinic appointment times or hormonal changes due to menstruation. Men's e-scale weights underpredicted clinic weights when seven day averaging methods were used at 4 months. These underpredictions could have occurred due to higher weight fluctuations throughout the day, and later clinic appointment times compared to e-scale weight times. Additionally, because all of these underpredictions occurred only when using seven day matching, it may be the case that there was an increase in time between measurements, allowing for more weight fluctuations. Thus, it may be preferable to use exact day matching methods, or perhaps use a shorter period of time, rather than seven day matching when possible.

The use of e-scales has significant implications for weight management research, especially for highly mobile or rural populations. E-scales reduce the need for in-person visits. Thus, participants who may have not been previously able to participate may now be better able to access these research studies or weight management programs. While there are measurement differences present between the clinic and e-scale measurements, these differences can seemingly be explained by the timing of the weight measurement. It may be the case that e-scales may actually have an advantage over clinic measurements in that all participants can be asked to weigh at the same time of day.

Limitations

Despite the strengths of the study, including data from multiple time points, the use of multiple matching methods, and stratification by race, gender, BMI, and age categories, there are limitations worth noting. Particularly, the number of participants within stratified groups (i.e., BMI, gender), while adequate, are lower than ideal. Future research with a larger sub-sample sizes would be useful to confirm the equivalence of clinic and e-scale measurements within these stratified categories.

Conclusion

The current study showed that, overall, there is measurement concordance between in-person clinic and e-scale weight measurements. This is similar to the results found in the previous study examining measurement concordance between e-scales and in-person clinic measurements. Thus, the use of e-scales in research studies for outcome data, especially among highly mobile and rural populations, may be reasonable. Further, the use of time matching and averaging methods both yielded similar results, indicating that there may be multiple ways to approach the analysis of e-scale weight measurements. Further research replicating these results with larger sample sizes within various groups of individuals, such as individuals with increased BMIs, or individuals enrolled in weight loss programs who are incentivized for weight decreases, will be helpful to ensure that there is measurement concordance between clinic and e-scale measurements.

Acknowledgments

The study was funded by the National Institute of Diabetes and Digestive and Kidney Diseases (RO1 DK097158) of the National Institutes of Health, with the title of "Dissemination of the Look Ahead Weight Management Treatment in the Military."

References

1. Crane M, Gavin K, Wolfson J, Linde J. How accurate are recalls of self-weighing frequency? Data from a 24-month randomized trial. Obesity 2018.
2. Krukowski RA, Hare ME, Talcott GW, Johnson KC, Richey PA, Kocak M, et al. Dissemination of the Look AHEAD intensive lifestyle intervention in the United States Air Force: study rationale, design and methods. Contemp Clin Trials 2015; 40:232–239. [PubMed: 25545025]
3. Steinberg DM, Tate DF, Bennett GG, Ennett S, Samuel-Hodge C, & Ward DS. The efficacy of a daily self-weighing weight loss intervention using smart scales and e-mail. Obesity 2013; 21:1789–1797. [PubMed: 23512320]
4. Ross KM, Qiu P, You L, & Wing RR. Characterizing the Pattern of Weight Loss and Regain in Adults Enrolled in a 12-Week Internet-Based Weight Management Program. Obesity 2018; 26:318–323. [PubMed: 29239141]
5. Ross KM, & Wing RR Concordance of in-home 'smart' scale measurement with body weight measured in-person. Obesity Science & Practice 2016; 2:224–228. [PubMed: 27499884]

Study Importance Questions

What is already known about the subject?

- E-scales have shown good measurement concordance with weight measurements taken by a trained staff member within a clinic in a relatively small sample.

What does your study add?

- There is measurement concordance between e-scale and clinic weight measurements, and our results indicate that concordance may be best tested using weight measurements from both e-scales and clinic weights that were measured on the same day.
- We tested measurement concordance between e-scale and clinic weight measurements among different groups (i.e., males, females, individuals with overweight or obesity, Caucasians, African Americans), while previous studies have only examined their overall sample.

Table 1.

