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Changes in College Students' Body Mass Index, Physical Activity, and Motivation Before and During the COVID-19 Third-wave Lockdown

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ABSTRACT

Background: It is less known how the constraints placed upon public spaces and social interaction have impacted college students' motivation to be physically active. **Objective:** This study examined, first, the changes in college students' body mass index (BMI), physical activity (PA), and self-determined motivation before and during the COVID-19 third-wave lockdown and, second, the role of moderate-to-vigorous PA (MVPA) and self-determined motivation on BMI during the lockdown. **Method:** This study was a longitudinal prospective study with two data collection phases. A sample of 104 college students (69 females, 35 males, M_{age} = 18.19[1.5]) completing both pre- and posttest data turned in self-report data on BMI, PA (vigorous PA - VPA, moderate PA - MPA), MVPA, and self-determined motivation. **Results:** The results showed a statistically significant increase in participants' BMI (t[79] = 4.70[2.98], p =.001, d =.11) but no statistically significant changes in PA. The findings demonstrated changes in college students' integrated regulation (↓; t[78]= -3.20[.16], p =.002, d =.35), identified regulation (↓; t[76] = -4.07[.16], p <.001, d =.52), extrinsic regulation (↑; t[78] = 2.28[1.80], p =.025, d =.02), and amotivation (↑; t[78] = 4.42[1.21], p <.001, d =.48). Finally, neither PA nor self-determined motivation played a role in BMI, but the previous MVPA and BMI did. **Conclusion:** This study suggests that COVID-19 had a negative impact on self-determined motivation decreasing adaptive and increasing maladaptive motivation. However, neither MVPA nor self-determined motivation played a role in BMI during the COVID-19 lockdown. Instead, pre-COVID BMI (large effect) and MVPA (small effect) determined students' BMI during the lockdown.

Key words: Obesity, Motivation, Young Adult, Body Weight, COVID-19

INTRODUCTION

Obesity is a chronic public health problem associated with elevated risks of chronic diseases, e.g., type 2 diabetes mellitus, metabolic syndrome, and cardiovascular diseases (Cardel, Atkinson, Taveras, Holm, & Kelly, 2020; Rankin et al., 2016; Styne et al., 2017). Regular physical activity (PA) is an important factor in prohibiting unwanted weight gain and unhealthy obesity (Donnelly et al., 2009). Research has shown that college years can have a negative effect on young adults' health behaviors, e.g., declining levels of regular PA and unhealthy weight gain (Kwan et al., 2008; Wengreen & Moncur, 2009). The national PA recommendations advise young adults to engage in 150-300 minutes of moderate-to-vigorous intensity PA (MVPA), 75-150 minutes of vigorous intensity PA (VPA), or an equivalent combination of MVPA/VPA weekly (Piercy et al., 2018). Although evidence indicates that more than 50% of college students fail to meet the PA recommendation and nearly 18% of college students move from normal weight to overweight/obesity during college (Keating, Guan, Piñero, & Bridges, 2005; Pope, Hansen, & Harvey, 2017), very little is known how COVID-19 pandemic has impacted college students' lives. Thus, the aim of this study was to examine the changes in college students' body mass index (BMI), PA, and self-determined motivation before and during the COVID-19 third-wave lockdown (Looi, 2020). The second aim of this study was to examine the role of MVPA and self-determined motivation on students' BMI during the lockdown.

Although there are multiple determinants impacting college students' PA behaviors and body composition, the conceptual framework for the role of motivation in this process was centered around the self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2017). SDT is a prominent social-cognitive theory to understand human motivation and comprehend adoption, adherence, and maintenance of PA behaviors (Deci & Ryan, 2000). SDT posits that individuals' motivation regulating behaviors can vary based on individuals' perception of the locus of control, which is argued to range from internal to external (Deci & Ryan, 2000). Intrinsic motivation (i.e., individuals' behavior is due to personal growth and enjoyment) together with internalized forms of extrinsic motivation e.g., integrated regulation

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(i.e., behavior consistent with one's sense of self and identity) and identified regulation (i.e., behavior due to personally important and valued goals) are regarded as self-determined and adaptive forms of motivation. On the other hand, introjected regulation (i.e., behavior is driven by the desire to avoid guilt and shame), external regulation (i.e., behaviors are due to external reasons such as rewards, or avoiding of punishment), and amotivation (i.e., a lack of motivation) are regarded as non-determined, maladaptive forms of motivation (Deci & Ryan, 2000). In this study, we conceptualize self-determined motivation to relate positively to PA, whereas the relationship between non-self-determined motivation and PA was assumed to be inverse.

