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Physical Activity and Psychological Well-being in Gym Exercisers During COVID-19 Lockdowns

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Abstract: The present study investigated the impact of COVID-19 lockdown restrictions on physical activity (PA) levels, gender differences in activity, and the relationship between PA, well-being, and mood among gym exercisers. A cohort of 366 gym exercisers (126 males, 240 females) aged 15 to 59 years (M_{age} = 34.63 ± 9.27) willingly participated in this study. Data were collected using the International Physical Activity Questionnaire - Short Form (IPAQ-SF) for PA and sedentary behavior, the Short Diet Behavior Questionnaire for Lockdowns (SDBQ-L) for healthy eating, the 4-Dimensional Mood Scale (4DMS) for mood, the 7-item Generalized Anxiety Disorder scale (GAD-7) for anxiety, and the WHO-5 Well-Being Index for mental well-being. Additionally, participants' attitudes and intentions toward exercise and returning to fitness centers were assessed. The findings revealed that moderate-to-vigorous PA (MVPA) and healthy eating behaviors significantly predicted participants' well-being and positive energy. Conversely, sedentariness along with healthy eating behaviors were significant predictors of negative arousal. Males reported higher levels of MVPA and intention to be physically active compared to females. Younger participants showed higher VPA, depression, and anxiety, and lower BMI compared to older participants. The findings underscore the importance of maintaining regular PA, particularly at moderate or vigorous intensities, and healthy eating habits for mental well-being during public health crises. These insights hold considerable value for shaping future policies and intervention strategies aimed at mitigating the detrimental consequences of prolonged physical inactivity.

Keywords: COVID-19 lockdown, Gym exercisers, Physical activity, Dietary habits, Well-being, Mental health

1. Introduction

In March 2020, the global community was confronted with the outbreak of the Coronavirus disease 2019 (COVID-19), a major virus outbreak. The World Health Organization (WHO) classified this phenomenon as a pandemic (WHO, 2020), and different countries reacted in various ways from placing the entire country on lockdown to suspending medical schools (Mahase, 2020). The global pandemic brought about numerous challenges on a societal, financial, psychological, and health basis for the entire world population (Nicola *et al.,* 2020; Xiong *et al.,* 2020). To mitigate this large-scale infectious threat, most government's implemented lockdowns, including "social distancing" measures, with the primary objective of reducing the spread of the virus. These measures varied from isolating citizens in their homes to restricting access to other social gathering places (Sandford, 2020), including gyms, fitness centres, and facilities for physical exercise (Honey-Roses *et al.,* 2020). Consequently, individuals' PA levels experienced a major decline during periods of lockdown, leading them to engage in more sedentary leisure activities, resulting in increased screen use and sedentary behavior (Stockwell *et al.,* 2021). This reduction in physical engagement had a detrimental effect on individuals' holistic health and overall well-being (Wilke *et al.,* 2022), elevating the risk of mental health challenges, including but not limited to symptoms of depression, anxiety disorders, and stress-related problems (Choi *et al.,* 2020; Jurak *et al.,* 2020; Ricci *et al.,* 2020).

Several systematic reviews and meta-analyses have examined the relationship between PA, emotional well-being, and mood during the COVID-19 pandemic