Matching Statistics

	Overall		Males		Females		Overweight		Obese		African American		Caucasian	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Baseline														
Exact day	164	69.2%	70	59.8%	94	78.3%	71	68.9%	93	69.4%	34	72.3%	107	68.6%
1 day	46	19.4%	29	24.8%	17	14.2%	17	16.5%	29	21.6%	9	19.2%	29	18.6%
2 days	10	4.2%	6	5.1%	4	3.3%	7	6.8%	3	2.2%	0	0.0%	7	4.5%
3 days	2	0.8%	2	1.7%	0	0.0%	1	1.0%	1	0.8%	0	0.0%	2	1.3%
4 days	6	2.5%	3	2.6%	3	2.5%	4	3.9%	2	1.5%	1	2.1%	5	3.2%
5 days	4	1.7%	3	2.6%	1	0.8%	3	2.9%	1	0.8%	1	2.1%	3	1.9%
6 days	3	1.3%	2	1.7%	1	0.8%	0	0.0%	3	2.2%	1	2.1%	2	1.3%
7 days	2	0.8%	2	1.7%	0	0.0%	0	0.0%	2	1.5%	1	2.1%	1	0.6%
Four months														
Exact day	140	78.2%	69	77.53	71	78.9%	66	82.5%	74	74.8%	27	77.1%	94	79.7%
1 day	25	14.0%	13	14.61	12	13.3%	13	16.3%	12	12.1%	4	11.4%	14	11.9%
2 days	6	3.4%	2	2.25	4	4.4%	1	1.3%	5	5.1%	2	5.7%	4	3.4%
3 days	2	1.1%	1	1.12	1	1.1%	0	0.0%	2	2.0%	0	0.0%	2	1.7%
4 days	2	1.1%	1	1.12	1	1.1%	0	0.0%	2	2.0%	1	2.9%	1	0.9%
5 days	2	1.1%	2	2.25	0	0.0%	0	0.0%	2	2.0%	0	0.0%	2	1.7%
6 days	1	0.6%	1	1.12	0	0.0%	0	0.0%	1	1.0%	1	2.9%	0	0.0%
7 days	1	0.6%	0	0.0%	1	1.1%	0	0.0%	1	1.0%	0	0.0%	1	0.9%
Twelve months														
Exact day	62	54.4%	31	58.5%	31	50.8%	27	52.9%	35	55.6%	14	73.7%	37	47.4%
1 day	28	24.6%	12	22.6%	16	26.2%	12	23.5%	16	25.4%	3	15.8%	23	29.5%
2 days	10	8.8%	3	5.7%	7	11.5%	4	7.8%	6	9.5%	1	5.3%	8	10.3%
3 days	4	3.5%	3	5.7%	1	1.6%	3	5.9%	1	1.6%	1	5.3%	3	3.9%
4 days	5	4.4%	1	1.9%	4	6.6%	3	5.9%	2	3.2%	0	0.0%	5	6.4%
5 days	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
6 days	3	2.6%	1	1.9%	2	3.3%	1	2.0%	2	3.2%	0	0.0%	1	1.3%
7 days	2	1.8%	2	3.8%	0	0.0%	1	2.0%	1	1.6%	0	0.0%	1	1.3%

Note. The number of days listed in the left-hand column indicate the number of days apart that the e-scale and in-person clinic weight measurements were taken.

Table 2.

