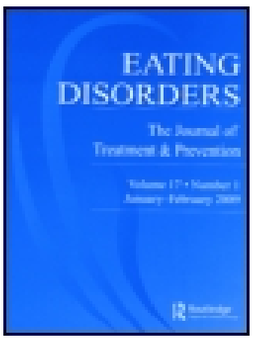

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Eating Disorders
The Journal of Treatment & Prevention

ISSN: 1064-0266 (Print) 1532-530X (Online) Journal homepage: https://www.tandfonline.com/loi/uedi20

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To cite this article: Jamie M. Smith, Brooke L. Whisenhunt, Erin M. Buchanan & Danae L. Hudson (2019): Evaluating the effectiveness of ecological momentary assessment and intervention targeting body checking behaviors, Eating Disorders, DOI: 10.1080/10640266.2018.1560850

To link to this article: https://doi.org/10.1080/10640266.2018.1560850

Published online: 21 Jan 2019.

EATING DISORDERS
https://doi.org/10.1080/10640266.2018.1560850

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Evaluating the effectiveness of ecological momentary assessment and intervention targeting body checking behaviors

Jamie M. Smith[a], Brooke L. Whisenhunt[b], Erin M. Buchanan [b], and Danae L. Hudson [b]

[a]Psychology Department, University of New Mexico, Albuquerque, NM, USA; [b]Psychology Department, Missouri State University, Springfield, MO, USA

ABSTRACT

This study investigated the efficacy of using ecological momentary assessment and intervention (EMA/EMI) to target body checking behaviors. Body checking has been shown to increase body dissatisfaction and play a role in eating disorders, but few treatments specifically targeting body checking have been empirically evaluated. Forty-four female undergraduates who reported engaging in frequent body checking behaviors participated in a five-day study wherein they were assessed five times a day via smart phone. On the final two days of the study, intervention messages were sent containing cognitive-behavioral strategies for decreasing body checking. Body checking behaviors increased within each day, but decreased across the five day intervention period. Pretest to posttest analyses found healthy improvements in a number of body image related constructs. These results highlight that 1) body checking appears to increase throughout the day, and 2) targeting body checking behaviors through brief EMA/EMI may be a useful clinical tool.

Clinical implications

- Brief digital assessment/intervention led to reduced body checking behaviors
- Intervention aimed at reducing body checking also led to higher body satisfaction
- Body checking increases throughout the day with highest checking behaviors at night

Body checking behaviors are performed to gather information about body size and weight (e.g., weighing, mirror checking; Walker & Murray, 2012). These behaviors are common in women and often performed multiple times throughout the day. While some behaviors are more intentional than others,

CONTACT Jamie M. Smith Jamie999@unm.edu Psychology Department, University of New Mexico, MSC03 2220, Albuquerque, NM 87131, USA

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most body checking is performed quickly (in less than 2 min) and often occurs outside of the awareness of the individual (Walker & Murray, 2012).

Body checking has been primarily discussed in relation to eating disorder populations, but these behaviors are also prevalent and problematic in nonclinical populations. Women who have beliefs about body checking (e.g., that it will reduce anxiety or help in controlling weight) have higher rates of body checking and body dissatisfaction (Mountford, Haase, & Waller, 2006). People who are dissatisfied with their bodies spend more time focusing on disliked areas of their bodies and also engage in more social comparisons (Walker & Murray, 2012). Women high in body dissatisfaction and low in self-esteem who frequently body check are at increased risk for the development of eating disorders (De Berardis et al., 2007). In a recent ecological momentary assessment (EMA) study conducted among non-clinical women with high body dissatisfaction, body checking was found to predict higher levels of negative affect and body dissatisfaction (Stefano, Hudson, Whisenhunt, Buchanan, & Latner, 2016). While body checking has been shown to increase body dissatisfaction and play a role in eating disorders (Shafran, Lee, Payne, & Fairburn, 2007), few treatments specifically targeting body checking have been empirically evaluated. Therefore, the purpose of the current study was to evaluate the efficacy of using ecological momentary assessment and intervention (EMA/EMI) to target body checking behaviors.