Research has shown that the degree of self-determined motivation is positively associated with PA behaviors, including PA intensity (Teixeira, Carraça, Markland, Silva, & Ryan, 2012), participation (Maltby & Day, 2001), and maintenance (Sibley, Hancock, & Bergman, 2013), as well as with enjoyment (Manninen, Deng, Hwang, Waller, Yli-Piipari, 2020 healthy eating behaviors (Pelletier & Dion, 2007), and weight loss (Teixeira et al., 2006). In particular, intrinsic motivation and identified regulation have been shown to be powerful predictors of a long-term exercise adherence (Fortier, Sweet, O'Sullivan, & Williams, 2007). In contrast, non-self-determined motivation has been found to be associated with poor PA adherence (Silva et al., 2011), with amotivation negatively associated with PA (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). Finally, PA and BMI have been shown to have a reciprocal relationship, with high BMI contributing to low levels of PA and a lack of regular PA contributing to a high BMI (Fogelholm & Kukkonen-Harjula, 2000).

Numerous studies have evidenced that PA declines during the transition from adolescence to young adulthood (Bray & Born, 2004; Corder et al., 2019), and this declining trend has shown to continue across college years (Huang et al., 2003). This decrease in PA has been shown to be negatively associated with unwanted weight gain (Jakicic et al., 2019). Research has found that college students' weight gain is from 3.0 to 4.4 kg across four years of college (Pope, Hansen, & Havery, 2017), with males gaining weight more than females (Irwin, 2004). It is noteworthy that we could not identify any reported studies examining the changes in motivational regulations in the college population. However, previous research has suggested that there may be gender differences in exercise motives, with males being motivated by intrinsic factors (e.g., strength, competition, and challenge), whereas females' motives have shown to be more extrinsic (e.g., weight management and appearance; Egli, Bland, Melton, & Czech, 2011).

The unpredictable changes initiated by the COVID-19 pandemic have greatly impacted university students' lives. Physical distancing, a lack of social interaction, online classes, and many, if not all, college services (e.g., recreation and fitness centers, outdoor parks) temporarily closed have reduced and limited students' PA opportunities. Research has shown that COVID-19 pandemic has had a negative effect on people's PA and dietary behaviors, including declining levels of PA, increased sedentary behaviors, and consumption of unhealthy foods (Ammar et al., 2020). Overwhelming evidence derived from the recent systematic review suggests that students' PA levels declined during the COVID-19 lockdown (López-Valenciano, Suárez-Iglesias, Sanchez-Lastra, & Ayá, 2020). In addition, Barkley et al. (2020) have found that only highly physically active students' PA declined, while some other less physically active students increased their PA participation (Barkley et al., 2020). Interestingly, another study suggested Spanish college students' PA and sedentary time to increase during the pandemic (Romero-Blanco et al., 2020). In our review, we were able to identify only one study reporting COVID-19 related changes in college students' BMI (Keel et al., 2020). The study by Keel et al. (2020) showed no significant changes in weight or BMI among American college students. To date, there are no studies examining the changes in college students' self-determined PA motivation during the lockdown. Information about pandemic related changes in college students' self-determined motivation is potentially important as very little is known about how the constraints placed upon public spaces and social interaction have impacted college students' motivation to be physically active.

Despite the emerging body of literature examining the potential impact of the COVID-19 on college students' PA behaviors, the impact of COVID-19 lockdown on students' BMI and self-determined motivation warrant further examination. Therefore, the primary aim of this study was to examine the changes (before and during the social lockdown) in college students' BMI, PA, and self-determined motivation. Secondly, this study aimed to examine the role of MVPA and self-determined motivation on BMI during the third-wave lockdown. We hypothesized that, first, college students' BMI would increase during the lockdown. Secondly, we hypothesized that college students' VPA, MVPA, and self-determined motivation would decline during the lockdown. Finally, we hypothesized that MVPA together with pre-COVID BMI, self-determination motivation and MVPA would play a part in predicting college students' BMI during the lockdown.

