



Investigating engagement in maladaptive and adaptive exercise behaviors before and during COVID-19

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Abstract

Purpose Evidence suggests that the coronavirus (COVID-19) pandemic has resulted in increased mental health concerns (e.g., anxiety) and there is ample discussion of how the pandemic has resulted in increases in weight control strategies (e.g., maladaptive exercise behaviors). It remains unclear, however, if maladaptive exercise behaviors are on the rise among non-clinical samples. The objective of this study was to examine college students' engagement in exercise behaviors (both adaptive and maladaptive) before and during COVID-19.

Method This study compared reports of compulsive exercise, weight and shape exercise, and positive and healthy exercise in two separate samples recruited from a large southeastern university. Sample 1 was collected pre-COVID-19 (August 2019–February 2020) and Sample 2 was collected during COVID-19 (August 2020–April 2021). Case–control matched samples were generated for this study ($N = 144$; 52.1% male). Three separate analysis of covariance models tested the differences between (1) adaptive exercise; (2) compulsive exercise; and (3) weight and shape exercise in pre- and during COVID-19 samples, controlling for sex.

Results Individuals in the during COVID-19 sample reported significantly more compulsive exercise ($p < .001$), weight and shape exercise ($p < .001$), and adaptive exercise ($p < .001$) compared to individuals in the pre-COVID-19 sample. Effects were of medium to large sizes.

Conclusion Consistent with reports from the research literature and popular press, the current study observed that both adaptive and maladaptive exercise were higher among college students during COVID-19 compared to pre-COVID-19.

Level of evidence *Level V: Opinions of authorities, based on descriptive studies, narrative reviews, clinical experience, or reports of expert committees.*

Keywords Compulsive exercise · COVID-19 · College students

Introduction

There have been many empirical and popular press articles describing how factors related to the coronavirus (COVID-19) pandemic's effects, such as increased isolation and loneliness, disruption to daily activities, increased general levels of stress and emotional distress, are associated with changes in eating behaviors, exercise, and weight fluctuations among college students, community populations, and among individuals with eating disorders [1–4]. For example, many studies hypothesize that maladaptive exercise behaviors (e.g.,

compulsive exercise) are broadly on the rise. However, the majority of empirical research is focused on symptoms worsening among individuals with eating disorder diagnoses [5, 6]. Further, some of these studies do not distinguish adaptive and maladaptive exercise behaviors (e.g., “In the past week have you experienced any significant changes in your exercise behaviors—more so than before the COVID-19 pandemic?” [6]). The broad nature of these questions makes it difficult to determine what type of exercise (i.e., maladaptive or adaptive)—if any—was reliably on the rise during the height of COVID-19. For example, if adaptive exercise increased, this may be considered a positive outcome. However, if maladaptive exercise increased, this may indicate a need for public health intervention. The lack of specificity of the type of exercise behaviors in the current research limits understanding of overall well-being of the population.

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Maladaptive exercise is multidimensional in nature [7], underscoring the importance of investigating different types of maladaptive exercise. Notably, it is not the exercise behavior itself that defines maladaptive exercise, but rather the underlying obsessive and rigid cognitions related to exercise behaviors [8]. Compulsive exercise is defined as driven, and inflexible exercise patterns combined with the inability to reduce or stop exercise behaviors [7]. Weight and shape exercise is defined as exercising for appearance related reasons [9]. The compulsive aspect of exercise is thought to maintain engagement in the behavior (e.g., “If I haven’t been physically active, I don’t eat”), whereas weight and shape exercise reflects appearance-specific reasons for exercise (e.g., “I am physically active to become thin”). While an individual may report engaging in both types of exercise, data suggest that engagement in compulsive exercise may be more maladaptive than weight and shape exercise [10]. To that end, the current study collected data on compulsive and weight and shape exercise, as well as adaptive exercise to provide a more nuanced understanding of how rates of maladaptive and adaptive exercise compared pre- and during COVID-19.

