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Calorie counting and fitness tracking technology: Associations with eating disorder symptomatology

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ABSTRACT

The use of online calorie tracking applications and activity monitors is increasing exponentially. Anecdotal reports document the potential for these trackers to trigger, maintain, or exacerbate eating disorder symptomatology. Yet, research has not examined the relation between use of these devices and eating disorder-related attitudes and behaviors. This study explored associations between the use of calorie counting and fitness tracking devices and eating disorder symptomatology. Participants ($N = 493$) were college students who reported their use of tracking technology and completed measures of eating disorder symptomatology. Individuals who reported using calorie trackers manifested higher levels of eating concern and dietary restraint, controlling for BMI. Additionally, fitness tracking was uniquely associated with ED symptomatology after adjusting for gender and bingeing and purging behavior within the past month. Findings highlight associations between use of calorie and fitness trackers and eating disorder symptomatology. Although preliminary, overall results suggest that for some individuals, these devices might do more harm than good.

1. Health tracking technology

Devices or applications used to self-monitor health-related indicators, globally referred to as "health tracking technology", are gaining popularity (Franco, Fallaize, Lovegrove, & Hwang, 2016). Weight, dietary intake, and physical activity are the most commonly tracked health indicators (Fox & Duggan, 2013). "Fitness tracking technology" encompasses devices that record an individual's daily physical activity, which includes things like calories burned, heart rate, and steps taken. "Calorie tracking technology" encompasses devices that record an individual's daily dietary consumption, which includes things like caloric and nutrient intake. Both fitness and calorie tracking technology also provide the opportunity to track body weight and set fitness and calorie goals. Adults ages 18–29 years old are more likely than younger or older individuals to use health tracking technology (Fox & Duggan, 2013), and women are more likely to use this technology than men (Fox & Duggan, 2013; Khalaf, 2014). With increases in the tracking devices available and the popularity of wearable technology, the use of online calorie and fitness monitors is rising exponentially (IHS, 2013; Nielsen, 2014).

The use of calorie and fitness trackers is grounded in research indicating that self-regulation motivates behavioral change (Anderson, Winett, & Wojcik, 2007; Franco et al., 2016). Use of health monitoring devices have demonstrated positive associations with weight loss in clinical and non-clinical samples (Jakicic et al., 2016; Pourzanjani, Quisel, & Foschini, 2016). Yet some concerns have been raised about the use of health tracking devices and their potential to trigger, maintain, or exacerbate eating disorders (EDs; Davies, 2015; Gregory, 2013; Mahdawi, 2014; Miller, 2015; Thorpe, 2015).

Numerous media reports suggest that there might be a downside to health tracking technology, specifically highlighting the potential for these devices to trigger or exacerbate disordered eating behavior and attitudes (Mahdawi, 2014; Miller, 2015). Several women have written personal accounts of their experiences using tracking technology and subsequent ED treatment (Davies, 2015; Gregory, 2013). Other reports document the association between calorie counting and impaired quality of life (Nicholson, 2015). "Techorexia" has been coined to describe the compulsive behavior normalized by the popularity of health technology (Mahdawi, 2014).

Health trackers require close monitoring of caloric consumption and/or physical activity, and quantify behaviors as a strategy for assessing health. However, when taken to an extreme, according to some anecdotal reports, these devices can become a way to quantify self-worth (e.g., based on caloric intake or output; Mahdawi, 2014). Rigid and perfectionistic thinking surrounding weight and related numbers (e.g., calories) is relatively common among individuals with EDs, who often work compulsively to meet certain (often unrealistic) numerical goals associated with weight outcomes (Jacobi, Hayward, de

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Zwaan, Kraemer, & Agras, 2004). Regular use of a device that emphasizes numbers might therefore induce inflexible thinking regarding caloric intake, time exercised, and/or body weight. Further, for individuals with perfectionistic tendencies, deviation from allotted calories or physical activity goals might engender feelings of anxiety and guilt; negative affect is a well-known predictor of eating pathology (Stice, 2002). Tracking technology also recommends exercise to "make up" for caloric transgressions, promoting dichotomous thinking surrounding food and weight behaviors.