(Marconcin *et al.*, 2022; Meyer *et al.*, 2020; Wilke *et al.*, 2022; Wolf *et al.*, 2021), suggesting that consistent PA during the pandemic is associated with favorable mental health outcomes. These outcomes include improved well-being and a reduction in symptoms of depression and anxiety (Wang *et al.*, 2023). Concerning the investigation of the psychological impact of the PA levels on the negative outcomes of social isolation, Violant-Holz *et al.* (2020) confirmed a general decline in PA levels during the pandemic, concluding that COVID-19 is associated with tremendous alterations in lifestyle behaviors and suggested that regular PA is associated with improved psychological well-being, including a reduction in negative emotions. Similarly, Marconcin *et al.* (2022) advocated PA as a sustainable method for alleviating the adverse psychological impacts of COVID-19. The optimal type and amount of physical activity to obtain those benefits to their full extent remains unclear (Carriedo *et al.*, 2020; Stockwell *et al.*, 2021). However, Wolf *et al.* (2021) concluded that individuals who engaged in regular PA, particularly at moderate-to-vigorous intensity, reported lower symptoms of depression and anxiety. Similarly, in Italy, Maugeri *et al.* (2020) reported that individuals who stopped engaging in moderate and vigorous physical activity (MVPA) experienced an intensification of depressive symptoms, confirming the findings of relevant literature. Additionally, the authors suggested that engaging in at least 30 minutes of MVPA per day, including activities such as aerobic exercises or strength training, was most beneficial in counteracting lockdown-related stress and depression. Ai *et al.* (2021) advocated that maintaining physical activity levels even during lockdown is feasible, arguing in favor of supervised exercise, as it shows that it keeps exercisers more motivated. Similarly, Moreira–Neto *et al.* (2021), confirmed these findings arguing that supervised exercise practice, could positively affect individuals' stress levels.

Concerning the age of the exercisers, Lee *et al.* (2022) conducted a study among elderly citizens in Singapore and investigated the psychological and economic effects as well as the prevailing levels of PA within this age group. Results indicated declined PA levels during the pandemic, and although the participants did not develop symptoms of depression, there was a significant increase in feelings of loneliness. Schuch *et al.* (2020) conducted their study among stay-at-home Brazilian adults during two distinct quarantine periods. Their research revealed that participants who sustained their exercise routines, reporting ≥30 min in MVPA daily, were less likely to exhibit symptoms of depression and anxiety, compared to those who led a sedentary lifestyle.

According to the official reports from the World Health Organization (WHO) in 2021, a substantial segment of Greek population, did not meet recommended PA levels, a situation potentially worsened by pandemic-related restrictions. Relevant studies found that during lockdown, sedentary behavior increased dramatically, with men and the highly physically active population being significantly more affected (Bourdas & Zacharakis, 2020). Morres *et al.*, 2021, not only corroborated the dramatic increase in physical inactivity but also highlighted the relationship between PA and well-being. The COVID-19 pandemic has exerted a profound influence on the connection between PA and well-being, especially for individuals who typically engage in indoor forms of exercise, with some populations even facing unequal access to indoor and outdoor leisure facilities (Tao *et al.*, 2022). This relationship has been examined in various studies, which have collectively illuminated the various ways in which pandemic-related restrictions and lifestyle modifications have influenced both the physical and psychological dimensions of well-being (Marconcin *et al.*, 2022; Tao et al., 2022; Wang et al., 2023). For example, Petersen *et al.* (2021) highlighted these alterations in their study, since participants stated that they replaced the activities they usually performed in gyms and recreational facilities with alternative activities, while others, especially those who had an inactive lifestyle before the pandemic, indicated a difficulty to overcome these challenges. It is interesting that former gym goers declared a reluctance to return to fitness and recreation facilities, despite their opening, expressing a desire for physical distancing measures and a preference for their newly established outdoor exercise routines. Yon *et al.* (2022) investigated college students' perceptions of physical activity during the pandemic. Findings indicated a significant increase in "intuitive exercise", as students trusted their body's signals more and tried a wider range of activities, reporting a positive relationship with exercise and higher levels of activity. In contrast, students who mainly exercised to release their stress, reported a less positive relationship with exercise and lower levels of activity. Authors indicated that the increased reliance on instinctive movement provided an opportunity for individuals to reconnect with their bodies and their unique preferences in terms of exercise.

In general, both males and females reported a marked decrease in overall movement, which, in many

cases, fell below the recommended levels set by the World Health Organization (WHO, 2020). Schöttl *et al.* (2022) conducted a longitudinal study into PA patterns during and after COVID-19 stay-at-home individuals in the Austrian, German, and Italian Alps. Their findings revealed a significant decline in PA levels during the lockdown phases, with partial recovery post-restrictions. However, gender differences were observed, as females reported a more pronounced decrease in PA engagement compared to males. Conversely, Jungwirth *et al.* (2021) documented an increase in outdoor activities among female participants, but a decline in life satisfaction, particularly among those whose previously active lifestyles had been disrupted. Orlandi *et al.* (2021) investigated gender differences in the impact of COVID-19 lockdowns on PA and lifestyle in Italy. Their study found that both males and females experienced a downturn in PA levels, with a more pronounced reduction among females, who reported higher levels of sedentary behavior and psychological distress, likely attributable to increased household and caregiving responsibilities during the lockdown. Consistent with Marconcin's review 2022, females may be more vulnerable to mental health alterations, whereas males tend to be more prone to shifts in their PA habits.