Fairburn's transdiagnostic model and enhanced cognitive behavior therapy (CBT-E; Fairburn, 2008; Fairburn, Cooper, & Shafran, 2003) focuses on how both anorexia nervosa and bulimia nervosa develop and are maintained. Common mechanisms among eating disorders were identified and body checking is described as a maintaining factor for the over-evaluation of eating, shape, and weight which has been supported in several experimental studies (Shafran et al., 2007; Smeets, Jansen, & Roefs, 2011; Smeets et al., 2010; Walker, 2014). Because body checking appears to maintain body dissatisfaction, targeted treatment for body checking behaviors is an important component of CBT. Fairburn's (2008) guidelines in CBT-E for body checking treatment strategies were used to inform the development of interventions in the current study.

Ecological Momentary Assessment (EMA) is a promising approach to further understand body checking behaviors. EMA prompts individuals to report behaviors and psychological states in the moment during their daily lives (Runyan & Steinke, 2015). Repeated measurements taken in the context of an individual's environment have many benefits compared to more traditional methods: they limit biases retrospective accounts contain, allow for analyses of daily intraindividual changes, and capture a more accurate representation of experiences compared to laboratory experiments (Runyan & Steinke, 2015). In recent years, EMA has been used to assess a wide variety of constructs including smoking cessation, depression, and body checking (Lavender et al., 2013; Leahey, Crowther, & Mickelson, 2007; McCarthy, Minami, Yeh, & Bold, 2015; Stefano et al., 2016; Vranceanu, Gallo, & Bogart, 2009). EMA is well-suited to

assess the frequency of behaviors like body checking because people are often unaware of the behaviors unless they are prompted in real time to identify them. In addition, EMA itself can lead to reductions in negative behaviors such as body checking because of the therapeutic impact of self-monitoring. For example, a previous EMA study assessing body checking showed a decrease in body checking behaviors over the course of a five-day period (Stefano et al., 2016).

Ecological momentary intervention (EMI) involves delivering interventions to people in their daily lives (primarily through mobile telephones; Heron & Smyth, 2010). EMI has been found to be effective for health behaviors including: diabetes management, smoking cessation, weight control, physical activity, healthy eating, and eating disorders (Franklin et al., 2006; Heron & Smyth, 2010; King et al., 2008; Patrick et al., 2009; Rodgers et al., 2005). While body-focused EMIs have been associated with a change in disordered eating for some people, overall body dissatisfaction has proven to be more resistant to change (Heron, 2012).

The current study sought to evaluate the effectiveness of combined EMA and EMI procedures specifically targeting body checking behaviors, which has been identified as an important future direction for research (Heron & Smyth, 2010). Interventions targeting body checking were developed based on CBT-E principles that were modified for a digitally delivered format (Fairburn, 2008). Additionally, important constructs related to body checking (e.g., beliefs, thoughts, and behaviors) were measured at pre- and post-test to assess for changes over time. It was hypothesized that: 1) levels of body checking, body dissatisfaction, body image avoidance, internalization of the thin-ideal, and body checking cognitions would decrease from pre-test to post-test after the five-day study, which included a two-day intervention, 2) body checking behaviors would decrease across the five-day study (due to the combined effects of EMA and EMI), and 3) during the intervention (i.e., days four and five), body checking would decrease directly following intervention prompts as compared to non-intervention prompts.

Method

Participants

Power analyses were calculated *a priori* using G*Power with multiple linear regression tests with a large effect size using previous EMA studies as a baseline (Stefano et al., 2016), $\alpha = .05$, desired power = .80, and two predictors (Faul, Erdfelder, Buchner, & Lang, 2009), which suggested a minimum sample size of 33 participants. Multilevel models are more powerful than normal linear regression, and we used this power analysis to create a best estimate for the necessary sample size, given the variables and proposed analyses before data collection.