METHODS

Research Design and Participants

This study was a longitudinal prospective study with two data collection phases. A sample of 118 college students (76 females, 42 males, M_{age} = 18.14[.96]) were recruited using the registrar's emailing list of a public university located in the Southeastern US, with 104 participants (69 females, 35 males, M_{age} =18.19[1.5]) turning in both pre- (T1; December, 2019) and posttest data (T2; December, 2020). First-year, 18-to 24-year-old college students were eligible to participate in this study. Pregnant students or students with a health condition preventing MVPA were excluded. The Institutional Review Board permission and participant consent were collected prior to the study.

Measurements

Physical activity

Participants' total weekly minutes spent in VPA, MPA, and MVPA were calculated using the short version of the International PA Questionnaire (IPAQ; Hagströmer, Oja, & Sjöström, 2006). VPA referred to weekly minutes spent in at least 10-minute bouts of physical activities that took hard physical effort and made participants breathe much harder than normal. MPA, on the other hand, referred to the activities that take moderate physical effort and make participants breathe somewhat harder than normal. The unit for MVPA was weekly minutes engaged in at least 10 min bouts of VPA and/or MPA. The IPAQ has been shown to have an acceptable validity and reliability (Craig et al., 2003).

Body mass index

BMI was calculated using a standard formula of the BMI = weight (kg)/height $(m)^2$. Participants were asked to self-report their height and weight. In addition, a sub-sample of 17 students visited the laboratory, and their height and weight were measured by a trained member of the research team during the T1/T2 data collection. The correlations between the self-reported and measured height/weight were .97-.99, and the *t*-tests on the outcome measures between the participants who provided self-report measures and participants who had both self-and researcher-measured assessments indicated appropriate data equivalence (2-tailed *t* values ranged 2.89 to .41). All this demonstrated good criterion validity for the self-reported BMI values.

Self-determined exercise motivation

Participants' self-determined exercise motivation was measured using Behavioral Regulation in Exercise Questionnaire-3 (Markland & Tobin, 2004). The scale included 24 items with four items per each dimension of intrinsic motivation, integrated, identified, introjected, extrinsic regulation, and amotivation. The stem ("Why do you exercise?") was introduced, and participants responded to each item on a 5-point Likert scale ranging from 1 (not true for me) to 5 (very true for me). The questionnaire has been shown to have good validity and reliability (Vlachopoulos, Kaperoni, & Moustaka, 2004).

Moderators

Moderating variables of gender, ethnicity, and age were measured using a background questionnaire. Age was a continuous variable, whereas ethnicity and gender were categorical variables.

Procedures

T1 data were collected during the week before the university's final exam week in December, 2019 and the T2 data exactly one year later in December, 2020. Participants responded to the online questionnaires through Qualtrics, an online survey platform.

Power Analysis

Sample size calculations for the paired samples *t* tests and hierarchical linear regression analysis (fixed model with R^2 increase) were performed using a G*Power 3.1.9.7 with a conservative effect size of .38, significance level of .05 and a desired power of 80% resulting in the sample size recommendation of 45 participants for the *t* tests and 71 participants for the hierarchical linear regression analysis (total 12 predictors and 7 tested predictors, e.g., intrinsic motivation, integrated regulation, identified regulation, introjected regulation, extrinsic regulation, amotivation, and MVPA). Effect size index for *t* test was μ-μ_0/σ, in which μ = population mean, μ_0 = specific value, σ = SD. For the regression analysis, the general definition of the effect size index f_2 is VS/VE, where VS is the proportion of variance explained by a set of predictors, and VE the residual or error variance (VE + VS = 1). In the special case of hierarchical linear regression, the proportion of variance explained is given by VS = $R^2_{Y\cdot B}$ and the residual variance by VE = 1 − $R^2_{Y\cdot B}$ (G*Power, 2021).

Statistical Analyses

Preliminary analyses included calculating descriptive statistics, e.g., means, standard deviations, and data normality for the outcome variables. Paired sample *t* tests were performed to analyze changes in college students' PA, BMI, and motivational regulations before (T1) and during the third-wave lockdown (T2). Stepwise hierarchical linear regression analysis was conducted to identify the role of MVPA and self-determined motivation on BMI. First, the T1 (BMI and MVPA) and moderator variables were controlled in the analysis (e.g., age, gender, ethnicity). Second, self-determined motivation (Step 2) and MVPA (Step 3) were added to the model. Each of the adjusted R^2s presents the predicted strength of the subsequent step, with the total adjusted R^2s presenting the total predictive strength of the empirical model. All statistical analysis was formed using SPSS 25.0 software.