Along with other changes, the pandemic led to notable alterations in the population's dietary behavior. In particular, European populations, including Greeks, increased home cooking, thereby improving the quality of their diet with a greater emphasis on Mediterranean dietary patterns. However, eating habits showed worrying trends with increased food intake, number of daily meals, and frequency of snack consumption (Mignogna *et al.,* 2022). According to Bakaloudi et al. (2021), systematic review and meta-analysis, following the first wave of COVID-19 lockdown, adults and children gained weight, attributing this increase to factors such as increased food consumption, reduced PA, increased stress, and changes due to restrictive measures, while a smaller percentage experienced weight loss. Androutsos *et al.* (2021), studied 397 Greek parents with children aged 2-18 and found that 35% of children and adolescents increased their body weight during the first lockdown. The main findings showed that although fast food consumption decreased, and children consumed more fruit, vegetables, and dairy products, the main factors associated with weight gain were increased consumption of snacks overall, reduced PA, and increased screen time.

1.4 Gym exercisers during COVID-19 restrictions

Gym exercisers represent a population uniquely affected by lockdown restrictions due to their reliance on specialized facilities for structured PA (Gjestvang *et al.,* 2022; Tertipi *et al.,* 2020). More specifically Gjestvang *et al.* (2022) surveyed 233 gym members in Norway and found that during the first lockdown, exercise frequency reduced, home workouts increased, and the gym exercisers with a BMI≥25 reduced their PA frequency even more. Although prior studies have extensively documented the negative impacts of lockdowns on PA and inactive behavior (Bourdas & Zacharakis, 2020; Meyer *et al.,* 2020; Natsis *et al.,* 2023) and a few have focused on athletes (Washif et al., 2021), to our knowledge, no studies have been conducted examining the impact of COVID-19 lockdown on the specific behaviors and psychological well-being of individuals who exercise regularly at gyms in Greece.

Considering all the above, the aim of this research was to understand the impact of COVID-19 lockdowns on gym exercisers by assessing changes in their PA levels, exploring gender and age differences in PA and psychological outcomes, and identifying predictors of mental well-being and mood among gym users during the lockdown period. Ultimately, this research seeks to inform future policies and interventions designed to mitigate the adverse effects of prolonged inactivity during public health crises.

2. Methods

2.1 Participants

Participants were three-hundred and sixty-six (N = 366) gym exercisers, aged 15 to 59 years old (M_{age}: 34.63±9.27 years) who voluntarily participated in the present study. One hundred and twenty-six were males (N = 126), while two-hundred and forty were females (N = 240). Eighty of them were studying or had finished the secondary education; one-hundred and seventy-one had university level education, while one-hundred and fifteen reported a postgraduate education (master). Two-hundred and fifteen reported that they visit their gym at least 1 to 3 days per week, while one-hundred and fifty-one reported that they visit their gym at least 4 to 7 days per week. Based on the calculation of the MVPA, 129 participants spent between 0 to 29 minutes on MVPA per day, 98 spent between 30 to 59 minutes in MVPA per day, and 139 spent more than 60 minutes in MVPA daily.

2.2 Instruments

The following instruments were used in the present study:

Demographics. Participants reported their birthdate, age, gender (male, female, other), educational level (high school, bachelor degree, master degree), work status (student, employee, unemployed), and family status (single, married and widowed). In addition, based on the median age of the participants (33 years old), two groups were created (The youngest age group was between 15 to 33 years old: *N* = 193; The oldest age group was between 34 to 59-year-old: *N* = 173; Eighteen participants did not report their age).