Baseline Descriptive Statistics

		Exact Day Match		Seven Day Match	
		Time Match	Averaging	Time Match	Averaging
Baseline		Median (Interquartile Range) n = 164	Median (Interquartile Range) n = 164	Median (Interquartile Range) n = 237	Median (Interquartile Range) n = 237
Overall	E-Scale	87.8 (78.8, 97.2)	87.5 (59.9, 96.7)	89.1 (79.3, 99.4)	88.1 (78.5, 98.6)
	Clinic Scale	87.0 (78.6, 95.9)	87.0 (78.6, 95.9)	89.1 (79.1, 99.1)	89.1 (79.1, 99.1)
	Difference	1.4 (0.1, 2.0)*	0.6 (0.1, 1.0)*	0.4 (−0.2, 1.9)*	−0.6 (−1.2, 0.0)*
Females	E-Scale	80.6 (75.4, 88.5)	80.5 (74.2, 88.4)	80.3 (74.2, 88.6)	79.4 (72.9, 86.7)
	Clinic Scale	80.2 (74.1, 87.7)	80.2 (74.1, 87.7)	80.0 (73.4, 87.7)	80.0 (73.4, 87.7)
	Difference	0.9 (0.1, 1.9)*	0.6 (0.1, 1.0)*	0.4 (−0.1, 1.8)*	−0.6 (1.1, 0.0)*
Males	E-Scale	98.0 (90.5, 106.9)	97.2 (89.5, 106.1)	98.5 (90.0, 106.9)	97.3 (89.1, 106.1)
	Clinic Scale	96.4 (90.0, 105.5)	96.4 (90.0, 105.5)	98.6 (90.0, 106.4)	98.6 (90.0, 106.4)
	Difference	1.7 (0.1, 2.1)*	0.7 (0.1, 1.0)*	0.4 (−0.3, 2.0)*	−0.7 (−1.3, −0.2)*
Overweight	E-Scale	80.5 (71.5, 87.3)	79.7 (70.6, 87.3)	79.4 (71.7, 87.3)	79.2 (71.4, 85.7)
	Clinic Scale	79.1 (0.1, 1.9)	79.1 (70.9, 86.4)	79.1 (71.4, 86.8)	79.1 (71.4, 86.8)
	Difference	0.9 (0.1, 1.9)*	0.6 (0.1, 1.0)*	0.7 (−0.1, 1.8)*	−0.5 (−1.1, 0.2)*
Obese	E-Scale	93.4 (85.8, 105.8)	92.8 (84.7, 104.2)	96.8 (88.6, 106.3)	94.8 (87.5, 103.8)
	Clinic Scale	94.3 (84.5, 104.1)	92.7 (84.5, 104.1)	95.9 (87.7, 105.0)	95.9 (−1.2, −0.3)
	Difference	1.7 (0.1, 2.1)*	0.6 (0.1, 1.0)*	0.3 (−0.3, 2.0)*	−0.8 (−1.2, −0.3)*
African American	E-Scale	87.2 (76.9, 93.7)	86.5 (76.9, 92.7)	86.4 (76.5, 97.9)	85.2 (75.0, 96.6)
	Clinic Scale	86.6 (76.4, 91.8)	86.6 (76.4, 91.8)	85.9 (76.4, 98.6)	85.9 (76.4, 98.6)
	Difference	1.8 (0.3, 2.3)*	0.8 (0.2, 1.2)*	0.9 (−0.6, 2.1)*	−0.6 (−1.5, 0.0)*
Caucasian	E-Scale	88.5 (80.1, 98.5)	87.6 (79.5, 99.0)	90.2 (81.4, 102.5)	89.2 (80.2, 100.2)
	Clinic Scale	87.3 (78.6, 98.2)	87.3 (78.6, 98.2)	90.2 (81.1, 101.1)	90.2 (81.1, 101.1)
	Difference	1.1 (0.0, 2.0)*	0.6 (0.0, 1.0)*	0.3 (−0.2, 1.9)*	−0.7 (−1.2, 0.0)*
Age < 30	E-Scale	84.7 (76.7, 97.2)	83.9 (75.6, 96.6)	88.8 (76.7, 99.1)	87.9 (75.2, 97.3)
	Clinic Scale	84.1 (75.0, 95.9)	84.1 (75.0, 99.1)	87.7 (75.0, 99.1)	87.7 (75.0, 99.1)
	Difference	−1.7 (−2.1, −0.1)*	−0.7 (−1.1, −0.2)*	−0.6 (−2.1, 0.1)*	0.3 (−0.2, 0.9)*