RESULTS

Table 1 reports the descriptive statistics of the study variables. Internal consistency scores were as follows: intrinsic motivation .93/.91, integrated regulations .86/.82, identified regulation .86/.78, introjected regulation .85/.75, extrinsic regulation .83/.83, and amotivation .80/.87, T1 and T2, respectively. Analyses showed 9.1/9.1%, 67.3/56.8%, 17.2/25%, and 6.4/9.1% of the sample to be underweight, normal weight, overweight, and obese, respectively (T1/T2).

To examine the changes in freshman college students' VPA, MPA, MVPA, BMI, and motivational regulations across pandemic, we conducted a series of paired sample *t*-test analysis. The results showed a statistically significant increase in BMI (M_{T1} = 22.73[4.00]kg/m^2;M_{T2}=24.30[4.43]kg/m^2;t[79]=4.70[2.98], p = .001, d = .11), but no statistically significant changes in VPA (M_{T1} = 54.84[91.53] min/w; M_{T2} = 54.77[82.21] min/week; t[63] = -.01[13.08], p = .995), MPA (M_{T1} =

Table 1. Descriptive statistics of the study variables

Descriptive Statistics	*N*	Min	Max	*M*	*SD*	Skewness	*SE*	Kurtosis	*SE*
BMI T1	110	16.04	33.90	23.05	3.81	0.72	0.23	0.50	0.46
BMI T2	88	16.18	36.49	24.47	4.42	0.46	0.28	-0.13	0.51
VPA T1 (min/w)	105	0	600.0	81.71	121.41	1.86	0.24	3.46	0.47
VPA T2 (min/w)	71	0	360	60.99	89.08	1.84	0.29	3.46	0.57
MPA T1 (min/w)	104	0	840	138.98	159.46	2.00	0.24	4.99	0.47
MPA T2 (min/w)	77	0	900	127.90	169.91	2.28	0.27	6.24	0.54
MVPA T1 (min/w)	105	0	1005	219.75	208.66	1.59	0.24	2.89	0.47
MVPA T2 (min/w)	71	0	990	190.81	195.30	1.73	0.29	2.95	0.56
Intrinsic Motivation T1	107	1	7	4.96	1.51	-0.74	0.23	-0.13	0.46
Intrinsic Motivation T2	87	1	7	4.59	1.61	-0.35	0.26	-0.63	0.51
Integrated Motivation T1	107	1	7	4.72	1.41	-0.29	0.23	-0.40	0.46
Integrated Motivation T2	88	1	7	4.19	1.58	0.04	0.26	-0.84	0.51
Identified Motivation T1	105	2	7	5.80	0.95	-1.00	0.24	1.70	0.47
Identified Motivation T2	88	1	7	5.10	1.63	-0.78	0.26	-0.34	0.51
Introjected Motivation T1	107	1	7	4.51	1.73	-0.45	0.24	-0.64	0.47
Introjected Motivation T2	88	1	7	4.63	1.58	-0.42	0.26	-0.48	0.51
Extrinsic Motivation T1	107	1	7	3.20	1.33	0.32	0.23	-0.40	0.46
Extrinsic Motivation T2	88	1	6.5	3.45	1.58	0.11	0.26	-1.06	0.51
Amotivation Motivation T1	107	1	4.67	2.02	0.82	0.96	0.23	0.79	0.46
Amotivation Motivation T2	88	1	6	2.48	0.82	0.73	0.26	0.48	0.51
Moderators									
Age	118	17	24	18.09	0.63	7.34	0.22	68.42	0.44
Gender	118	1	3	na	na	na	na	na	na
Ethnicity	118	1	7	na	na	na	na	na	na

165.00[155.89]; M_{T2} = 125.41[174.65]; *t*[68] = 1.84[21.48], *p* =.07), or MVPA (M_{T1} = 218.20[193.22]; M_{T2} = 188.95[197.30]; *t*[67] = -1.21[24.18], *p* = .231).

