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EMPIRICAL RESEARCH

BodiMojo: Efficacy of a Mobile-Based Intervention in Improving Body Image and Self-Compassion among Adolescents

Rachel F. Rodgers[1,2] · Elizabeth Donovan[3,4] · Tara Cousineau[3] · Kayla Yates[1] · Kayla McGowan[3] · Elizabeth Cook[1] · Alice S. Lowy[1] · Debra L. Franko[1]

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Abstract

Mobile interventions promoting positive body image are lacking. This study presents a randomized controlled evaluation of *BodiMojo*, a mobile application (app) intervention grounded in self-compassion to promote positive body image. A sample of 274 adolescents, mean (SD) age = 18.36 (1.34) years, 74% female, were allocated to a control group or used *BodiMojo* for 6 weeks. Appearance esteem, body image flexibility, appearance comparison, mood, and self-compassion were assessed at baseline, 6, and 12 weeks. Significant time by group interactions emerged for appearance esteem and self-compassion, with appearance esteem and self-compassion increasing in the intervention relative to the control group. These findings provide preliminary support for *BodiMojo*, a cost-effective mobile app for positive body image.

Keywords Body image · Prevention · Self-compassion · Mobile technology · Adolescents

Introduction

Poor body image among late adolescents and emerging adults is an important area to study, as body image concerns have been shown to be associated with a number of negative physical and psychological health outcomes (Holsen et al. 2001; Neumark-Sztainer et al. 2006) and constitute one of the principal risk factors for eating disorders (Stice and Shaw 2002). In fact, Bucchianeri and colleagues (2013) found that for both female and male participants (N = 1902), body dissatisfaction increased between middle and high school and further, that body dissatisfaction increased even more so during the transition to young adulthood, indicating that body image concerns continue to develop through late adolescence and emerging adulthood. Helping youth to sustain a positive body image is therefore a critical focus. In recent years, technology-based interventions have emerged as a useful way of delivering content aiming to target body image (Melioli et al. 2016; Zabinski et al. 2001). In addition, self-compassion has received early support as a useful framework within which to ground such interventions (Braun et al. 2016). The aim of the present study was to evaluate the efficacy of *BodiMojo*, a mobile application (app) intervention grounded in self-compassion principles that promotes positive body image, among a sample of late adolescents and emerging adults.

Adolescence and early adulthood have been described as a critical period for the development of body image and self-identity (Neff and McGehee 2010; Paxton et al. 2006; Rodgers et al. 2016b). However, given the importance placed upon appearance as a primary aspect of self-worth in Western society, as well as the promotion of largely unattainable appearance standards, many frequently experience body image concerns and low appearance esteem (Thompson et al. 1999). The sociocultural theory of body image development has highlighted how these concerns are maintained through appearance comparisons with others as well as with unrealistic media images (Thompson et al. 1991). Given these concerns, designing and testing programs that are successful in developing positive body esteem and decreasing associated factors, such as appearance comparison, is important.

✉ Rachel F. Rodgers
r.rodgers@northeastern.edu

[1] APPEAR, Department of Applied Psychology, Northeastern University, Boston, MA 02115, USA

[2] Department of Psychiatric Emergency & Acute Care, Lapeyronie Hospital, CHRU Montpellier, Montpellier, France

[3] BodiMojo Inc., 1631 Canton Ave, Milton, MA 02168, USA

[4] Department of Psychology, Simmons College, Boston, MA 02115, USA

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Self-compassion has recently been identified as a promising framework within which to ground interventions aiming to support positive body image (Ferreira et al. 2013). Self-compassion is described as incorporating three main components: mindfulness, self-kindness, and common humanity. As such, self-compassion involves being accepting and non-avoidant of one's experiences, being non-judgmental and caring towards oneself, and recognizing that experiences of oneself as inadequate are intrinsic to the human experience (Neff 2003).