		Exact Day Match		Seven Day Match	
		Time Match	Averaging	Time Match	Averaging
Baseline		**Median (Interquartile Range) n = 164**	**Median (Interquartile Range) n = 164**	**Median (Interquartile Range) n = 237**	**Median (Interquartile Range) n = 237**
Age 30–40	E-Scale	88.6 (81.2, 97.2)	88.4 (81.0, 96.9)	89.2 (80.4, 100.2)	88.3 (79.4, 98.8)
	Clinic Scale	87.7 (80.0, 96.4)	87.7 (80.0, 96.4)	89.6 (80.5, 99.1)	89.6 (80.5, 99.1)
	Difference	−1.1 (−2.0, −0.1) *	−0.5 (−1.0, −0.1) *	−0.3 (−1.8, 0.3) *	0.8 (0.2, 1.3) *
Age > 40	E-Scale	86.7 (79.0, 96.2)	86.7 (78.9, 94.5)	89.2 (79.4, 99.9)	86.8 (79.2, 98.6)
	Clinic Scale	86.4 (78.9, 94.5)	86.4 (78.9, 94.5)	88.6 (79.1, 98.6)	88.6 (79.1, 98.6)
	Difference	−0.7 (−1.9, 0.0) *	−0.4 (−0.9, 0.0) *	−0.3 (−1.7, 0.1) *	0.7 (0.0, 1.1) *

Note. Weight measurements are in kilograms. The difference values were computed within participant as body trace clinic weight subtracted from the e-scale weight.

* = Significant at the multiplicity corrected significance level of 4.1667E-04.

Table 3.

Month 4 Descriptive Statistics

		Exact Day Match		Seven Day Match	
		Time Match	Averaging	Time Match	Averaging
		Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 179	Median (Interquartile Range) n = 179
Overall	E-scale	83.3 (72.9, 90.9)	83.3 (72.9, 90.9)	83.4 (75.5, 94.5)	83.5 (75.1, 93.9)
	Clinic Scale	84.3 (73.9, 92.3)	84.3 (73.9, 92.3)	84.5 (75.9, 95.9)	84.5 (75.9, 95.9)
	Difference	−1.0 (−1.6, −0.4)*	−1.0 (−1.6, −0.4)*	−1.0 (−1.6, −0.3)*	−1.0 (−1.6, −0.3)*
Females	E-scale	74.4 (68.4, 82.9)	74.4 (69.0, 82.9)	76.4 (69.6, 82.5)	76.1 (69.7, 82.8)
	Clinic Scale	75.9 (70.0, 84.1)	75.9 (70.0, 84.1)	77.3 (70.9, 83.6)	77.3 (70.9, 83.6)
	Difference	−1.0 (−1.7, −0.5)*	−0.9 (−1.7, −0.5)*	−1.0 (−1.7, −0.4)*	−1.2 (−1.6, −0.5)*
Males	E-scale	89.5 (83.5, 99.1)	89.5 (83.5, 99.1)	93.2 (83.7, 101.9)	93.1 (84.1, 102.0)
	Clinic Scale	90.9 (85.0, 99.5)	90.9 (85.0, 99.5)	93.6 (85.0, 102.7)	93.6 (85.0, 102.7)
	Difference	−1.2 (−1.5, −0.4)*	−1.0 (−1.4, −0.4)*	−1.0 (−1.5, −0.3)*	−0.9 (−1.5, −0.1)*
Overweight	E-scale	73.3 (68.2, 83.2)	73.3 (68.4, 83.2)	77.5 (69.4, 82.8)	77.5 (69.6, 83.2)
	Clinic Scale	74.3 (69.1, 84.1)	74.3 (69.1, 84.1)	77.7 (70.9, 83.6)	77.7 (70.9, 83.6)
	Difference	−1.0 (−1.6, −0.5)*	−1.0 (−1.6, −0.5)*	−0.9 (−1.5, −0.3)*	−1.0 (−1.6, −0.3)*
Obese	E-scale	90.4 (82.5, 98.2)	90.4 (82.5, 98.5)	92.6 (82.2, 101.5)	92.7 (81.6, 101.8)
	Clinic Scale	91.6 (84.1, 99.5)	91.6 (84.1, 99.5)	93.2 (82.3, 102.7)	93.2 (82.3, 102.7)
	Difference	−1.0 (−1.6, −0.4)*	−1.0 (−1.6, −0.4)*	−1.0 (−1.6, −0.3)*	−1.0 (−1.5, −0.3)*
African American	E-scale	87.4 (71.9, 96.8)	87.4 (71.9, 96.8)	84.1 (73.4, 96.8)	83.8 (73.0, 96.6)
	Clinic Scale	88.2 (72.7, 99.1)	88.2 (72.7, 99.1)	85.0 (73.6, 99.1)	85.0 (73.6, 99.1)
	Difference	−1.0 (−1.8, −0.5)*	−1.0 (−1.8, −0.5)*	−1.0 (−1.7, −0.5)*	−1.1 (−1.5, −0.3)*
Caucasian	E-scale	83.3 (73.0, 89.8)	83.3 (73.0, 89.8)	84.0 (76.8, 95.6)	84.7 (76.6, 95.5)
	Clinic Scale	84.3 (74.1, 91.4)	84.3 (74.1, 91.4)	85.0 (76.8, 95.9)	85.0 (76.8, 95.9)
	Difference	−1.0 (−1.5, −0.4)*	−0.9 (−1.5, −0.4)*	−0.9 (−1.5, −0.2)*	−1.0 (−1.7, −0.2)*
Age < 30	E-Scale	82.9 (69.8, 93.2)	82.9 (69.8, 93.2)	83.9 (73.4, 96.8)	84.6 (73.0, 96.6)
	Clinic Scale	85.0 (71.4, 93.6)	85.0 (71.4, 93.6)	85.5 (73.6, 97.3)	85.5 (73.6, 97.3)
	Difference	0.91 (0.2, 1.8)*	0.91 (0.2, 1.8)*	0.9 (0.1, 1.8)*	1.0 (0.3, 1.5)*