Participants were selected for the study based on the following inclusion criteria: 1) owning a smartphone, 2) having a Body Mass Index (BMI) in the healthy or underweight range (i.e., less than 25), and 3) having high levels of body checking

using >1 *SD* above the mean on the Body Checking Questionnaire (>72) based on the college female mean (*M* = 56.0, *SD* = 16; Reas, Whisenhunt, Netemeyer, & Williamson, 2002). These criteria were selected to obtain a sample of women who engage in significant body checking despite their healthy or underweight status. Since body checking functions as a way to gather information about the body's weight and shape, the information gathered in overweight populations may differ in important aspects and checking behaviors may have different psychological and behavioral outcomes (e.g., Reas, Grilo, Masheb, & Wilson, 2005), and therefore, this preliminary study excluded those who were overweight or obese. A total of 353 female participants from introductory psychology classes were screened to obtain the 57 participants who met the study inclusion criteria. Participants were recruited throughout one semester, and they started the five-day study on one of four start dates throughout the semester. The final sample included 44 participants who completed the full study protocol. Participants received course credit and were entered into a lottery to win one of three $50 Visa gift cards (with higher study compliance resulting in more entries into the lottery such that participants would receive a range of lottery entries from five lottery entries for a 100% response rate down to one lottery entry for response rate of less than 60%).

The mean age of the female participants was 18.39 (*SD* = 0.58, 95% CI [18.21, 18.56]) and the mean BMI was 21.83 with no women falling in the underweight range (*SD* = 1.88, 95% CI [21.55, 22.11]). The ethnic/racial identification of the 44 participants mirrored the broader campus community, 90.9% identified themselves as White, 2.3% as Hispanic or Latino, 4.5% as Black or African American, 2.3% as American Indian or Alaska Native, and 2.3% as other. Participants obtained a pre-test mean score of 82.41 (*SD* = 8.05, 95% CI [80.15, 85.08]) on the Body Checking Questionnaire (BCQ; scores range from 23 to 115).

Measures

Pre/post measures

The following five measures were administered at pre-test and post-test to evaluate if the body checking intervention leads to improvements in target areas. The Body Checking Cognitions Scale (BCCS; Mountford et al., 2006) is a 19-item self-report measure of cognitions about the function of body checking and has been shown to have good reliability and validity (current study Cronbach's α = .64 which was lower than ideal). The Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairbum, 1987) is a self-report measure of trait body dissatisfaction with well-established psychometric properties consisting of 34 items assessing feelings about various aspects of body shape and weight (current study Cronbach's α = 93). The Body Image Avoidance Questionnaire (BIAQ; Rosen, Srebnik, Saltzberg, & Wendt, 1991) is a 19-item self-report measure of body image avoidance, and scores on the BIAQ have been shown to be reliable and valid (current study Cronbach's α = .83). The Body Checking Questionnaire (BCQ; Reas et al., 2002) is a 23-item

measure of trait body checking behaviors associated with overall appearance, idiosyncratic checking rituals, and checking of specific body parts; the BCQ has demonstrated good reliability and validity (current study Cronbach's α = .73). Both the BIAQ and BCQ were included in a recent psychometric analysis where confirmatory factor analysis confirmed the original factor structures for both measures (Pellizzer, Tiggemann, Waller, & Wade, 2018). The Sociocultural Attitudes Towards Appearance Scale (SATAQ-3; Thompson, van Den Berg, Roehrig, Guarda, & Heinberg, 2004) is a 30-item self-report measure of internalization of the thin ideal with established good internal consistency (current study Cronbach's α = .90).

EMA body checking behaviors

At every prompt during the five-day EMA portion of the study, participants completed the Body Checking Behaviors measure. This measure asked participants to report the number of times they had engaged in eight common body checking behaviors (Stefano et al., 2016) since they were last contacted (or since they woke up if it was the first contact of the day). These behaviors included: weighing the self, feeling thighs for fatness, sucking in the stomach, feeling/pinching stomach to measure fatness, comparing the body to other individuals, checking body size in the mirror, checking for fat jiggling, and checking to see if thighs spread while sitting down.

Procedure

This study received approval from the university Institutional Review Board prior to data collection. After obtaining informed consent, a total of 353 female participants completed the pre-test, and 57 qualified based on the inclusion criteria. Of those who qualified, 49 participants enrolled in the study (average number of days from completing pre-test to starting EMA/EMI portion of the study = 5.76 days, *SD* = 8.49). Participants watched an instructional video explaining the nature of body checking behaviors and the procedure of the study, and they were told the purpose of the study was to gather information about how women look at their bodies and the impact of such examinations. Participants then enrolled in Remind 101, which allowed researchers to send text messages directly to participants' phones through a third party number. Participants subsequently received questionnaire links via text message for one practice day and five study days that contained a hyperlink directing participants to a questionnaire hosted through Qualtrics. For each day of the study, participants received a total of five text messages between 9:00 AM and 10:00 PM, which were sent at randomized times at least 120 min apart. If the questionnaire was not completed within 30 min, a reminder text was sent.