Anthropometrics. Participants also reported their body weight (kg) and height (m). Then, Body Mass Index (BMI) was calculated based on the equation of body weight divided by the square of the body height (kg/m^2). According to the WHO recommendations (WHO, 2000), four BMI categories were used to separate volunteers in underweight (< 18.5; *N* = 18; 5%), normal BMI (18.5 to 24.99; *N* = 211; 58.6%), overweight (25 to 29.99; *N* = 112; 31.1%), and obese (> 30; *N* = 19; 5.3%). Twenty-four participants did not report either their body weight or height. Self-reported anthropometry is a technique that has been used in the past in many clinical and epidemiological studies with adults (e.g., Fayyaz *et al.,* 2024; Lin *et al.,* 2012).

PA and Sedentary Behavior. Participants' PA levels and sedentary behavior were assessed using the International Physical Activity Questionnaire - Short Form (IPAQ-SF; Craig *et al.,* 2003), which has already been adopted in the Greek language (e.g., Morres *et al.,* 2021; Papathanasiou *et al.,* 2009). The questionnaire recorded the frequency (days per week) and duration (minutes per day) of participants' light PA (e.g., "*During the last 7 days, on how many days did you walk for at least 10 minutes at a time?*" and "*How much time did you usually spend walking on one of those days?*"), moderate PA (e.g., "*During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis?*" and "*How much time did you usually spend doing moderate physical activities on one of those days?*"), vigorous PA (VPA; e.g., "*During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?*" and "*How much time did you usually spend doing vigorous physical activities on one of those days?*"), as well as participants' sedentary behavior in minutes per day (e.g., "*During the last 7 days, how much time did you spend sitting on a week day?*"). We also calculated the levels of MVPA which was the sum of participants' MPA and VPA in minutes per day, respectively.

Healthy Eating Behaviors. Participants' dietary habits over the past seven days were assessed with the Short Diet Behavior Questionnaire for Lockdowns (SDBQ-L; Ammar *et al.*, 2020), which has already been used in relevant Greek studies (e.g., Ammar *et al.,* 2021; Morres *et al.,* 2021). The questionnaire comprises four items (e.g., "*In the last 7 days do you consider yourself to be eating healthy?"* or *"In the last 7 days do you think you have been eating on a proper schedule?"*). Participants were asked to answer in a 7-point Likert scale from 1 (Not at all) to 7 (Absolutely yes) with higher scores indicated more healthy nutritional behaviors.

Mood. Ten items of the 4-Dimensional Mood Scale (4DMS; Huelsman *et al.,* 1998) were used to capture participants' dispositional mood state over the past seven days. More specifically, six items were measuring participants' negative arousal (e.g., "*Over the last seven days I felt … irritable*" or "*Over the last seven days I felt … upset*", while four items were assessing participants' positive energy (e.g., "*Over the last seven days I felt … active*" or "*Over the last seven days I felt … lively*"). Respondents rated how much they experienced each feeling on a 5-point Likert-type scale from 1 (Not at all) to 5 (Very much), with higher scores reflecting greater levels of the respective mood state. This scale has already been translated and used in the Greek language (e.g., Morres *et al.,* 2021).

Mental well-being. Mental well-being was assessed using the WHO-5 Well-Being Index (WHO, 1998). This scale is a brief five-item self-report measure where participants rate how often they experienced each positive feeling over the past two weeks (e.g., "*Over the past two weeks … I have felt calm and relaxed*" or "*… I have felt active and vigorous*"). Responses were given on a 6-point Likert scale from 0 (At no time) to 5 (All of the time). According to Topp et al. (2015, p. 168) "*the raw score ranging from 0 to 25 is multiplied by 4 to give the final score from 0 representing the worst imaginable well-being to 100 representing the best imaginable well-being*". This scale has also been used in previous studies with Greek populations (e.g., Morres *et al.,* 2021; Sischka *et al.,* 2020; Topp *et al.,* 2015).