In the context of body image, self-compassion is thought to foster a compassionate view of oneself and one's body, and encourage a nurturing and caring stance, as well as the capacity to respond to environmental pressures (such as appearance pressures) in a non-reactive way (Ferreira et al. 2013). The conceptual framework linking self-compassion to body image posits that self-compassion serves as a protective factor against the sociocultural pressures to look a certain way. From a theoretical perspective, two of the main pathways for this protective factor that have been considered include: (1) that self-compassion may have a direct relationship with positive body image; and (2) that self-compassion may buffer against the effects of risk factors, including sociocultural factors, on body image (Rodgers et al. 2017). Thus, there is strong theoretical grounding for the notion that self-compassion may be effective in sustaining positive body image.

Consistent with this, a recent review confirmed a positive relationship between self-compassion and improved body image (Braun et al. 2016). For example, young women with more positive body image were found to report lower levels of body preoccupation, body dissatisfaction, and drive for thinness (Ferreira et al. 2013; Wasylkiw et al. 2012). In addition, higher levels of self-compassion were found to be associated with experiencing self-esteem as less contingent on appearance (Neff and Vonk 2009). Finally, among young women athletes, self-compassion was negatively related to body surveillance and body shame (Mosewich et al. 2011).

In addition, self-compassion has been proposed as an effective emotional regulation strategy by encouraging awareness of, and willingness to, experience negative emotions, and the subsequent framing of them as part of human experience (Neff 2003; Odou and Brinker 2015). Consistent with this, self-compassion interventions for decreasing negative mood have shown initial promise (Odou and Brinker 2015). Given the role of negative affect in poor body image and disordered eating (Stice and Shaw 2002), the emotion regulation benefits of self-compassion might also contribute to promoting positive body image. As a related concept, gratitude has also been identified as a promising component for such interventions. Defined as the recognition and appreciation of positive aspects of one's life, attributes or outcomes, gratitude has been shown to play an important part in wellbeing, independent of what is deserved or earned (Wood et al. 2010).

A small number of interventions grounded in self-compassion and related frameworks have been evaluated regarding their capacity to promote positive body image. In a randomized controlled trial, adult women with body image concerns who listened to self-compassion meditations for three weeks reported lower levels of body dissatisfaction, body shame, and contingent self-worth, and higher levels of body appreciation, compared to the control group (Albertson et al. 2015). In another randomized controlled trial, young women allocated to a mindfulness-based intervention with a focus on being non-judgmental and accepting of body image-related experiences reported improvements in body image and associated behaviors following three weekly sessions (Atkinson and Wade 2016). A similar mindfulness-based intervention conducted in schools among female adolescents aged 14–18 revealed similar effects related to improved body image (Atkinson and Wade 2015). Interestingly, despite late adolescents being a particularly high-risk group for poor body image, interventions aiming to promote positive body image grounded more specifically in self-compassion have yet to be developed. The goal of the present study was therefore to develop and evaluate such an intervention.

BodiMojo was created as a mobile application (app) to promote positive body image through self-compassion. Given the rise of mobile phone use, mobile interventions for health promotion have been identified as having a high potential for success among this age group (Rodgers et al. 2016a, 2016c; Schoffman et al. 2013). In addition, mobile delivery has been suggested to have a number of advantages in the context of programs targeting body image-based concerns in particular (Zabinski et al. 2003). Despite the advantages of delivering interventions via mobile technology, and the proliferation of mobile apps, to date, very few mobile interventions have been evaluated in rigorous randomized controlled trials, and most commercially-available mobile apps lack empirical support (Breton et al. 2011).

Although there is emerging evidence that app-based interventions are feasible and display good uptake (e.g., Tregarthen et al. 2015), few data are available to date to support their efficacy. For example, a recent systematic review of mental health mobile apps for preadolescents and adolescents (Grist et al. 2017) revealed that of the 15 apps available, only 5 reported any kind of outcome data, and some of these data were from laboratory-based evaluations. The few studies that did assess outcomes did so in a very similar way to our study, with pre-, post-, and follow-up questionnaire packets. For example, Kauer et al. (2012) evaluated an app designed to target depression among a sample of 200 adolescents who completed measures of mental health including depression and stress, at pre-, post-, and 6-weeks follow-up.