Moreover, activity trackers do not include rest days or time limits on physical activity. Devices might therefore encourage individuals to exceed their physical limits, resulting in exhaustion or injury. Reliance on activity trackers might also induce excessive exercise behavior, leading to withdrawal symptoms when exercise is obstructed (Berczik et al., 2012). Overall, the numerical focus of health trackers might be detrimental, especially for individuals searching for ways to quantify their self-worth.

2. Purpose

Despite the popularity of health tracking technology, it is unclear whether use of these devices is associated with ED symptomatology. Previous research has not examined the relation between use of these devices and ED-related attitudes and behaviors. As health tracking technology for eating and weight-related purposes is prevalent among young adults, especially women, a population vulnerable to EDs, the current study investigated whether regular use of health tracking technology is associated with ED symptomatology. It was hypothesized that regular use of calorie tracking technology, and regular use of fitness tracking technology, would each be uniquely related to more severe ED attitudes and greater ED symptomatology.

3. Method

3.1. Participants

Participants were undergraduate students (all 18 years of age or older) from a large, public university in the mid-Atlantic United States. Eighteen individuals were excluded due to either: failure to respond to a tracking technology question ($N = 7$), or inconsistent/invalid responses ($N = 11$). The final sample ($N = 493$) included 345 women (69.7%) and 148 men (29.9%). Women represented the following racial/ethnic groups: 49.6% ($N = 171$) White, 24.6% ($N = 85$) Black, 10.1% ($N = 35$) Latino/a/Hispanic, 17.4% ($N = 60$) Asian, 6.1% ($N = 21$) "Other" (participants were instructed to check all race/ethnicities that applied). Female participants' mean age was 20.30 ($SD = 3.52$); mean BMI was 24.19 ($SD = 5.37$). Men represented the following racial/ethnic groups: 51.4% ($N = 76$) White, 17.6% ($N = 26$) Black, 6.1% ($N = 9$) Latino/a/Hispanic, 22.3% ($N = 33$) Asian, 11.5% ($N = 17$) "Other." Male participants' mean age was 21.04 ($SD = 3.93$); mean BMI was 24.89 ($SD = 6.02$). The Virginia Commonwealth University Institutional Review Board approved this study.

3.2. Measures

3.2.1. Demographics

Participants reported their age, gender, race/ethnicity, and current height and weight (used to calculate BMI).

3.2.2. ED symptomatology

ED symptomatology was measured with the Eating Disorder Examination-Questionnaire (EDE-Q; Peterson et al., 2007). The EDE-Q is a 28-item measure that assesses past-month frequency of ED behaviors. One item assesses frequency of objective binge episodes over the past 28 days; four items assess frequency of different purging behaviors over the past 28 days. The EDE-Q also includes four subscales: eating concern (5 items), shape concern (8 items), weight concern (5 items), and dietary restraint (5 items). The severity of ED attitudes comprises the EDE-Q Global Score, which is the average of the four subscales. Cronbach's alphas in the current study were as follows: 80 (eating concern), 0.92 (shape concern), 0.88 (weight concern), 0.84 (restraint), and 0.95 (global score).

3.2.3. Health tracking technology

Participants indicated (by answering either "yes" or "no") whether they used a calorie tracking device or application (e.g., MyFitnessPal) and fitness tracking device or application (e.g., FitBit, pedometer) regularly.

3.3. Procedure

Participants were recruited from an undergraduate psychology participant pool. After providing informed consent, participants completed an anonymous online survey assessing demographics, health tracking technology use, and ED symptomatology. Participants were compensated with course credit.

3.4. Data analysis

Bivariate associations between study variables are reported in Table 1. Descriptive statistics explored the prevalence of health tracking technology use (either fitness or calorie tracking), as well as the relation between use of calorie tracking and fitness tracking. A multivariate analysis of covariances (MANCOVA) was used to examine differences in EDE-Q subscales between individuals who regularly used health tracking technology and those who denied using tracking technology when controlling for BMI. Hierarchical multiple linear regression was used to examine if ED symptomatology (via EDE-Q Global Score) was uniquely associated with health tracking technology, after accounting for known predictors. The first step included gender, purging, and binge eating. The second step included use of calorie tracking and fitness tracking devices.