The first practice day was intended to familiarize participants with the study procedure. Questionnaires, similar in length and format, covering study habits

instead of body checking, were completed. At the end of the practice day, participants who responded to at least 60% of the questionnaires were permitted to continue in the study for the five experimental days. Four participants were removed for failure to meet the minimum response rates. This EMA protocol was intended to increase compliance and was modeled after other EMA designed studies (Heron & Smyth, 2013; Ridolfi, Myers, Crowther, & Ciesla, 2011; Stefano et al., 2016). The text messages for the five experimental days contained links to Qualtrics for the Body Checking Behaviors questionnaire. One participant was excluded as an outlier from analyses for extremely discrepant body checking behavior frequencies (frequency of body checking was 19 times higher than the mean); therefore, the final sample size was $N = 44$.

Participants received an intervention at every other time point (a total of five interventions) on experimental days four and five. Interventions were delivered, in the same order for all participants, after the Body Checking Behaviors questionnaire on the same Qualtrics survey. The interventions were expected to impact the time point after reading about the intervention. Therefore, if a participant received an intervention at time point one, then time point two was considered the measurement for that intervention. The five interventions consisted of the following:

Psychoeducation intervention

The first intervention focused on helping participants understand the connection between body checking and negative affect (Cooper, Whitehead, & Boughton, 2004; Fairburn, 2008; Smeets et al., 2011). Participants were instructed to "*Think of a time in your life when you were checking your body a lot. Reflect on how you felt about your body overall during that time period. Research has shown that when people engage in a lot of body checking, they actually tend to focus more on their bodies and become more preoccupied with their shape and weight. Think about whether this is true for you. How do you feel about your body when you engage in a lot of body checking?*"

Visualization intervention

The second intervention focused on utilizing visualization techniques to help participants recognize that focusing on aspects of their body they view negatively serves to increase their preoccupation with shape/size (Fairburn, 2008; Shafran et al., 2007; Walker, 2014). Participants read the following: "*Imagine yourself standing in front of a full length mirror wearing only a swimsuit. Now, think about focusing on all the parts of your body that you dislike. What would your mood and feelings about your body be like after doing this? Compare this imaginary experience to what occurs when you engage in a lot of body checking. How are those experiences similar or different?*"

Behavioral intervention

Next, participants were provided with a behavioral strategy (deep breathing) to challenge unwanted urges to check (Cooper et al., 2004; Fairburn, 2008). Participants read the following: "*Body checking is very common and not necessarily bad. When you're getting dressed, you often want to check your body in a mirror. On the other hand, there are also times when people can experience unwanted urges to check their bodies. For example, feeling the urge to weigh yourself frequently may become problematic. Techniques such as deep breathing can help you to 'ride out' an urge until it fades. Deep breathing involves inhaling for a count of four, holding for a count of two and exhaling for a count of four, holding for a count of two, and repeating. Identify two checking urges that you will attempt to resist by using deep breathing in the next day.*"

Cognitive intervention

The fourth intervention contained a strategy to challenge unwanted urges using cognitive challenging (Cooper et al., 2004; Fairburn, 2008). Participants read the following: "*Many strategies can be used when an unwanted urge to check your body occurs. Cognitive challenging is one of these strategies. When you have an unwanted urge to check, you can try repeating to yourself "checking will only make me want to check more" and/or "this too shall pass". How do you think it would feel to use this technique? What could you say to yourself the next time you have an unwanted urge to check?*"

Cognitive dissonance intervention

The fifth intervention required participants to reflect on how to interact with a friend who was engaging in excessive checking (Fairburn, 2008; Stice, Marti, Spoor, Presnell, & Shaw, 2008), and participants read the following: "*Imagine you are having coffee with a close friend. This friend appears fit and physically active. She shares with you how bad she feels about her body. She tells you how long it takes her to get ready in the morning because of how often she changes clothes and examines herself in the mirror. She describes being unhappy with her stomach and constantly sucking her stomach in and feeling if it sticks out from her pants. Think about what type of things you would tell this friend regarding her constant mirror checking and checking of her stomach. What would you tell this friend about her checking behaviors (mirror checking, sucking in stomach, and feeling stomach)? Would you tell her to do anything differently?*"

After study day five, participants received an email directing them to complete the post-test questionnaires. All 44 participants completed the post-test (average number of days from the end of EMA/EMI to completion of post-test = 1.07 days, SD = 0.93) and then received a debriefing email containing further resources and referrals.