Notably, a recent review concluded that six programs have been found to effectively reduce eating disorder risk,

and examined body image (Stice et al. 2013); however, none of these programs were online or app-based. A 2015 meta-analytic review of brief body image interventions analyzed 62 tests of interventions, resulting in a small-to-medium improvement in body image ($d+ = 0.38$), a small-to-medium reduction in beauty ideal internalization ($d+ = -0.37$), and a large reduction in social comparison tendencies ($d+ = -0.72$). Again, none of the programs reviewed were online programs (Alleva et al. 2015). However, a recent review of app-based interventions in the context of eating disorders identified six evidence-based apps designed for the treatment of eating disorders, four of which including some form of mindfulness (Juarascio et al. 2015). Mobile applications designed to promote positive body image that are evidence-based are even scarcer. Brief online interventions however, although not mobile, have been shown to be effective in the reduction of body image concerns, thus supporting the feasibility of such an approach (Melioli et al. 2016; Stice et al. 2017).

The Current Study

Given the literature reviewed above highlighting the need for mobile resources for adolescents designed to promote positive body image, and the support for self-compassion as a framework, the current study reports on a randomized-controlled evaluation of a mobile app created to fill this gap. Grounded in self-compassion and sociocultural theory as well as aspects of gratitude, *BodiMojo* was developed specifically for late adolescents and emerging adults and revealed high acceptability in a pilot trial among a racially and ethnically diverse sample (Donovan et al. 2016). The aim of the current study was to evaluate the efficacy of *BodiMojo* in improving body image and mood, as well as decreasing appearance comparison, within a randomized controlled trial. It was hypothesized that adolescents using *BodiMojo* would report more positive body image, greater self-compassion, more positive mood, and lower negative mood following the 6-week trial period, and at the 12 week follow-up point, as compared to adolescents in the control group.

Method

Participants and Procedures

Two hundred seventy-four late adolescents and emerging adults, mean age = 18.36 (1.34) years, 26% male, were recruited from two high schools and two local youth organizations ($n = 88$), as well as the campus of a large and diverse private urban university ($n = 186$). Students recruited from the two high schools (one urban and one suburban) and youth organizations (urban) were aged 14 to 18 years old, mean (SD) = 16.44 (1.07). University recruitment was limited to first-year students and students aged 17 years ($n = 1$), 18 years ($n = 87$), and 19 years ($n = 98$), mean age (SD) = 19.03 (.55) years. Approximately half of the sample was White (56%, $n = 154$), 19% ($n = 51$) was Asian, 10% was Black ($n = 28$), 8% was Hispanic ($n = 23$) and the rest of the sample (7%) reported other racial/ethnic backgrounds. The participants recruited from the University campus did not differ from the others in terms of the proportion identifying as non-white $p = .34$; however, they were significantly older, $p < .001$, mean (SD) = 19.03 (.55) years versus mean (SD) = 16.44 (1.07) years.

Participants were recruited through posters, advertisement, leaflets, and emails and were randomly allocated to the control or experimental group upon inclusion using a randomization schedule. Group information sessions were scheduled in each location (on the university campus and on the premises of the high schools and youth organizations). After providing informed consent or assent, all participants completed the baseline assessment online. Participants under the age of 18 provided parental consent in addition to assent. Participants allocated to the experimental group then received more detailed information about *BodiMojo*. Participants were asked to review the three main features of the app each day, including opening the twice daily messages for the duration of the 6-week intervention. With the help of the research assistant, participants in the experimental group then downloaded the app and were guided through registration, app features and activities, and ways of contacting the researchers in case of difficulties or to provide feedback.

At baseline, the end of six weeks, and then again at 12 weeks, participants were invited to complete online assessments containing measures of the main outcomes. This procedure is similar to that conducted by the other few studies that have evaluated apps aiming to improve mental health among adolescents (e.g., Kauer et al. 2012). The assessments were housed on a survey software, separate from the app, such that the procedure was identical for participants in both the intervention and the control group who were all provided with a web link at the three time points via email. Thus, the assessments were conducted separately from the app by all participants through an online questionnaire housed on separate survey software at pre-test, 6-weeks (post-test), and 12 weeks. After the end of the 6-week period, participants retained the use of the app; however, they no longer received any intervention messages.

Participants who were 18 years old and over provided informed consent. The study was approved by the Northeastern University Institutional Review Board. Participants were provided with a $15 gift card for their time after the initial information session, and $25 and $40 gift cards after the second and third assessment points, respectively.