Maladaptive exercise exists among non-eating disordered samples [11] suggesting that observing these behaviors among community samples is warranted. Research on maladaptive exercise during COVID-19 among community samples is mixed. Some studies suggest that the frequency of compulsive exercise/compensatory physical exercise did not change from before to during the COVID-19 pandemic [3, 12]. In contrast, other data suggest that the women’s engagement in driven exercise increased from 66 to 75% from before to during COVID-19 [13]. Understanding the extent to which maladaptive exercise behaviors may have changed during COVID-19 among non-clinical samples is essential for predicting future mental health needs among the general population. College students are a particularly vulnerable non-clinical population, as they are more generally at risk for the development of maladaptive exercise behaviors [14] and this risk may have been exacerbated by COVID-19’s impact on college students’ mental health [15–17].

The evidence that COVID-19 has impacted exercise behaviors broadly (both adaptive and maladaptive) also is mixed. Studies including individuals with current or previous eating disorder diagnosis report increased compulsive exercise [5, 6]. Some studies with community samples, however, report no change [3] or *less* overall exercise behaviors compared to pre-pandemic exercise [6]. Importantly, many of these studies rely on retrospective reports of participants’ pre-pandemic exercise behaviors and self-reports of their current exercise behaviors. Retrospective reports of exercise behaviors may be biased such that exercise behaviors

are overreported [18], especially when participants also are asked to report on their current exercise behavior. This methodological limitation reduces confidence in differences in reported exercise behaviors pre- and during the pandemic.

Current study

The current study examined the extent to which reports of exercise behaviors differed immediately prior to and during the height of COVID-19 in two samples of college students attending a large southeastern university. Importantly, this study compared reports of two different categories of maladaptive exercise (i.e., compulsive exercise and weight and shape exercise), as well as adaptive exercise. Given that risk factors (e.g., anxiety and disordered eating behaviors [6, 15]) associated with maladaptive exercise behaviors increased during COVID-19, we hypothesized that compulsive exercise would be higher in the COVID-19 sample compared to the pre-COVID-19 sample. Further, given that some studies suggest that disordered eating behaviors have increased among community samples [6] and that disordered eating is typically associated with weight and shape concerns [19], it was hypothesized that weight and shape exercise also would be higher in the COVID-19 sample. Given the mixed evidence related to rates of adaptive exercise during COVID-19 among community samples [3, 6], we opted not to posit a directional hypothesis and left comparison of rates of adaptive exercise pre- and during COVID-19 as an exploratory aim.

Method

Two separate studies recruited undergraduate students using convenience sampling from a large southeastern university’s online Psychology Department research pool. Eligibility criteria for both studies included being: (1) 18 years or older and (2) currently enrolled in a psychology class (to participate in the research pool). After providing informed consent, participants completed measures via an online survey and received partial course credit for study participation. Both studies were deemed exempt by the university’s Institutional Review Board, as the research was deemed of minimal risk to participants.

Participants

Sample 1 was collected pre-COVID-19 from August 2019 to February 2020. A total of 304 individuals completed the survey; 27 participants were removed for having no data and 52 participants were removed for failure of attention

checks [20]. Additionally, as the present hypotheses were specific to college-aged individuals, 19 participants were removed for age > 25. This left a final sample of 207 undergraduate students available for case–control matching.

Sample 2 was collected during COVID-19 from August 2020 to April 2021. A total of 699 individuals completed the survey; 159 participants were removed for having no data, 90 were removed for failure of attention checks [20], and 27 participants were removed for age > 25. This left a final sample of 423 individuals available for case–control matching.

Participants were case–control matched on basic demographic information including: age, sex, self-reported athlete status, race, and ethnicity. After case–control matching, 144 individuals from each sample were available for analysis. The samples were 52.1% male with 38.9% self-identifying as an athlete, and primarily non-Hispanic (79.8%; White: 73.0%; Black or African American: 8.7%; Asian: 13.0%; and Multiracial: 5.2%). Hispanic individuals primarily identified as White (96.6%) and other: 3.4%). Participants were between 18 and 24 years ($M = 19.41$, $SD = 1.40$).