4. Results

4.1. Prevalence of health tracking use

Nearly one-seventh ($N = 68$; 13.8%) of the sample regularly used a calorie tracking device; 64.7% of these individuals also endorsed using a fitness tracking device. Nearly one-fifth ($N = 98$; 19.6%) of the sample regularly used a fitness tracking device; 44.9% of these individuals also endorsed using a calorie tracking device. Almost one-tenth ($N = 44$; 8.9%) of the sample endorsed regular use of a calorie and fitness tracking device. There was a positive correlation between use of calorie tracking and fitness tracking ($r = 0.45$; $p < 0.001$).

4.2. Health tracking use & EDE-Q subscales

Results identified a significant multivariate effect of calorie tracking use, Pillai's Trace = 0.03, $F(4469) = 4.19$, $p = 0.002$, $\eta^2 = 0.034$, when controlling for BMI. Findings also demonstrated a significant multivariate effect of fitness tracking use, Pillai's Trace = 0.02, $F(4469) = 2.40$, $p = 0.049$, $\eta^2 = 0.020$, when controlling for BMI. Between group univariate effects revealed that individuals who reported using calorie trackers manifested higher levels of eating concern and dietary restraint (all $ps < 0.05$). Shape concern and weight concern did not differ between groups ($p > 0.05$). Further, between group univariate effects did not reveal significant differences on any of the EDE-Q subscales between individuals who endorsed using fitness tracking devices and those who did not (all $ps > 0.05$). Table 2 provides means, standard errors, and univariate tests statistics across groups.

Table 1
Bivariate associates between study variables.

		1	2	3	4	5	6	7	8
1.	Shape concern	–	–	–	–	–	–	–	–
2.	Weight concern	0.92**	–	–	–	–	–	–	–
3.	Eating concern	0.73**	0.73**	–	–	–	–	–	–
4.	Dietary restraint	0.70**	0.66**	0.74**	–	–	–	–	–
5.	EDE-Q Global Score	0.94**	0.93**	0.87**	0.85**	–	–	–	–
6.	Binge eating	0.36**	0.37**	0.50**	0.33**	0.42**	–	–	–
7.	Purging	0.22**	0.25**	0.35**	0.26**	0.29**	0.26**	–	–
8.	Fitness tracking	0.17**	0.17**	0.07	0.17**	0.16**	0.02	0.07	–
9.	Calorie tracking	0.14**	0.15**	0.11*	0.23**	0.18**	0.10*	0.12**	0.45**

* $p < 0.05$.
** $p < 0.01$.

4.3. Health tracking as an indicator of ED symptomatology

Hierarchical multiple regression analysis revealed that use of fitness tracking devices uniquely accounted for ED symptomatology (Table 3). Step 1 accounted for 52.2% of the EDE-Q Global Score variance, $F(3, 434) = 54.20$, $p < 0.001$. The addition of calorie and fitness tracking use significantly improved the model ($\Delta R^2 = 0.02$, $p = 0.004$), accounting for 53.9% of the EDE-Q Global Score variance $F(5, 432) = 35.45$, $p < 0.001$. Gender, binge eating, purging, and fitness tracking use were also significant independent variables.

5. Discussion

Use of health tracking technology is associated with some aspects of ED symptomatology. Specifically, regular calorie tracking is linked with eating concern and dietary restraint. These findings corroborate media reports documenting a relation between calorie tracking technology and ED attitudes, and indicate that monitoring consumption might enhance rigidity and anxiety regarding caloric intake (Davies, 2015; Gregory, 2013). Thus, the ubiquity of dietary tracking technology is potentially concerning, especially for individuals susceptible to disordered eating symptomatology.

Nevertheless, it might be expected that individuals regularly monitoring their consumption experience eating concern and dietary restraint. Indeed, research indicates that dietary restraint efforts might be beneficial for various health markers (e.g., weight management, insulin levels; Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016). In light of the finding that regular calorie tracking was not associated with weight concern or shape concern, individuals who use calorie tracking devices might be monitoring their dietary intake for reasons unrelated to body dissatisfaction. Future research is needed to understand the associations between use of calorie tracking technology and ED attitudes and behaviors.