Table 1 Intervention message and emotional regulation content

Intervention messages	
Mindfulness	Thoughts are messages your mind creates at any moment. Imagine that they are clouds moving through the sky. Notice them. Let them drift off
Common humanity	When something goes wrong, it's easy to think you're the only one going through it. NOT! You're not alone. Others have felt the same way. Hang in there and stay hopeful!
Self-kindness	Saying mean things to yourself? The good news is you noticed. Ask that voice to step back and give you some space, or turn down the volume
Body image (media literacy, fat-talk and teasing)	Negative talk about body shape and appearance makes everyone feel bad. Do you and your friends a favor. Drop the fat chat
Health behaviors (mindful and healthy eating, sleep, physical activity)	Healthy bodies come in many shapes and sizes. The secret recipe for all of them? Nutrition, activity and rest! Check out your habits here
Emotional regulation	
Negative emotions: e.g. Miserable, irritable, ashamed, angry, guilty, disgusted, rejected, lonely, scared, anxious	(a) Try a mini-meditation: Imagine a peaceful place. Take a few deep, slow breaths and send warmth throughout your body
	(b) Sometimes, we bury stuff deep down instead of talking it out. Think no one will understand? Think again. Most people find that reaching out helps. Who is one person you can trust?
	(c) Feelings don't last forever. This one will pass. Trust that
Positive emotions: e.g. Interested, content, relaxed, hopeful, brave, amused, excited, happy	(a) Remember this great feeling the next time you are in a funk!
	(b) The more you focus on the good things in life, the more good things show up
	(c) Cool! That must feel terrific

Intervention

BodiMojo (Table 1) is an application developed for mobile phones (iOS) designed around three active components: (1) intervention messages delivered twice daily through the app; (2) mood tracking and emotional regulation; and (3) gratitude journaling. The intervention messages were distributed across five main content areas focused on: (1) the three pillars of self-compassion: mindfulness, self-kindness, and common humanity (Neff 2003); (2) body image-related content, specifically media literacy, peer influences such as fat talk and appearance-based teasing, and appearance comparison (Franko et al. 2013; Ross et al. 2013); and (3) healthy lifestyle-related content including healthy and mindful eating, sleep hygiene, and physical activity (Rodgers et al. 2016c). The daily intervention messages came in the form of an affirmation, a behavioral tip, or psychoeducation, and some contained a link to a quiz or an audio meditation and the content and the order of presentation was identical for all participants. For example, meditations included those focused on breath awareness, body scanning and loving kindness. Quiz topics included stress, body image, and eating and healthy behaviors. Unfortunately, due to a major technical malfunction, we were not able to capture the amount of time spent using the app.

BodiMojo pilot data indicated that participants appreciated a variety of formats for intervention messages (Donovan et al. 2016). As outlined above, one of the proposed mechanisms of self-compassion is improved emotional regulation (Odou and Brinker 2015). For this reason, participants were asked on a daily basis to record their feelings in a "mood cloud", which provided a graphic depiction of the different emotions chosen. By clicking on the feelings that appeared in the mood cloud, participants could access supportive emotional regulation statements (see Table 1). The third component consisted of a daily gratitude journal within the app, where adolescents were asked to record five things each day for which they were grateful. Among adolescents, gratitude journaling has been associated with positive outcomes for general wellbeing, as well as satisfaction with the school context (Emmons and McCullough 2003; Froh et al. 2008).

Measures

Demographics

Participants provided their age, gender, race and ethnicity.

Self-compassion

The Self-Compassion Scale (SCS; Neff 2003) is a 26-item questionnaire used to assess participants' feelings of self-