Measures

Measures were collected as part of two larger studies examining disordered eating behaviors and attitudes, exercise behaviors, and identity. The survey for Study 1 included seven measures and the Study 2 survey included 13 measures. Only measures included in the present study are described below.

Demographic information

Participants self-reported, age, sex (“Please indicate your sex”: male, female), gender (“Please indicate your gender: male, female, transgender, other, prefer not to say), race (select all that apply: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, Other, Multiracial), ethnicity (“Are you Hispanic?”: yes/no), and athlete status (“Do you identify as an athlete?”: yes/no).

Exercise behaviors

The Exercise and Eating Disorder Questionnaire (EED) is an 18-item measure that assesses attitudes towards compulsive exercise [9]. Items are rated on a scale from 0 (*never*) to 5 (*always*). The current study used the compulsive (e.g., “It feels wrong if I can’t be physically active every day”; $\alpha_{\text{sample1}} = 0.73$, $\alpha_{\text{sample2}} = 0.82$), weight and shape (e.g., “I am physically active to become thin”; $\alpha_{\text{sample1}} = 0.85$, $\alpha_{\text{sample2}} = 0.87$) and positive and healthy exercise subscales (e.g., “I am physically active to be healthy”; $\alpha_{\text{sample1}} = 0.79$, $\alpha_{\text{sample2}} = 0.81$). All three subscales demonstrated acceptable

internal consistency in the current samples. The current study also calculated the global score for each sample to understand levels of severity of maladaptive exercise in each sample. The ranges for severity are as follows: global score 1.80–2.39 (low severity); global score: 2.40–3.19 (moderate severity) and global score: 3.20 (high severity) [9]. Typically, all positive statements are reverse scored on this measure; however, for ease of interpretation, items were left untransformed when computing the positive and healthy exercise subscale. Higher scores represent more exercise. Factor structure for the EED is supported in both clinical and community samples [9, 21].

Data analysis

All analyses were conducted in SPSS v26. Missing data were minimal and listwise deletion was used. All outcome variables were within the acceptable range for skewness and kurtosis. Case–control matching was used to match subsets of Samples 1 and 2 using the demographic variables: age, sex, age, ethnicity (Hispanic), all racial categories (white, American Indian, or Alaska Native, Black or African American, Asian, Native Hawaiian or Other Pacific Islander, Other, Multiracial), and athlete status with a match tolerance of 0 for all categories. Three separate analysis of covariance models were calculated with the case–control matched samples to test differences in reports of (1) positive and healthy exercise, (2) compulsive exercise, and (3) weight and shape exercise, controlling for sex. Given the multiple comparisons, a Bonferroni correction was applied providing an adjusted p value threshold of <0.017. A chi-squared likelihood ratio test was used to compare the proportion of participants in each category of maladaptive exercise severity (low, moderate, and high) across Sample 1 and Sample 2.

Results

Descriptive findings

All three types of exercise were significantly and positively correlated within both samples ($r_s = 0.20$ – 0.62 , $p_s < 0.01$; see Table 1). Sex was significantly and positively correlated with weight and shape exercise in Sample 1 and athlete status was significantly and positively correlated with compulsive and positive and healthy exercise in both Sample 1 and Sample 2.

Comparison of exercise behaviors

Sample 1 reported an average global EED score of 1.81 ($SD = 0.42$) and Sample 2 reported an average global EED score of 2.25 ($SD = 0.60$), both of which were above the

Table 1 Descriptive statistics and correlations for all study variables ($N_{\text{sample1}} = 144; N_{\text{sample2}} = 144$)