Depression. The Patient Health Questionnaire-9 (PHQ-9; Kroenke *et al.,* 2001) was used to access participants' depressive symptoms over the last two

weeks. PHQ-9 consists of nine items (e.g., "*Over the last two weeks, how often have you been bothered by any of the following problems? … Little interest or pleasure in doing things*" or "*… Feeling tired or having little energy*"). Participants were asked to answer in a 4-point Likert scale from 0 (Not at all) to 3 (Nearly every day) with higher scores indicating greater severity of depression. This scale has already been translated and used in the Greek language (e.g., Hyphantis *et al.,* 2011, 2014).

Anxiety. The seven-item Generalized Anxiety Disorder scale (GAD-7; Spitzer et al., 2006) was used to capture participants' worry and anxiety symptoms over the past two weeks (e.g., "*Over the last 2 weeks, how often have you been bothered by the following problems? … Feeling nervous, anxious or on edge*" or "*… Worrying too much about different things*"). Items were rated on a 4-point Likert scale from 0 (Not at all) to 3 (Nearly every day), yielding total scores of 0 to 21, while cut-offs of 5, 10, and 15 represent mild, moderate, and severe anxiety, respectively (Spitzer et al., 2006). This scale has also been validated and used in the Greek language (e.g., Tsipropoulou *et al.,* 2021; Vogazianos *et al.,* 2022).

Self-report heatlh. A single item of Idler and Angel (1990) was used to capture participants' general health status (e.g., "*Would you say your health in general is excellent, very good, good, fair, or poor?*"). Responses were given on a 5-point Likert scale from 1 (Bad) to 5 (Excellent). This single item has already been used in epidemiological studies with Greek populations (e.g., Cavallo *et al.,* 2015; Ravens-Sieberer *et al.,* 2009).

Intention to be physically active during quarantine. Three items were developed to measure participants' intention to exercise during the quarantine period (e.g., "*I intend to exercise systematically in any form of exercise for as long as the COVID-19 quarantine lasts*" or "*I am determined to exercise systematically in any form of exercise for as long as the COVID-19 quarantine lasts*") based on the previous research and instructions of Ajzen (1991, 2019). Participants' answers were given on a 7-point Likert scale and varied from "*Absolutely likely*" to "*Absolutely unlikely*", from "*Absolutely yes*" to "*Absolutely no*", and from "*Absolutely right*" to "*Absolutely wrong*". Similar scales to assess participants' intention to exercise have also been used in Greek populations (e.g., Krommidas *et al.,* 2016; Psouni *et al.,* 2016; Touloudi *et al.,* 2025).

2.3 Procedure

Initially, the study was approved by the Bioethics Committee of the School of Physical Education & Sport Science, University of Thessaly (Ref. Number: 1723; Date: 09-12-2020). The questionnaire was distributed electronically during the second period of the COVID-19 lockdown in Greece (November 2020 to January 2021). An online consent form was also signed by the volunteers after being informed about the purpose of the present study. Participants then responded to the online questionnaire, which took approximately 30 minutes to complete.

2.4 Data Analysis

Normal distribution of the examined scales was checked by using the absolute values of skewness (< 2) and kurtosis (< 7). All data were normally distributed. Descriptive statistics (means, standard deviation), Cronbach's α reliability index and correlations among the examined variables were also calculated. Then, three separate hierarchical multiple linear regression analyses were conducted in order to explore if daily behaviors (MVPA, sedentariness, healthy eating behaviors) significantly predict gym exercisers' well-being and mood (positive energy, negative arousal) after controlling for gender, age and BMI effect. In the first step, the independent variables of gender, age and BMI were entered, while in the second step the behavioral variables of MVPA (min/day), sedentariness, and healthy eating behaviors were entered. Separate independent samples t-tests were performed in order to examine possible differences on the examined variables due to gender (males, females), age groups (15 to 33 years old - younger age, 34 to 59-year-old - older age) and days per week spent at gym (1 to 3 days/week at gym, 4 to 7 days/week at gym). Finally, separate one-way analyses of variance (ANOVA) were conducted in order to explore possible differences on the examined variables due to BMI groups (Underweight: < 18.5; Normal BMI: 18.5 to 24.99; Overweight: 25 to 29.99; Obese: > 30; WHO, 2000) and number of minutes spent in MVPA daily (0 to 29 min/day, 30 to 59 min/day, ≥ 60 min/day). All data were analyzed using the SPSS software v26, while the level of significance was set at $p < .05$.