Results

Compliance

A total of 1,084 text messages were sent to the 44 participants, and the overall compliance rate for the experimental days was 93.08%. Reminder messages were sent 27.86% of the assessment times, which prompted 75.17% of the participants to complete the current questionnaire. Of the 220 interventions sent to participants, follow-up questions were completed 86.82% of the time. The compliance rate for each of the five interventions is as follows: 1) 84.09%, 2) 86.36%, 3) 90.91%, 4) 88.64%, and 5) 84.09%.

Aggregate and descriptive analyses

Table 1 shows the frequency of the 11,528 body checking behaviors across each of the eight categories. All further analyses were conducted using one aggregate score of all checking behaviors for each assessment point. Analyses revealed that of the 1,009-time points where participants responded to surveys, some checking was reported 90.19% of the time. At each time point, a mean number of 11.43 (SD = 15.42, 95% CI [10.51, 12.34]) checking behaviors were reported. Individual participants reported engaging in a five-day total number of checking behaviors that ranged from 36 to 950 (M = 262.00, SD = 255.03, 95% CI [185.38, 338.62]).

Hypothesis 1: pre-test and post-test analyses

A series of dependent t-tests were conducted to analyze changes from pre- to post-test measures. All five measures displayed healthy (i.e., decreased scores) changes following the intervention (Table 2). Body checking was impacted the greatest, representing a large effect size. Body dissatisfaction, body image avoidance, body checking cognitions, and internalization of the thin-ideal all decreased at medium effect sizes.

Table 1. Aggregate breakdown of reported body checking behavior frequencies.

Behavior Type	Reported Frequency	Number of Participants	Percentage of Total Checking Behaviors
Weighed self	141	n = 25	1.2%
Felt thighs for fatness	878	n = 41	7.6%
Sucked in stomach	2513	n = 44	21.8%
Felt/pinched stomach	1490	n = 44	12.9%
Compared body to others	2556	n = 44	22.2%
Checked body in mirror	2441	n = 44	21.2%
Checked for fat jiggling	677	n = 35	5.9%
Checked thighs while sitting	832	n = 39	7.2%

Number of participants endorsing a specific body checking behavior at least one time.

Table 2. Means of pre- and post-test scores.

Scale	Pre-test *M* (*SD*) 95% CI	Post-test *M* (*SD*) 95% CI	*t*	d_{avg} 95% CI
Body Shape Questionnaire (BSQ)	130.00 (24.35) [122.60, 137.40]	113.95 (29.18) [105.08, 122.83]	−5.11**	0.60 [0.28, 0.92]
Body Checking Questionnaire (BCQ)	82.61 (8.11) [80.15, 85.08]	67.16 (15.43) [62.47, 71.85]	−7.51**	1.31 [0.90, 1.71]
Body Image Avoidance Questionnaire (BIAQ)	41.45 (11.63) [37.92, 44.99]	34.20 (11.75) [30.63, 37.78]	−5.18**	0.62 [0.29, 0.94]
Body Checking Cognitions Scale (BCCS)	61.23 (10.90) [56.58, 62.96]	53.52 (15.67) [48.76, 58.38]	−3.29*	0.58 [0.26, 0.90]
Sociocultural Attitudes Towards Appearance Questionnaire- 3 (SATAQ- 3)	115.80 (15.14) [111.14, 120.47]	107.10 (19.87) [100.99, 113.21]	−4.09**	0.50 [0.18, 0.81]

* = $p \leq .002$, ** = $p \leq .001$. The *d* statistic represents mean difference scores divided by the average standard deviation, along with 95% non-central confidence intervals, as suggested by Cumming (2012).

Hypothesis two: multilevel analyses

A multilevel model (MLM) was the primary method of analysis due to its ability to account for the nested nature of EMA data (i.e., each participant has twenty-five time points).