Interestingly, fitness tracking, but not calorie tracking, emerged as a unique indicator of ED symptomatology. This finding suggests that activity monitoring might be more aligned with disordered eating attitudes and behaviors than calorie tracking. Results suggest that fitness tracking technology might be a mechanism for promoting exercise for appearance rather than health reasons (Vartanian, Wharton, & Green, 2012). Indeed, exercising for health need not be excessive; yet without rest days or time limits on physical activity, activity tracking might encourage excessive exercise for appearance reasons. This is potentially concerning, as exercising for appearance reasons is associated with negative health outcomes, and excessive exercise can lead to injury and exhaustion (Gonçalves & Gomes, 2012; Vartanian et al., 2012).

It is important to note that the use of self-tracking technology is not inherently harmful. Indeed, for individuals with overweight or obesity, behavioral monitoring is advantageous for weight loss (Jakicic et al., 2016; Pourzanjani et al., 2016). Yet results suggest that it might be beneficial for treatment providers to assess for ED-related attitudes and behaviors prior to recommending health tracking devices for weight management.

This study was the first to examine the relation between use of health tracking technology and ED-related attitudes and behaviors. It was conducted in a particularly relevant population, as young adults are most likely to use health tracking applications, and are at heightened risk for ED symptomatology (Eisenberg, Nicklett, Roeder, & Kirz, 2013; Fox & Duggan, 2013). However, the nonclinical sample limits generalizability to clinical populations. Additionally, the cross-sectional design precluded longitudinal examination of the relation between health tracking technology and ED symptomatology. Future research is needed to investigate if individuals with a history of EDs are more likely to use health tracking technology, or if heath tracking technology triggers ED symptomatology in individuals without a prior diagnosis. Participants also did not report frequency or length of health tracking technology use, or name the specific brand used. Future research should assess frequency, duration, and brand of tracking device used to examine how these factors might influence ED symptomatology.

Findings call attention to the potential negative consequences of health tracking technology. Companies manufacturing these devices

Table 2
Means, standard errors, and bivariate test statistics between groups.

	Users *M* (SE)	Non-users *M* (SE)	*F* (*df*)	*p*	η^2
Calorie tracking					
Shape concern	3.04 (0.21)	2.70 (0.12)	2.03 (1, 472)	0.155	0.00
Weight concern	2.73 (0.21)	2.34 (0.12)	2.09 (1, 472)	0.149	0.00
Eating concern	1.47 (0.16)	1.11 (0.09)	3.96 (1, 472)	0.047	0.01
Dietary restraint	2.35 (0.18)	1.55 (0.10)	14.21 (1, 472)	<0.001	0.03
Fitness tracking					
Shape concern	3.07 (0.17)	2.67 (0.18)	2.70 (1, 472)	0.101	0.01
Weight concern	2.75 (0.17)	2.36 (0.17)	2.50 (1, 472)	0.115	0.01
Eating concern	1.25 (0.13)	1.33 (0.13)	0.24 (1, 472)	0.627	0.00
Dietary restraint	2.02 (0.15)	1.88 (0.15)	0.46 (1, 472)	0.500	0.00

Table 3
Hierarchical multiple regression predicting EDE-Q Global Score.

	B	*SE B*	β	ΔR^2	*p*
Step 1					
Gender	0.61	0.12	0.21		<0.001
Binge eating	0.09	0.01	0.35		<0.001
Purging	0.03	0.01	0.21		<0.001
Step 2				0.02	
Gender	0.55	0.12	0.19		<0.001
Binge eating	0.09	0.01	0.35		<0.001
Purging	0.03	0.01	0.20		<0.001
Fitness tracking	0.39	0.16	0.12		0.013
Calorie tracking	0.15	0.18	0.04		0.406

Note: Gender was coded as 0 = male, 1 = female. Regular fitness tracking was coded as 0 = no, 1 = yes. Regular calorie tracking was coded as 0 = no, 1 = yes. Binge eating and purging frequency in the past 28 days were assessed via the EDE-Q.

might consider encouraging individuals to use tracking technology in accordance with professional recommendations to avoid the development or potential exacerbation of ED symptomatology. Results also highlight the potential benefit of inquiring about health tracking technology use when assessing for ED behaviors. These devices appear to be associated with ED-related impairment, and it might be advantageous to target their use in treatment.

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