3. Results

3.1 Descriptives statistics, reliability analysis and correlations

All scales showed acceptable reliability ranged from .83 to .94. Participants reported that they spent 1.70±1.66 days in MPA, 1.18±1.59 days in VPA, 47.84±43.73 minutes per day in MVPA and 6.88±3.70 hours per day in sedentary behaviors. About half of them (50.8%, N = 186) spent zero or one day per week in MPA, while 6.5% (N = 24) of them spent more than 5 days per week in MPA. Similarly, 67.5% (N = 247) spent zero or one day per week in VPA, while only 5.4% spent more than 5 days per week in VPA. A percentage of 35.2% (N = 129) stated that they engage in MVPA for less than 30 minutes per day, 26.8% (N = 98) spent 30 to 59 minutes per day in MVPA, while 38% (N = 139) of them reported that they perform MVPA for more than 60 minutes daily. Regarding their BMI, 5% (N = 18) were underweight (<18.5), 58.6% (N = 211) had normal BMI (18.5 to 24.9), 31.1% (N = 112) were overweight 25 to 29.9), while 5.3% (N = 19) were obese (≥ 30).

As for their mental health, 29.2% (N = 107) reported mild depression (> 5), 9.8% (N = 36) had moderate depression (> 10), 5.2% (N = 19) stated moderately severe depression (> 15), while only 2.7% (N = 10) of them had severe depression (> 20). Furthermore, 24.6% (N = 90) reported mild anxiety (> 5), 14.2% (N = 52) had moderate anxiety (> 10) and only 7.4% stated that they suffer from severe anxiety (> 15). Regarding their well-being, 39.8% (N = 136) reported poor well-being (values ≤ 50 on WHO-5 index), while 60.2% (N = 206) stated better quality of life (values > 50 on WHO-5 index).

Correlation analysis revealed that participants' BMI was negatively related to their healthy eating behaviors and health. Positive energy was positively related to MPA (days/week and min/day), VPA (days/week and min/day), MVPA, health, well-being, and healthy eating behaviors. In contrast, positive energy was negatively related to sedentariness, negative arousal, depression severity and anxiety. Positive relations were found between negative arousal and the variables of depression severity and anxiety, while negative relations were found between negative arousal and the scales of health and well-being. There was also a significant positive correlation between depression severity and the variables of sedentariness and anxiety, while depression severity was negatively related to VPA (days/week and min/day) and MVPA. Intention to be physically active was positively related to MPA (min/day) and MVPA, while sedentariness was negatively linked with participants' intention to be physically active. Finally, healthy eating behaviors had positive relations with VPA (days/week), MVPA, well-being and health. Descriptives statistics (means, standard deviations), reliability analysis and correlations between the examined variables are presented below in Table 1.

3.2 Hierarchical regression analyses

Three separate hierarchical multiple linear regression analyses were conducted in order to explore if daily behaviors (MVPA, sedentariness, healthy eating behaviors) significantly predict gym exercisers' well-being and mood (positive energy, negative arousal) after controlling for gender, age and BMI effect. In the first step, the independent variables of gender, age and BMI were entered, while in the second step the behavioral variables of MVPA (min/day), sedentariness, and healthy eating behaviors were entered.

Regarding well-being, the variables of gender, age and BMI did not predict significantly the variance of well-being in the first step ($F_{3,362}$ = 1.432, p = .233). In the second step, the addition of the behavioral variables predicted 20% of the variance ($F_{3,359}$ = 30.313, p < .001). Only MVPA (β = .13, t = 2.719, p < .01) and healthy eating behaviors (β = .42, t = 8.674, p < .001) were significant predictors of the participants' well-being.