MLM was used to investigate the relationship between time, pre-test BSQ scores (a measure of body dissatisfaction), and reported body checking. Preliminary graphical investigation of body checking across time indicated an unexpected interaction between the day of the EMA and the time of day during those EMA days (Figure 1 x-axis) wherein body checking behaviors

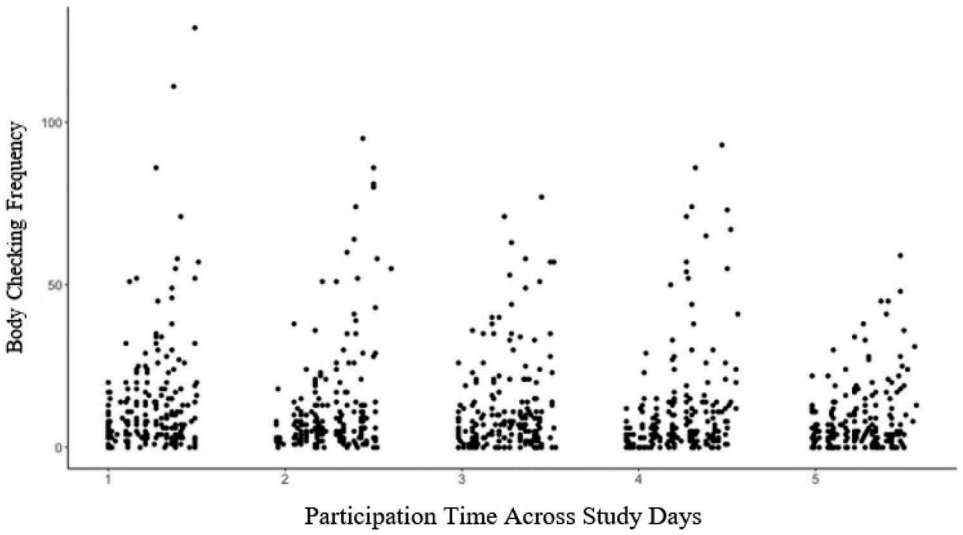

Figure 1. Reported number of body checking behaviors performed by the time of participation in the study. Participation times (x-axis) are based on the start of the study's first survey message, and the numbers indicate the start of each study day. Each dot represents a participant's body checking behavior total count (y-axis) for that surveyed time point.

appeared to decrease across days (y-axis) while increasing within each day. Therefore, these variables were coded separately into day and time of day calculated by creating a time since the first text message (i.e., first text message time by day minus time completed survey). This time of day variable was used to capture the true time that participants responded to prompt; thus, controlling for differences in response times by participant.

Data were screened for assumptions and found to be satisfactory. The analyses were conducted using the *nlme* package in *R* (Pinheiro, Bates, DebRoy, & Sarkar, 2014). First, an intercept only model and a random intercept only model were compared and examined for the necessity of including random intercepts by the participant. Table 3 includes statistical values for all model comparisons and regression values for the predictors for the step they were entered into the equation. The random intercept model was found to be better than the intercept only model; therefore, all further analyses were nested by a random intercept by the participant. Next, body dissatisfaction (pre-test BSQ) was controlled to attempt to account for the large spread in body checking across participants, as seen in Figure 1. This model was significant, indicating that as BSQ increased, the number of checking behaviors increased. In the next model, the day was added as a predictor to examine the trend across days after controlling for body dissatisfaction. In support of the original hypothesis, body checking decreased from day one to day five (see Table 3 for negative across day slope values). Figure 1 shows this decrease across days, as body checking decreased from day one to day five. Time of day was then added to the model to examine within day checking trends found in preliminary screening. Body checking increased throughout each day, even after controlling for body dissatisfaction and across day trends, as shown in Table 3 with a positive within day predictor. Finally, the interaction of day and time of day was not significant ($p = .085$).[1] We did not include a random slopes model for simplicity in understanding the interaction.

We then examined the simple slopes within each day predicting body checking, controlling for body dissatisfaction, as this interaction between day and time of day has not previously been seen in the literature. While the interaction was not deemed "significant" by traditional standards, we explored each day to understand how body checking changed throughout the day, as well as across days. The daily body checking slopes decreased in magnitude from day one to five as seen in Table 3. Therefore, across days overall there was a decrease in body checking. Furthermore, the overall magnitude of increased body checking within each day also decreased.