		Exact Day Match		Seven Day Match	
		Time Match	Averaging	Time Match	Averaging
		Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 179	Median (Interquartile Range) n = 179
Age 30–40	E-Scale	83.5 (72.9, 90.4)	83.8 (72.9, 90.4)	83.7 (75.7, 92.9)	83.8 (76.1, 93.1)
	Clinic Scale	84.6 (73.6, 91.4)	84.6 (73.6, 91.4)	85.0 (77.3, 93.6)	85.0 (77.3, 93.6)
	Difference	1.02 (0.4, 1.6)*	1.0 (0.4, 1.6)*	1.0 (0.3, 1.6)*	1.04 (0.1, 1.5)*
Age > 40	E-Scale	82.2 (74.3, 94.0)	82.2 (74.3, 94.0)	82.2 (74.3, 94.0)	81.1 (73.8, 93.9)
	Clinic Scale	82.3 (75.5, 95.0)	82.3 (75.5, 95.0)	82.3 (75.5, 95.0)	82.3 (75.5, 95.0)
	Difference	1.2 (0.8, 1.5)*	1.0 (0.8, 1.4)*	1.2 (0.7, 1.5)*	0.9 (0.3, 1.7)*

Note. Weight measurements are in kilograms. The difference values were computed within participant as body trace clinic weight subtracted from the e-scale weight.

* = Significant at the multiplicity corrected significance level of 4.1667E-04.

Table 4.