compassion during difficult times. The SCS comprises six subscales that measure distinct components of self-compassion, with negative aspects being reverse coded: Self-Kindness (5 items, e.g., "I try to be understanding and patient towards those aspects of my personality I don't like"), Self-Judgment (5 items, e.g., "When I see aspects of myself that I don't like, I get down on myself"), Common Humanity (4 items, e.g., "I try to see my failings as part of the human condition"), Isolation (4 items, e.g., "When I fail at something that's important to me I tend to feel alone in my failure"), Mindfulness (4 items, e.g., "When I'm feeling down, I try to approach my feelings with curiosity and openness"), and Over-Identification (4 items, e.g., "When something upsets me, I get carried away with my feelings"). Items are rated on a 5-point Likert-type scale, ranging from 1 (almost never) to 5 (almost always), with higher scores reflecting greater self-compassion and negative items reverse coded. The scale has been previously used to effectively measure self-compassion and demonstrates adequate psychometric properties (Neff 2003). As has been done previously and supported in earlier research (Neff 2003; Neff et al. 2017), we calculated a total self-compassion score. Internal consistency for the total score in the current sample was $\alpha = .70$ at time 1, $\alpha = .76$ at time 2, and $\alpha = .78$ at time 3.

Three body image-related constructs were assessed: body esteem, physical appearance comparison, and body image flexibility.

Appearance esteem

The Appearance Esteem subscale of the Body Esteem Scale for Adults and Adolescents (Mendelson et al. 2001) is a 10-item questionnaire used to assess appearance concerns among youth (e.g., "I like what I look like in pictures"). Items are rated on a 5-point Likert-type scale, ranging from 0 (never) to 4 (always), with higher scores reflecting greater body esteem and negatively phrased items reverse coded. The scale has been previously used to effectively measure body esteem for adults and adolescents and demonstrates high internal consistency and test-retest reliability (Mendelson et al. 2001). In the current sample, $\alpha = .91$ at time 1, time 2, and time 3.

Physical appearance comparison

The Physical Appearance Comparison Scale (Thompson et al. 1991) is a 5-item measure of tendencies to compare one's physical appearance with that of others (e.g., "At parties or other social events, I compare how I am dressed to how other people are dressed"). Items are rated on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores reflecting greater tendencies to compare oneself to others. This scale has been previously used to effectively measure physical appearance comparison and demonstrates adequate internal consistency and test-retest reliability (Thompson et al. 1991). In the current sample, $\alpha = .90$ at time 1, $\alpha = .87$ at time 2, and $\alpha = .93$ at time 3.

Body image flexibility

The Body Image-Acceptance and Action Questionnaire (BIAAQ; Sandoz et al. 2013) is a 12-item questionnaire that measures body image flexibility. The scale assesses perceptions, sensations, feelings, thoughts, and beliefs associated with one's body while pursuing chosen values (e.g., "I get on with my life even when I feel bad about my body"). Items are rated on a 7-point Likert-type scale, ranging from 1 (never true) to 7 (always true), and reverse coded with higher scores reflecting higher levels of body image flexibility. The scale has been previously used to effectively measure body image flexibility and demonstrates excellent internal consistency reliability across various samples (Sandoz et al. 2013). In the current sample, $\alpha = .93$ at time 1, $\alpha = .94$ at time 2, and $\alpha = .94$ at time 3.

Positive and negative affect

The Positive and Negative Affect Schedule 10-Children (PANAS-C10; Ebesutani et al. 2012) is a well-validated brief measure of mood for youth. While the original scale was developed as a 27-item questionnaire to assess positive and negative affect for children (Laurent et al. 1999), the PANAS-C10 consists of 5 positive affect items (joyful, cheerful, happy, lively, proud) and 5 negative affect items (sad, scared, miserable, afraid, mad). It has been previously successfully used to assess mood in youth aged 14–18 years old (Schoenfelder et al. 2017). Participants are asked to indicate to what extent they have felt each emotion in the past few weeks, with items rated on a 5-point Likert-type scale, ranging from 1 (very slightly or not at all) to 5 (extremely). Positive and negative affect items are combined separately into two subscales, with higher scores reflecting greater positive and negative affect, respectively. Both subscales have demonstrated adequate internal consistency, as well as convergent and discriminant validity (Ebesutani et al. 2012). In the current sample, $\alpha = .74$ and $\alpha = .85$ for the negative and positive scales at time 1, $\alpha = .76$ and $\alpha = .87$ for the negative and positive scales at time 2, and $\alpha = .78$ and $\alpha = .87$ for the negative and positive scales at time 3.