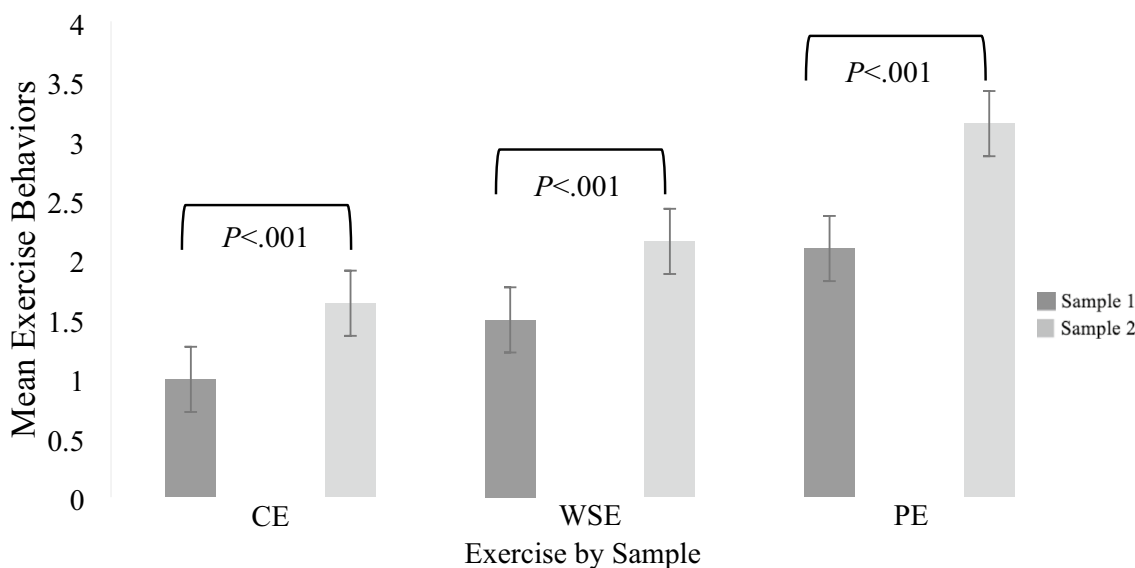
Variable	1	2	3	4	5	6
1. Compulsive exercise	–	0.62**	0.30**	0.15	– 0.002	0.19*
2. Weight and shape exercise	0.49**	–	0.28**	0.12	0.02	0.07
3. Positive and healthy exercise	0.23**	0.20*	–	– 0.13	– 0.04	0.46**
4. Sex (1 = female)	0.15	0.27**	– 0.14	–	0.007	– 0.20*
5 Age	– 0.03	0.04	– 0.15	0.007	–	– 0.05
6. Athlete status	0.17*	– 0.03	0.35**	– 0.20*	– 0.05	–
Sample 1 mean (SD)	0.99 (0.61)	1.49 (1.26)	2.09 (1.24)	52.1% Male	19.41 (1.40)	38.9% Athlete
Sample 2 mean (SD)	1.63 (0.99)	2.15 (1.49)	3.14 (1.29)	52.1% Male	19.41 (1.40)	38.9% Athlete

Sample 1 statistics are presented below the diagonal. Sample 2 statistics are presented above the diagonal

SD standard deviation

* $p < 0.05$; ** $p < 0.01$

Mean exercise behaviors by sample



Note: Sample 1 was collected pre-COVID-19. Sample 2 was collected during COVID-19. CE=Compulsive Exercise, WSE= Weight and Shape Exercise, PE= Positive and Healthy

Fig. 1 Mean exercise behaviors by sample

threshold for low severity compulsive exercise (global score 1.80–2.39). In terms of specific types of exercise, Sample 2 reported more compulsive exercise [$F(1, 285) = 44.72, p < 0.001; \eta_p^2 = 0.14$; Table 1; Fig. 1], more weight and shape exercise [$F(1, 285) = 17.18, p < 0.001; \eta_p^2 = 0.06$; Table 1; Fig. 1], and more positive and healthy exercise [$F(1, 285) = 50.61, p < 0.001; \eta_p^2 = 0.15$; Table 1; Fig. 1] than Sample 1. A partial eta squared (η_p^2) of 0.01 indicates a small effect, $\eta_p^2 = 0.06$ indicates a medium effect, and $\eta_p^2 = 0.14$ indicates a large effect [22], and observed effects

ranged from medium to large. Sex was a significant covariate for both maladaptive exercise outcomes ($ps < 0.014$).