Regarding positive energy, gender, age and BMI did not predict significantly the variance of well-being in the first step ($F_{3,362}$ = 1.942, p = .122). In the second step, the addition of the behavioral variables predicted 19% of the variance ($F_{3,359}$ = 28.498, p < .001). Similarly, MVPA (β = .26, t = 5.353, p < .001) and healthy eating behaviors (β = .31, t = 6.512, p < .001) were significant predictors of the gym exercisers' positive energy.

As for negative arousal, gender, age and BMI did not predict significantly the variance of well-being in the first step ($F_{3,362}$ = .250, p = .862). In the second step, the addition of the behavioral variables predicted significantly only 8% of the variance ($F_{3,359}$ = 9.729, p < .001). Here, only sedentariness (β = .11, t = 2.151, p < .05) and healthy eating behaviors (β = -.25, t = -4.774, p < .001) were significant predictors of the participants' negative arousal. All regression analyses results are presented below in Table 2.

Table 1. Descriptives statistics (means, standard deviations), reliability analysis and correlations between the examined variables

	M±SD	*α*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. BMI	23.80±3.52	-	-																
2. LPA (days/week)	2.36±1.93	-	.01	-															
3. LPA (min/day)	32.90±24.48	-	-.00	.47**	-														
4. MPA (days/week)	1.70±1.66	-	-.02	.33**	.23**	-													
5. MPA (min/day)	27.13±24.90	-	.00	.12*	.35**	.57**	-												
6. VPA (days/week)	1.18±1.59	-	-.05	.06	.02	.31**	.21**	-											
7. VPA (min/day)	20.71±28.13	-	-.08	-.07	.04	.17**	.36**	.71**	-										
8. MVPA (min/day)	47.84±43.73	-	-.05	.02	.22**	.44**	.80**	.58**	.85**	-									
9. Sedentariness (hours/day)	6.88±3.70	-	.05	-.06	-.04	-.08	-.09	-.13*	-.07	-.10	-								
10. Healthy eating behaviors	4.69±1.22	.83	-.14**	.05	.02	.09	.09	.16**	.10	.12*	-.09	-							
11. Positive energy	2.77±.90	.91	-.03	.07	.04	.18**	.19**	.33**	.31**	.30**	-.13*	.35**	-						
12. Negative arousal	2.33±1.01	.92	.00	-.03	.02	.02	.01	-.04	-.05	-.03	.13*	-.25**	-.17**	-					
13. Well-being	63.05±23.07	.89	-.05	.04	.08	.05	.09	.30**	.23**	.20**	-.06	.43**	.59**	-.51**	-				
14. Depression	6.33±5.58	.88	.01	-.01	-.01	-.10*	-.07	-.11*	-.12*	-.12*	.13*	-.36**	-.38**	.66**	-.56**	-			
15. Anxiety	6.14±5.33	.94	-.00	-.00	-.02	-.05	-.04	-.08	-.11*	-.09	.08	-.29**	-.30**	.71**	-.54**	.76**	-		
16. Health	3.54±.83	-	-.18**	-.03	.05	.05	.18**	.22**	.24**	.26**	-.11*	.34**	.37**	-.30**	.49**	-.40**	-.37**	-	
Intention to be PA	5.41±1.66	.92	.03	-.08	.04	-.01	.13*	.08	.09	.14**	-.11*	.01	.05	.00	.01	.03	.01	.08	-

Notes. M: mean; SD: standard deviation; *α*: reliability index; BMI: Body Mass Index; LPA: low physical activity; MPA: moderate physical activity; VPA: vigorous physical activity; MVPA: moderate to vigorous physical activity; PA: physically active; *$p < .05$; **$p < .01$.