Data Analyses

Intervention effects were tested using 2 (intervention group vs. control group) × 3 (time: baseline, 6 weeks, 12 weeks)

repeated measure ANOVAs, and multivariate tests were interpreted. Where appropriate, total scores were calculated using mean substitution for the missing items (Parent 2013). For variables that showed significant interaction effects, mixed-model analyses were conducted including the fixed effects of time, and college status (yes/no), in addition to the random effect of the intercept. All analyses were conducted using SPSS version 23. The alpha value was set at $p = .05$.

Results

Descriptive Statistics

Of the initial sample of $n = 274$, $n = 251$ (92%) completed the assessments at Time 2, and $n = 237$ (86%) at Time 3. Across all time points, for all outcomes, group sizes varied between $n = 109$ and $n = 130$. No significant differences were found on the outcome variables between those who dropped out and those who remained within the study. Descriptive statistics for the intervention and control group participants with complete data across the three time points are presented in Table 2.

Intervention Effects

No group differences (intervention vs. control) emerged in terms of the outcomes variables at baseline. A series of 3 (time) × 2 (group) repeated measures analyses of variance were conducted to test the efficacy of the intervention in improving body image, self-compassion, and mood after the 6-week intervention period, and at 12 weeks. Regarding body image, an interaction effect emerged for appearance esteem, $F(2, 423) = 3.99$, $p = .023$, $\eta_p^2 = .018$, such that appearance esteem increased in the intervention group relative to the control group over time. No main effect of time was found, $F(2, 423) = .48$, $p = .62$, $\eta_p^2 = .00$. For appearance comparison, a main effect of time emerged, $F(2, 422) = 14.96$, $p < .001$, $\eta_p^2 = 0.66$, such that appearance comparison decreased over time; however, no interaction effects were found $F(2, 422) = 2.19$, $p = .114$, $\eta_p^2 = 0.01$. For body image flexibility, no significant main effects or interaction effects were found, $F(2, 412) = 2.97$, $p = .059$, $\eta_p^2 = 0.01$ and $F(2, 414) = .019$, $p = .80$, $\eta_p^2 = 0.01$ respectively. Regarding self-compassion, both an interaction effect, $F(2, 400) = 7.38$, $p = .002$, $\eta_p^2 = .036$, and a main effect of time $F(2, 400) = 3.45$, $p = .043$, $\eta_p^2 = .017$, were found such that self-compassion increased in both groups over time, but more so in the intervention group as compared to the control group. Finally, regarding mood, a main effect of time emerged for positive mood, $F(2, 408) = 3.12$, $p = .045$, $\eta_p^2 = 0.15$, such that positive mood decreased over time; however, no interaction effects were found, $F(2, 408) = .85$, $p = .429$, $\eta_p^2 = 0.01$. No significant main effects or interaction effects were found for negative mood, $F(2, 408) = .64$, $p = .53$, $\eta_p^2 = 0.01$ and $F(2, 408) = 4.71$, $p = .49$, $\eta_p^2 = 0.01$ respectively.

Findings from the mixed models examining the effects of college status on change among the intervention group revealed that the time × college status term did not significantly predict appearance esteem ($p = .94$), although a main effect of college status did emerge ($p < .001$). A similar pattern emerged for self-compassion, with no effect of the time × college status interaction term ($p = .98$), but a significant main effect of college status ($p = .002$).

Discussion

Adolescence is a high-risk period for body image concerns, and has been highlighted as a key time for intervention (Rodgers et al. 2016b). Interventions that can be delivered through mobile technology have been identified as having a high potential for success in this age group (Rodgers et al. 2016a). However, to date there is a gap in available mobile resources developed to support body image. Thus, to bridge this gap, the aim of the current study was to examine the efficacy of a mobile app, *BodiMojo*, in promoting positive body image. Overall, findings provide preliminary evidence for the usefulness of *BodiMojo* for improving body image and self-compassion among our sample of late adolescents and emerging adults, and highlight it as one of the few existing mobile platforms for the promotion of positive body image. These findings extend the previous literature regarding the usefulness of body image interventions that focus on fostering accepting and non-judgmental attitudes towards body image experiences (Atkinson and Wade 2015) and support further research evaluating self compassion-based interventions for enhancing body image.