On the motivational regulations, the results showed a statistically significant decline in integrated regulation (M_{T1} = 4.55[1.42]; M_{T2} = 4.03[1.55]; *t*[78]= -3.20[.16], *p* = .002, *d* = .35) and identified regulation (M_{T1} = 5.68[.97]; M_{T2} = 4.03[1.55]; *t*[76] = -4.07[.16], *p* <.001, *d* = .52). In addition, our analyses showed statistically significant increase in extrinsic regulation (M_{T1} = 3.11[1.36]; M_{T2} = 3.58[1.53]; *t*[78] = 2.28[1.80], *p* = .025, *d* = .02) and amotivation (M_{T1} = 1.98[.83]; M_{T2} = 2.59[1.32]; *t*[78] = 4.42[1.21], *p* <= .001, *d* =.48), but no statistically significant changes in intrinsic motivation (M_{T1} = 4.73[1.53]; M_{T2} = 4.41[1.57]; *t*[77] = 1.75[1.63], *p* = .085) or introjected regulation (M_{T1} = 4.52[1.65]; M_{T2} = 4.54[1.53]; *t*[78] = .14[1.60], *p* = .888).

To examine the role of motivational regulations and PA on BMI, our model illustrated in Table 2 explained 92.2% of the variance in college students' T2 BMI. The predictive strength on the STEP 1 was .76, with T1 BMI (β = .64, *p* < .001) and MVPA (β = -2.30, *p* = .030) being only statistically significant predictors. Step 2, i.e., motivational regulation variables, added 15.2 percent to the explanatory strength of the model, with identified regulation (β = -.44, *p* < .001) being the only statistically significant predictor of BMI. Finally, T2 MVPA (Step 3) did not predict BMI in T2.

DISCUSSION

The purpose of this study was to gather evidence about the changes in college students' BMI, PA, and motivation during COVID-19 lockdown and increase our understanding on the role of PA and self-determined motivation in the third-wave lockdown. The results of our study identified a significant increase in college students' BMI, but no changes in VPA, MPA, or MVPA. In addition, self-determined motivation did not play a role in BMI, but the pre-COVID MVPA and BMI did. The findings of this study provide a depth understanding of the roles of college students' motivation and PA behaviors on healthy body composition.

The results from our study showed that almost 24% of the college students in the sample were either overweight or obese. This suggests that overweight and obesity is less prevalent in our sample compared to the findings in the National College Health Risk Behavior Survey (overweight/obesity 46%; Lowry et al., 2000; 41%; Pope, Hansen, & Harvey, 2017). The subsequent BMI T2 values 12-months later, during the lockdown, were 25% (overweight) and 9.2% (obesity). In addition, our study showed that students experienced modest weight gain from the pre-COVID levels to the third-wave lockdown levels. These results are inconsistent with the previous findings of Keel et al. (2020) that have shown no changes in college students' weight or BMI during lockdown. It is notable that Keel et al. (2020) study

Table 2. Summary of hierarchical linear regression analyses predicting body composition

Variable	BMI T2				
	B	***B SE***	**β**	***F***	***p* value**
Adjusted R^2 Total 0.922					
Adjusted R^2 STEP 3 0.010					
STEP 3 – MVPA					
MVPA	-0.85	0.00	-0.08	-1.43	0.20
Adjusted R^2 STEP 2 0.152					
STEP 2 – Motivational Regulations					
Intrinsic Motivation	-0.12	0.42	-0.04	-0.29	0.77
Integrated Regulation	-0.30	0.44	-0.10	-0.69	0.49
Identified Regulation	-1.23	0.36	-0.44	-3.46	**< 0.01**
Introjected Regulation	0.02	0.22	0.00	0.07	0.94
Extrinsic Regulation	0.40	0.33	0.01	0.12	0.90
Amotivation	0.57	0.39	0.20	1.48	0.14
Adjusted R^2 for Moderators 0.760					
STEP 1 - Moderators					
Gender	-90	0.53	-0.10	-1.70	0.10
Ethnicity	-0.05	0.19	-0.02	-0.26	0.80
Age	0.90	0.79	0.07	1.13	0.26
BMI T1	0.71	0.07	0.64	9.8	**< 0.01**
MVPA T1	-0.00	0.00	-0.18	-2.30	**0.03**

Values at the $p<0.05$ significance level are bolded;
B=unstandardized regression coefficient; β = standardized regression coefficient

tracked college students only for three months from January to April, 2020, while our study followed students for a year from December 2019 to 2020. It maybe that three months is too short of a timeframe to detect changes in BMI accurately. In addition, our study indicates that the increasing of BMI may be due to other factors, such as dietary behaviors and sedentary behaviors changes, but not due to a lack of PA, as our sample reported identical PA in both pre- and during-COVID stages. The lack of changes in MPA, VPA, or MVPA were against our hypotheses and thus unexpected considering a plethora of studies that have shown PA to decline during COVID-19 (Barkley et al., 2020). It may be that the effects of pandemic vary a lot based on the location and the severity and compliance of social lockdowns guidelines. This study took place in the Southeastern region of the United States with less rigorous social restrictions compared to the states such as California and New York.