Hypothesis three: intervention analysis

Days four and five (intervention days) were analyzed to determine how body checking was impacted when participants had seen an intervention at the previous time point. Two regressions were conducted to examine the impact of interventions on day four and on day five, by using the same MLM analyses

Table 3. Model and predictor statistics for MLM analyses for hypothesis 2.

		Predictor Statistics				*Model Statistics*				
Model	*b*	*SE*	*95% CI*	*t*	*p*	*df*	*AIC*	*BIC*	*LogLik*	*L. Ratio*
Non-Random Intercept						2	8386.813	8396.647	−4191.407	
Random Intercept					<.001	3	7825.286	7840.036	−3909.643	563.527
BSQ Control	0.194	0.065	[0.063, 0.324]	2.981	.004	4	7819.176	7838.843	−3905.588	8.110
Day	−1.067	0.240	[−1.537, −0.600]	−4.436	<.001	5	7801.638	7826.221	−3895.819	19.538
Within Day	19.190	2.015	[15.236, 21.144]	9.525	<.001	6	7716.663	7746.163	−3852.331	86.975
Interaction	−2.476	1.437	[−5.300, 0.344]	−1.723	.085	7	7715.683	7750.100	−3850.842	2.980
Day 1	24.335	5.819	[12.844, 35.826]	4.182						
Day 2	27.280	4.839	[17.721, 36.840]	5.637						
Day 3	15.133	3.754	[7.718, 22.548]	4.032						
Day 4	22.029	4.349	[13.440, 30.618]	5.065						
Day 5	11.513	2.935	[5.715, 17.311]	3.922						

Models were compared sequentially to the one below it. Each *b* value presented is for the step the variable was entered. Simple slopes for each day are included as part of the follow-up for the interaction. All values were significant at $p < .001$.

described above and adding the intervention as an independent variable. Overall, the addition of the intervention variable was not significant, $b = -0.68$, 95% CI [−2.54, 1.17], $t(355) = -0.73$, $p = .468$. On day four, body checking behaviors were not found to be significantly different when assessed directly following an intervention ($M = 11.53$, $SD = 15.23$, 95% CI [5.83, 16.20]) compared to not directly following an intervention ($M = 11.02$, $SD = 16.86$, 95% CI [6.85, 16.21]), $b = 0.28$, 95% CI [−2.80, 3.36], $t(159) = 0.18$, $p = .859$. Day five body checking behaviors directly following an intervention ($M = 7.78$, $SD = 9.97$, 95% CI [6.01, 12.56]) compared to not directly following an intervention ($M = 9.29$, $SD = 10.65$, 95% CI [4.71, 10.84]) was in the hypothesized direction (i.e., directly following an intervention, less body checking was performed), although not significant, $b = -1.45$, 95% CI [−3.34, −0.43], $t(153) = -1.52$, $p = .131$.

Discussion

The current study combined EMA and EMI procedures to examine the effectiveness of a five-day study targeting body checking behaviors. Hypotheses 1 and 2 were supported, demonstrating that a number of attitudes and behaviors related to body checking were positively impacted (i.e., decreased in the direction toward healthy levels) following the five-day study, and that body checking decreased across the five-day study. Hypothesis 3 is not supported, as body checking did not significantly decrease directly following the intervention prompts on the final two days of the intervention.

Comparisons on pre-test and post-test scores demonstrated improvements in body checking, body dissatisfaction, body image avoidance, and internalization of the thin-ideal. This evidence in support of Hypothesis 1 suggests that the five-day study had a positive impact on a range of attitudes and behaviors related to body checking. Additionally, body checking was shown to be most strongly impacted by the study, providing more support for the ability of EMA/EMI to change body checking behaviors. Effect sizes for this five-day digital based study were comparable to effects seen in a range of other more intensive body related interventions (small to large Cohen's *d* effect sizes in previous studies ranging from .03 to 1.32; Albertson, Neff, & Dill-Shackleford, 2015; Posavac, Posavac, & Weigel, 2001; Richardson & Paxton, 2010; Wade, George, & Atkinson, 2009).

The second hypothesis was also supported, with body checking decreasing across the five-day study period. Participants reported an average of 76 body checking behaviors on day 1 and 58 behaviors on day 5. This result mirrors findings seen in weight loss literature suggesting text messaging interventions can be effective in promoting health behaviors and weight loss (Patrick et al., 2009; Shapiro et al., 2012).