Month 12 Descriptive Statistics

		Exact Day Match		Seven Day Match	
		Time Match	Averaging	Time Match	Averaging
		Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 140	Median (Interquartile Range) n = 179	Median (Interquartile Range) n = 179
Overall	E-Scale	83.6 (73.5, 94.3)	83.7 (73.5, 94.3)	83.1 (73.5, 95.8)	83.0 (73.4, 96.0)
	Clinic Scale	84.3 (73.6, 95.9)	84.3 (73.6, 95.9)	83.9 (74.1, 96.4)	83.9 (74.1, 96.4)
	Difference	−1.0 (−1.4, −0.4)*	−1.0 (−1.4, −0.3)*	−0.9 (−1.6, −0.3)*	−0.8 (−1.8, −0.2)*
Females	E-Scale	73.5 (67.9, 81.3)	73.5 (67.9, 81.3)	74.0 (69.2, 83.0)	74.0 (69.6, 83.0)
	Clinic Scale	74.1 (68.6, 82.7)	74.1 (68.6, 82.7)	75.9 (70.5, 84.1)	75.9 (70.5, 84.1)
	Difference	−0.8 (−1.3, −0.4)*	−0.8 (−1.2, −0.3)*	−0.9 (−1.6, −0.4)*	−0.8 (−1.6, −0.1)*
Males	E-Scale	94.3 (85.5, 105.6)	94.3 (85.5, 105.6)	94.3 (83.8, 103.7)	94.4 (83.2, 103.4)
	Clinic Scale	95.9 (85.5, 105.5)	95.9 (85.5, 105.5)	95.9 (84.5, 103.2)	95.9 (84.5, 103.2)
	Difference	−1.1 (−1.6, −0.4)*	−1.0 (−1.6, −0.3)*	−1.0 (−1.7, −0.3)*	−0.9 (−1.9, −0.4)*
Overweight	E-Scale	73.5(67.8, 83.3)	73.5 (67.8, 83.3)	74.0 (68.7, 82.0)	74.0 (69.0, 82.0)
	Clinic Scale	73.6 (67.7, 83.6)	73.6 (67.7, 83.6)	75.9 (69.5, 83.6)	75.9 (69.5, 83.6)
	Difference	−0.9 (−1.4, −0.2)*	−0.9 (−1.4, −0.2)*	−1.0 (−1.7, −0.2)*	−0.9 (−1.8, −0.1)*
Obese	E-Scale	90.0 (81.2, 103.7)	90.2 (81.2, 103.7)	90.0 (81.6, 100.9)	89.8 (82.4, 100.5)
	Clinic Scale	90.5 (81.8, 102.7)	90.5 (81.8, 102.7)	90.5 (82.7, 101.8)	90.5 (82.7, 101.8)
	Difference	−1.1 (−1.4, −0.5)*	−1.0 (−1.5, −0.4)*	−0.9 (−1.6, −0.4)*	−0.8 (−1.7, −0.3)*
African American	E-Scale	87.7 (80.2, 95.8)	88.2 (80.2, 95.8)	85.0 (73.4, 93.3)	85.2 (73.6, 93.3)
	Clinic Scale	88.2 (81.4, 96.4)	88.2 (81.4, 96.4)	85.5 (75.0, 95.9)	85.5 (75.0, 95.9)
	Difference	−0.8 (−1.4, −0.5)*	−0.8 (−1.5, −0.4)*	−0.6 (−1.4, −0.4)*	−0.4 (−1.4, 0.1)*
Caucasian	E-Scale	81.6 (73.5, 90.2)	81.6 (73.5, 90.2)	83.2 (73.7, 96.7)	83.1 (73.5, 96.9)
	Clinic Scale	82.7 (73.6, 91.8)	82.7 (73.6, 91.8)	84.3 (75.0, 98.6)	84.3 (75.0, 98.6)
	Difference	−0.9 (−1.3, −0.3)*	−0.9 (−1.2, −0.3)*	−1.0 (−1.7, −0.3)*	−0.9 (−1.9, −0.4)*
Age < 30	E-Scale	74.5 (66.3, 96.1)	74.4 (66.1, 96.1)	78.9 (69.7, 95.8)	83.0 (69.8, 98.2)
	Clinic Scale	75.2 (66.8, 97.7)	75.2 (66.8, 97.7)	81.8 (69.5, 98.6)	81.8 (69.5, 98.6)
	Difference	1.0 (0.5, 1.5)*	1.0 (0.6, 1.5)*	1.13 (0.4, 2.3)*	1.2 (0.7, 2.0)*