In terms of severity of compulsive exercise, there were significant differences across the samples in the proportion of participants in each severity category of maladaptive, and the effect was moderate, $\chi^2(2, N = 288) = 36.72, p < 0.001$; Cramer’s $V = 0.33$). Sample 1 had more individuals in the mild category ($n_{\text{sample1}} = 131$ versus $n_{\text{sample2}} = 93$) and fewer in the both the moderate ($n_{\text{sample1}} = 13$ versus $n_{\text{sample2}} = 39$) and high categories ($n_{\text{sample1}} = 0$ versus $n_{\text{sample2}} = 12$).

Discussion

Research on how exercise behaviors have changed from before to during the COVID-19 pandemic demonstrates mixed findings [3, 6]. The current study extended this nascent work by investigating both maladaptive and adaptive exercise behaviors in two cohorts of college students, a population known to be at risk for the development of maladaptive exercise behaviors [14]. Data from samples collected before and during COVID-19 were compared, limiting concerns about retrospective recall bias of exercise behaviors. Consistent with hypotheses and recent data [13], rates of both adaptive and maladaptive exercise behaviors were higher in the data collected during COVID-19. Importantly, both categories of maladaptive exercise (e.g., compulsive and weight and shape) were higher in Sample 2 compared to Sample 1, indicating COVID-19 may have contributed to unhealthy exercise behaviors among college students.

While many popular press and empirical articles highlight the potential negative impact of COVID-19 on health behaviors, results of this study suggest there may also be some positive effects of the pandemic on health behaviors. For example, positive and healthy exercise had the largest net increase of any type of exercise across Sample 1 and Sample 2. This increase in both adaptive and maladaptive exercise behaviors could be related to individuals having more time in their day to engage in exercise behaviors due to work from home policies or lack of social opportunities due to social restrictions. Further, in general, exercise is thought to assist with emotion regulation [23] and the two most popular psychosocial models of maladaptive exercise (compulsive exercise [11] and exercise dependence [24]) posit that affect regulation may be the main motivation of maladaptive exercise. Given that anxiety increased over the COVID-19 pandemic [15], it may be that individuals were engaging in additional exercise (both adaptive and maladaptive) as a way to cope with negative emotions. Indeed, research suggests that COVID-19-related anxiety was more strongly related to compulsive exercise among individuals with lower intolerance of uncertainty [17]. While emotion regulation and free time may be possible reasons for why exercise behaviors increased, future research would benefit from explicitly testing motivations for exercise to help increase engagement in adaptive exercise and decrease engagement in maladaptive exercise.

One important point of consideration is that it is difficult so say that positive and healthy exercise and maladaptive exercise are unrelated. Indeed, among both samples adaptive and maladaptive exercise were significantly and positively correlated, suggesting that participants may simultaneously endorse adaptive and maladaptive

exercise. Individuals may engage in maladaptive exercise behaviors under the guise of overall health promotion. For example, individuals endorsing items on the positive and healthy exercise subscale such as “I enjoy being physically active” may still have cognitions related to compulsive exercise such as “If I haven’t been physically active, I can’t relax”. Future research should investigate psychosocial factors that may help distinguish exercise as adaptive or maladaptive.

It is also important to consider geographical effects when contextualizing results. The current data were collected at a university in a southern state that primarily remained open during the pandemic and had less stringent COVID-19 restrictions than other areas of the country (e.g., gyms were reopened Summer 2020). College students may have turned to exercise behaviors as an available activity when there were limited other options for entertainment and/or socialization. Further, environmental conditions (e.g., warmer weather) may have made engagement in outdoor physical activity behaviors increasingly accessible compared to individuals who reside in colder climates. Though many college students did not return to college campuses during the pandemic, we feel confident that participants primarily were located in Florida during Study 2. The vast majority of students attending the university where the research was conducted come from Florida, with 78% of new students admitted for the 2021–2022 academic year identifying as Florida residents [25]. Rates were similar for years prior as well (82% for 2020–2021 [25] and 83% for 2019–2020 [25]). It will be important to compare differences in exercise behaviors among college students from different geographic areas from before and during the COVID-19 pandemic.