Our findings revealed that in comparison to the control group, participants who used the *BodiMojo* intervention reported improved appearance esteem. Our positive effects are consistent with those of previous studies investigating the usefulness of self-compassion and mindfulness interventions on body image (Albertson et al. 2015; Atkinson and Wade 2015). In addition, consistent with previous reports of the cross-sectional relationships between positive body image and self-compassion (Braun et al. 2016), our findings revealed that compared to the control group, the participants who used *BodiMojo* reported improvements in self-compassion. These are important and novel findings, as to our knowledge this is the first intervention designed to improve body image and self-compassion among late adolescents and emerging adults. Furthermore, these findings are promising given the documented relationships between

Table 2 Descriptive statistics and intervention effects

	Condition	Baseline mean (SD; *n*)	6 weeks mean (SD; *n*)	12 weeks mean (SD; *n*)	Time (3) × group (intervention vs. control)
Appearance esteem	Intervention	22.95 (7.99; 129)	24.02 (7.13; 112)	23.50 (7.77; 112)	$F(2, 423) = .3.99$, $p = .023$, $\eta_p^2 = .018$
Appearance esteem	Control	22.45 (7.46; 129)	21.73 (7.28; 123)	21.58 (7.63; 118)	
Body image flexibility	Intervention	62.48 (15.62; 129)	63.56 (15.08; 117)	61.67 (15.24; 110)	$F(2, 414) = .41$, $p = .64$, $\eta_p^2 = .002$
Body image flexibility	Control	61.36 (14.98; 130)	63.56 (15.08; 119)	61.67 (15.24; 117)	
Appearance comparison	Intervention	17.25 (5.59; 129)	15.51 (5.32; 118)	16.15 (5.88; 110)	$F(2, 422) = 1.50$, $p = .22$, $\eta_p^2 = .007$
Appearance comparison	Control	18.02 (5.73; 130)	16.53 (4.17; 122)	17.91 (5.70; 117)	
Self-compassion	Intervention	80.24 (16.02; 128)	85.55 (17.07; 121)	83.73 (17.93; 114)	$F(2, 400) = 7.38$, $p = .002$, $\eta_p^2 = .036$
Self-compassion	Control	75.43 (17.19; 129)	74.51 (17.59; 116)	74.47 (18.25; 117)	
Positive mood	Intervention	17.88 (3.67; 129)	17.46 (4.27; 117)	17.05 (4.28; 108)	$F(2, 410) = .91$, $p = .40$, $\eta_p^2 = .004$
Positive mood	Control	17.41 (3.32; 129)	16.93 (3.87; 118)	17.12 (3.59; 117)	
Negative mood	Intervention	10.23 (3.11; 128)	10.79 (3.53; 116)	10.39 (3.46; 109)	$F(2, 410) = .79$, $p = .45$, $\eta_p^2 = .004$
Negative mood	Control	11.27 (3.97; 129)	11.28 (3.92; 118)	11.39 (4.46; 117)	

self-compassion and various dimensions of wellbeing, above and beyond body image (Neff 2011).

In contrast, however, significant effects were not found in our sample for body image flexibility. While one previous study has revealed change in body image flexibility among a residential clinical sample using the measure employed here, it is unclear whether the measure is sufficiently sensitive to change in a non-clinical sample (Butryn et al. 2013), and this may not have been the best choice for this sample. Reliable and sensitive measures of positive body image have only recently begun to become available for non-clinical groups (Tylka and Iannantuono 2016), and future research should aim to capture change in positive body image through a number of tools.

Our findings did not reveal improvements in appearance comparison or mood. Previous self-compassion and mindfulness interventions have not assessed appearance comparison (Albertson et al. 2015; Atkinson and Wade 2015), thus it is unclear whether including more intervention content specifically targeting appearance comparisons would have led to greater improvements. Regarding mood, the only previous study evaluating the effects of a school-based mindfulness intervention among female adolescents found no improvements in terms of negative affect (Atkinson and Wade 2015), which is consistent with our findings. Given that the focus of self-compassions is openness to, and acceptance of, negative affect, these findings might not be entirely surprising. In line with the theoretical assumption of gains in emotional regulation (Odou and Brinker 2015), it might be more relevant in the future to assess change in the awareness, duration or impact of negative affect, as well as dimensions such as rumination and mindfulness. In addition, our findings did not reveal a positive effect of the intervention on body image flexibility. It may be that other means of assessing self-compassionate attitudes toward the body might better capture improvements and are more sensitive to change. Future research should include recently published measures that have been developed for this purpose (Altman et al. 2017).