		Exact Day Match		Seven Day Match	
		Time Match	**Averaging**	**Time Match**	**Averaging**
		Median (Interquartile Range) n = 140	**Median (Interquartile Range) n = 140**	**Median (Interquartile Range) n = 179**	**Median (Interquartile Range) n = 179**
Age 30–40	E-Scale	85.0 (73.6, 95.8)	85.0 (77.3, 93.6)	83.6 (73.5, 93.3)	83.2 (73.4, 93.3)
	Clinic Scale	85.9 (75.0, 96.4)	85.9 (75.0, 96.4)	84.3 (74.5, 95.9)	84.3 (74.5, 95.9)
	Difference	0.6 (0.4, 1.4)*	1.0 (0.3, 1.6)*	0.6 (0.3, 1.4)*	0.7 (0.2, 1.6)*
Age > 40	E-Scale	81.3 (74.3, 90.2)	81.3 (74.3, 90.2)	83.6 (78.3, 99.2)	83.1 (79.0, 97.7)
	Clinic Scale	82.7 (75.5, 91.8)	82.7 (75.5, 91.8)	84.3 (79.1, 100.0)	84.3 (79.1, 100.0)
	Difference	1.25 (0.0, 1.4)*	1.1 (−0.3, 1.2)*	1.1 (0.3, 1.6)*	0.8 (0.2, 1.9)*

Note. Weight measurements are in kilograms. The difference values were computed within participant as body trace clinic weight subtracted from the e-scale weight.

* = Significant at the multiplicity corrected significance level of 4.1667E-04.

Table 5.

Slope Results for Testing if Clinic and E-scale Measurements Significantly Differ from Equality

		Exact Day Matching		Seven Day Matching	
		Time Match Slope	**Averaging Slope**	**Time Match Slope**	**Averaging Slope**
Baseline	Overall	0.99	1.00	1.00	1.00
	Males	0.98	0.99	1.00	1.00
	Females	0.99	1.01	0.97	1.00
	Overweight	0.98	1.00	0.97	0.98
	Obese	0.98	0.99	1.00	1.00
	African American	0.98	0.99	1.00	1.00
	Caucasian	0.98	1.00	0.97	0.99
	Age < 30	1.00	1.00	1.02	1.02
	Age 30–40	0.98	1.00	0.98	0.99
	Age > 40	0.98	0.99	0.99	0.99
Four months	Overall	1.00	1.00	1.00	1.00
	Males	1.00	1.01	1.00	1.01
	Females	0.99	0.98	0.99	0.99
	Overweight	0.98	0.98	0.97 *	0.97 *
	Obese	1.00	1.01	1.00	1.00
	African American	1.00	1.00	1.00	1.00
	Caucasian	0.99	0.99	0.99	0.98
	Age < 30	1.03	1.03	1.01	1.02
	Age 30–40	0.99	0.99	0.99	0.99
	Age > 40	0.98	0.98	0.99	0.99
12 months	Overall	1.00	1.00	1.00	0.99
	Males	0.99	0.99	0.98	0.99
	Females	0.99	0.98	1.02	1.02
	Overweight	1.00	1.00	1.01	1.00
	Obese	1.00	0.99	1.00	1.00
	African American	1.00	1.00	1.00	1.00
	Caucasian	1.00	1.00	1.01	1.00
	Age < 30	1.01	1.01	1.01	1.01
	Age 30–40	1.00	1.00	1.01	1.01
	Age > 40	0.98	0.98	0.97	1.00
Multi-Level Modeling	Overall	0.99 *	0.99	0.99	1.00
	Males	0.99 *	0.99	0.99	1.00
	Females	0.98 *	0.99	0.99	1.00
	Overweight	0.99 *	0.99	0.99	0.99
	Obese	0.99 *	0.99	0.99	0.99
	African American	0.99	0.99	0.99	1.00
	Caucasian	0.99	1.00	0.99	1.00

	Exact Day Matching		Seven Day Matching	
	Time Match Slope	**Averaging Slope**	**Time Match Slope**	**Averaging Slope**
Age < 30	0.99	0.99	0.99	1.00
Age 30–40	0.99*	0.99	0.99	1.00
Age > 40	0.99	0.99	0.99	1.00

Note.

*= Significant at $p = 0.01$ level without multiplicity correction, representing a potentially significance of departure of the slope of equality, i.e., 1.0.

Author Manuscript
Author Manuscript
Author Manuscript