Given the study design, it is not possible to know for sure if the interventions caused most of the reduction in body checking or if the EMA prompts

themselves were responsible for the improvements. The simple act of monitoring body checking behaviors over the course of five-days could have led to the reduction in body checking behaviors. EMA procedures repeatedly ask participants assessment questions, and reactivity can occur when the procedure itself causes changes. In fact, a previous EMA study assessing body checking without implementing an 'intervention' also found decreased body checking over the course of a five-day period (Stefano et al., 2016). Therefore, body checking behaviors that are often performed without conscious awareness in non-clinical women may be reactive to EMA procedures that result in greater awareness. This finding shares similarities to the results demonstrating the effectiveness of self-monitoring procedures used in weight loss intervention studies (Burke, Wang, & Sevick, 2011).

One unexpected finding was that body checking behaviors increased throughout the course of each individual day. Previous studies have found increased anxiety, mood, and stress levels to predict body checking (Lavender et al., 2013; Smyth et al., 2007). It is possible that anxiety and stress levels also increase throughout the day which contributes to higher frequency body checking behaviors. Future treatments targeting body checking should attempt to replicate and address this trend.

Hypothesis 3 is not supported; body checking did not decrease directly following intervention time points on days four and five. This finding could have been obtained because some of the interventions themselves were not particularly effective. Qualitative analyses found that participants rated some of the strategies as less helpful than others. For example, two participants reported deep breathing strategies to not be useful ("*I don't think that deep breathing will help me resist these urges, it will just draw attention to how self-conscious I am. But if I were to use this technique, I'd do it when I am constantly looking at my reflection")*, and 10 participants expressed not liking cognitive challenging or not feeling like it would be effective (*"Using this technique would make me feel like I have a serious problem and in turn make me feel anxious… I could remind myself that checking will only make me sad."*). Future studies should further investigate the types of interventions participants find to be most useful. Additionally, the lack of personalized intervention messages in the current study could have reduced the effectiveness of the interventions (Heron & Smyth, 2010; Robinson et al., 2006). It is also possible that the interventions were not immediately effective in reducing body checking because most of the interventions used would require some practice to successfully implement the strategies. Results did suggest that by day five, body checking was lower directly following an intervention compared to not directly following an intervention, although this difference was not significant. A longer period of daily assessment (e.g., a 10-day assessment) would help determine the impact of a potentially slower-acting intervention.

The current study does have several limitations. Participants were not asked about how they were implementing the intervention strategies presented to them, and it is unclear how frequently or the extent to which participants were utilizing the intervention strategies. Additionally, demand characteristics may have led participants to respond in ways that conformed to what they believed to be the intention of the study (Heron, 2012). Additionally, the sample was comprised of predominately white college females with high levels of body dissatisfaction, limiting the generalizability of the findings.

Fairburn and Rothwell (2015) discuss the need for continued investigation of smartphone applications that are designed for assessment and monitoring of eating behaviors within cognitive behavioral treatment. Continued work should be conducted to evaluate the feasibility of implementing technology-based interventions in clinical populations. Additionally, future research should aim to clarify the unique impact that EMA procedures have on behavior above and beyond EMI. Our study suggests that the assessment and intervention of body checking using a digital ecological design is a feasible and reliable option. Additionally, response rates were extremely high for this study, with approximately 90% compliance throughout the study. The results of this study revealed that the evening was a high-risk time for body checking behaviors, and this finding should serve to inform clinicians in how to best intervene with clients. Future research should continue to examine body checking interventions that are delivered in "real-time" in clinical populations and as add-ons to in-person treatments. Such interventions should aim to be personalized for individual needs, and participants should be given opportunities to report on their use of strategies and preferences for interventions.

Note

1. We additionally examined the influence of age and BMI on these results, as suggested by a reviewer. The results did not change with these covariates, and neither age nor BMI were significant predictors. Therefore, the original hypotheses and analyses are presented here.

Funding

This work was supported by the Missouri State University.

ORCID

Erin M. Buchanan http://orcid.org/0000-0002-9689-4189
Danae L. Hudson http://orcid.org/0000-0003-0425-9127

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