Our findings, while preliminary, therefore suggest that a brief intervention delivered through a mobile phone twice a day might be sufficient to create change in appearance-related cognitions and emotions, as well as to increase their overall self-compassion. The development of interventions that are cost-effective, easy to disseminate, and do not rely on delivery by an expert is essential for the broader field of mental health, but particularly in the area of body image, which is such a widespread concern (Melioli et al. 2016). In addition, mobile apps may improve engagement and provide increased agency in terms of their use, thus broadening the reach of mobile interventions (Kenny et al. 2016).

Our study does, however, include a number of limitations. First, our means of assessing information about time spent on the app were limited due to a major technical difficulty we did not become aware of until the study was complete. It will be important for future studies to assess usage. Secondly, our study assessed two dimensions of positive body image, but did not assess body dissatisfaction. It would be important to examine the capacity of *BodiMojo* to improve body dissatisfaction. In addition, our sample was recruited across a number of different settings, and was therefore somewhat heterogeneous. Finally, future studies should aim to explore the duration of gains in body image and self-compassion, to clarify whether these improvements are sustained over a longer period of time.

Conclusion

This study presents an evaluation of a mobile-based intervention for body image grounded in self-compassion conducted among late adolescents and emerging adults. As such, our work bridges a gap in empirically-based available resources for this age group, and extends previous work on the feasibility of *BodiMojo* (Donovan et al. 2016). Our findings provide preliminary evidence that daily use of the *BodiMojo* app was associated with improvements in appearance esteem and self-compassion. Thus, they provide additional support for self-compassion as a useful framework for promoting positive body image (Braun et al. 2016), and suggest that further work in this direction is warranted. Mobile-based interventions are extremely cost-efficient, easy to disseminate, and have a wide reach, particularly among underserved populations (Schoffman et al. 2013). Future research should aim to clarify the mechanisms of action of the intervention so as to potentiate its effects and examine its capacity to achieve sustained effects on wellbeing.

Authors' Contributions R.R., D.F., E.L., and T.C. conceived of the study, participated in its design and coordination and drafted the manuscript; K.M. participated in the design and interpretation of the data; K.Y. participated in the design and coordination of the study, as well as the assessment management; E.C. participated in the design and coordination of the study; E.C., A.L. and R.R. performed the statistical analysis; and E.C. and A.L. helped to draft the manuscript. All authors read and approved the final manuscript.

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Data Sharing Declaration This manuscript's data will not be deposited.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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Rachel F. Rodgers , Ph.D., is an Associate Professor in the Department of Applied Psychology at Northeastern University, Boston. Her research interests are in the area of body image, disordered eating and adolescent/young adult psychopathology, in particular focusing on sociocultural influences on body image and eating concerns.

Elizabeth Donovan , Ph.D., is affiliated with BodiMojo inc. and a lecturer at Simmons College of Arts and Sciences, Boston. Her research interests lie in the management of chronic health conditions.

Tara Cousineau , Ph.D., is the founder of BodiMojo inc. Her research interests include the development and evaluation of technology-based platforms for health promotion among youth.

Kayla Yates , B.S., is an undergraduate in Health Sciences at Northeastern University. Her interests lie in the intersection of mental and physical health, and the development of holistic interventions.

Kayla McGowan , M.S., BodiMojo inc., is interested in nutrition, obesity prevention, and mental health and wellness, as well as child and mother health.

Elizabeth S. Cook , M.S., is a doctoral student in the Department of Applied Psychology at Northeastern University, Boston. Her research interests are in the intersectionality of dimensions such as gender and race as they pertain to health outcomes.

Alice S. Lowy , M.A., is a doctoral student in the Department of Applied Psychology at Northeastern University, Boston. Her research interests are in the area of body image and eating concerns and their prevention, particularly among minority populations.

Debra L. Franko , Ph.D., is a Professor in the Department of Applied Psychology at Northeastern University, Boston. Her research interests lie in improving outcomes of eating disorders and the development and evaluation of technology-based programs for the prevention of body image and eating concerns.