Importantly, among individuals in both samples, the average EED global score ($M_{sample1} = 1.81$, $M_{sample2} = 2.25$) was above the threshold for compulsive exercise suggested by Danielsen et al. [9] and approximately 8% of participants in Sample 2 met criteria for very severe compulsive exercise. This suggests that college students were engaging in more severe levels of maladaptive exercise behaviors during compared to before the COVID-19 pandemic. Compulsive exercise is associated with a variety of problematic physical (e.g., stress fractures [24]) and mental health outcomes among college students (e.g., increased negative mood [26]). Yet, there are no current preventative interventions to address compulsive exercise. Programs to prevent and/or reduce compulsive exercise among college students clearly are needed and future work should focus on developing new or adaptive existing health risk behavior preventative interventions to target college students’ maladaptive exercise.

Last, it may be that the increase in social media engagement at the beginning of the pandemic [27] affected engagement in both adaptive and maladaptive exercise behaviors. Engaging with “fitspiration” on social media is associated

with compulsive exercise behaviors and body image concerns [28]. Increased social media use may have included increased engagement with fitspiration content, which may have contributed to engagement in both adaptive and maladaptive exercise. For example, individuals and groups creating fitness content on YouTube reported seeing significant spikes in number of subscribers and views during the pandemic [29]. It is impossible to discern, however, if the new users were engaging with this content in adaptive or maladaptive ways. As noted above, although adaptive and maladaptive exercise are theorized to be distinct, it may be that they are empirically similar. Nonetheless, future research should investigate how social media use may contribute to different types of exercise (adaptive and maladaptive) to better understand what may place someone at greater risk for engaging in maladaptive exercise behaviors.

Strengths and limitations

To our knowledge, this is the first study to observe exercise behaviors in two separate samples to assess differences in these behaviors pre-compared to during the COVID-19 pandemic. The two samples were case–control matched, limiting variation in demographic characteristics and included approximately 50% male participants. Nonetheless, there are limitations to consider. This study can only draw conclusions related to differences in mean levels of exercise behaviors across two separate cross-sectional data collections (pre and during COVID-19). Second, there are limited measures that overlap across the two studies, reducing our ability to compare the samples on other important mental health constructs (e.g., anxiety, depression, etc.). Third, measurement of compulsive exercise was self-reported and did not include assessments of frequency of exercise behaviors. Future research should link objective assessments of exercise (e.g., Fitbit, Apple Watch, etc.) with self-reported cognitions and motivations related to both maladaptive and adaptive exercise. Last, given variability in COVID-19 restriction by geographic location, the current findings may not generalize to college students in other locations across the USA and internationally.

What is already known on this subject?

Currently, many popular press articles and peer-reviewed research suggests that maladaptive weight control behaviors are on the rise. However, research specifically related to how COVID-19 has impacted exercise behavior is mixed [3, 6]. Further, no research has examined how COVID-19 may have impacted both adaptive and maladaptive exercise among college students.

What this study adds?

The current study supports and extends research and popular press articles discussing increases in maladaptive exercise during COVID-19. In line with hypotheses, maladaptive was higher among college students during COVID-19 as compared to pre-COVID-19, with rates of high severity compulsive exercise rising from 0% pre-COVID-19 to 8% during the pandemic. Notably, college students' adaptive exercise also was higher during COVID-19 compared to pre-pandemic. Given higher rates and severity of maladaptive exercise, there is a clear need for preventative interventions of maladaptive exercise among this college students.

Funding Not applicable.

Data availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Code availability Not applicable.

Declarations

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

Ethics approval The study was approved by the institutional review board of the University of South Florida and was in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. This article does not contain any studies with animals.

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

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