In addition, the findings of this study showed a statistically significant decline in college students' integrated and identified regulation (i.e., self-determined forms of motivation) and an increase in extrinsic regulation and amotivation. The findings largely supported our hypothesis suggesting that students' self-determined motivation would decline from T1 to T2. Specifically, these negative changes in integrated and identified regulation suggest that PA-restricted environments, e.g., lockdown, can be detrimental to college students, undermining the value of PA in their everyday lives. It is noteworthy that our study did not show changes in college students' intrinsic motivation, i.e., motivation to participate in PA due to enjoyment, stimulation, and other intrinsic reason such as personal growth. This finding suggests that individuals who have fully internalized PA motives, seem to maintain their PA motivation during unprecedented times, e.g., pandemic. In addition, our study showed that non-self-determined, i.e., maladaptive PA motivation, actually increased from T1 to T2, corroborating the negative impact of COVID-19 lockdowns on PA motivation. Future research and practical efforts should be offered to college students to find alternative methods to motivate them to be physically active. Maybe offering exergaming, i.e., active videogaming, opportunities to be physically active at home during future lockdowns. Young adults have previously perceived exergaming as a very motivational form of exercise (Hwang et al., 2022).

To examine the role of MVPA and motivation on BMI during a lockdown, our analyses showed that our model explained ~92.2 % of college students' BMI during a lockdown. This finding corroborates the findings on the modest BMI changes across college students' first semester (Deng, Hwang, Campbell, McCullick, & Yli-Piipari, 2021). However, the moderator variables such as age, ethnicity, or gender did not moderate the changes. Our analyses showed that a great portion on the explanatory strength of our model was due to previous BMI and MVPA. This suggests that BMI is a rather stable construct and does not vary much. The same stability is evident in MVPA and BMI relationship. Interestingly, these findings showed that motivation had a role in lockdown BMI as 15.2 percent of the explanatory strength of the model was contributed by motivational regulations, with identified regulation being the statistically significant predictor of BMI. Previously, integrated regulation has been shown to be a stronger predictor of short-term exercise adherence compared to intrinsic motivation (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). The role of intrinsic motivation has been shown to be more important when predicting long-term PA adherence (Teixeira et al., 2012). To our knowledge, no previous studies have examined a direct relationship between motivational regulations in PA and BMI, as this relationship is not direct but mediated by actual PA behavior.

There are several strengths associated with our study. This is one of the first studies providing information about the role of COVID-19 in health behaviors among college students. Further efforts should be directed to facilitate college students' PA motivation and MVPA participation. In addition, there is a lack of research explaining how lockdown impacts college students' PA motivation. This study showed that lockdown restrictions may initiate negative changes in college students' self-determined motivation. Lastly, although this study focused on COVID-19 lockdown, the implications of our finding extend beyond this context to the further crises that could contribute college students' PA participation.

The following limitation should be considered when interpreting the findings of this study. First, this study was a cohort panel study with the data collected from one large public university located in the Southeastern United States. Thus, these study findings have limited external validity. Secondly, we did not collect data on COVID-19 infection exposure, the factor that could have influenced our findings. Thirdly, height and weight of the participants were obtained using self-report, which may have under- or over-estimate BMI. However, research has shown self-report height and weight measurement to have an excellent validity when measured against researcher obtained measurements (Quick et al., 2015).

CONCLUSION

Overall, the finding of this study supports a significant increase in BMI, however, no significant changes in MPA or VPA before and during the COVID-19 pandemic lockdown. There is a significant negative change in PA motivation, with integrated and identified regulation declining and extrinsic regulation and amotivation increasing. Neither MVPA nor self-determined motivation played a role in BMI during the COVID-19 lockdown. Instead, pre-COVID MVPA and BMI determined students' BMI during the lockdown. These findings highlight a need to promote college students PA participation and motivation during lockdowns. One option for positive PA promotion and participation is exergaming which has been shown to be an enjoyable and motivational PA for young adults.

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