Table 2. Daily behaviors as predictors of gym exercisers' well-being and mood

Dependent variables	Predictor(s) entered	*B*	*SE B*	*β*	*t*	R^2	*F*
Well-being	*Step 1*					.01	.233
	Gender	-4.905	2.624	-.101	-1.869		
	Age	-.033	.135	-.013	-.242		
	BMI	-.443	.367	-.068	-1.210		
	Step 2					.20	30.313***
	Gender	-4.540	2.389	-.094	-1.901		
	Age	-.080	.122	-.032	-.650		
	BMI	.016	.333	.002	.048		
	MVPA (min/day)	.069	.025	.131	2.719**		
	Sedentariness	-.114	.299	-.018	-.383		
	Healthy eating behaviors	7.838	.904	.415	8.674***		
Positive energy	*Step 1*					.02	1.942
	Gender	-.116	.102	-.062	-1.143		
	Age	.011	.005	.113	2.089		
	BMI	-.018	.014	-.071	-1.265		
	Step 2					.19	28.498***
	Gender	-.062	.093	-.033	-.666		
	Age	.009	.005	.091	1.850		
	BMI	-1.406	.013	.000	.000		
	MVPA (min/day)	.005	.001	.258	5.353***		
	Sedentariness	-.015	.012	-.061	-1.267		
	Healthy eating behaviors	.229	.035	.313	6.512***		
Negative arousal	*Step 1*					.01	.250
	Gender	.010	.116	.005	.087		
	Age	-.005	.006	-.047	-.862		
	BMI	.004	.016	.013	.231		
	Step 2					.08	9.729***
	Gender	.042	.114	.020	.372		
	Age	-.002	.006	-.019	-.358		
	BMI	-.008	.016	-.029	-.530		
	MVPA (min/day)	.000	.001	.016	.301		

	Sedentariness	.031	.014	.112	2.151*		
	Healthy eating behaviors	-.205	.043	-.247	-4.774***		

Notes. SE: standard error; *p < .05; **p < .01; ***p < .001; BMI: body mass index; MVPA: moderate to vigorous physical activity.

Table 3. Means, standard deviations and significant differences on the examined variables among gender, age and BMI groups.

Variables	Male (M±SD)	Female (M±SD)	Younger age (M±SD)	Older age (M±SD)	Underweight (M±SD)	Normal BMI (M±SD)	Overweight (M±SD)	Obese (M±SD)
BMI	25.07±2.69***	23.14±3.72***	22.93±3.26***	24.77±3.57***	-	-	-	-
LPA (days/week)	2.24±2.04	2.43±1.87	2.34±1.97	2.39±1.89	2.44±2.20	2.38±1.93	2.32±1.82	2.79±2.39
LPA (min/day)	32.70±25.56	33.00±23.95	32.23±25.10	33.64±23.82	30.00±33.25	34.12±24.76	31.16±21.76	34.21±24.96
MPA (days/week)	2.00±1.75*	1.54±1.59*	1.60±1.62	1.82±1.70	1.28±1.78	1.75±1.69	1.62±1.49	1.68±1.64
MPA (min/day)	30.52±26.32	25.35±23.98	25.83±24.60	28.58±25.22	15.83±17.51	28.15±25.42	26.79±23.23	27.63±30.79
VPA (days/week)	1.76±1.78***	.87±1.38***	1.26±1.62	1.09±1.56	1.00±1.75	1.22±1.59	1.17±1.52	.79±1.55
VPA (min/day)	25.52±28.06*	18.19±27.90*	23.60±30.14*	17.49±25.41*	15.00±23.89	22.84±30.42	17.86±22.69	18.68±33.03
MVPA (min/day)	56.03±44.77**	43.54±42.64**	49.43±46.17	46.07±40.89	30.83±33.66	50.99±46.00	44.64±36.61	46.31±58.92
Sedentariness (hours/day)	7.19±3.92	6.72±3.59	7.14±3.77	6.60±3.62	5.89±4.14	6.76±3.67	7.28±3.73	6.79±3.36
Healthy eating behaviors	4.58±1.31	4.74±1.17	467±1.23	4.71±1.21	4.53±.90	4.77±1.21	4.53±1.26	4.33±1.06
Positive energy	2.84±.92	2.74±.88	2.73±.94	2.83±.85	2.79±.97	2.75±.89	2.80±.89	2.67±.79
Negative arousal	2.33±1.10	2.34±.97	2.41±1.01	2.25±1.02	2.47±.88	2.28±.97	2.35±1.07	2.55±1.10
Well-being	65.68±25.51	61.67±21.60	62.96±23.14	63.14±23.05	61.56±23.21	63.55±22.88	63.14±23.85	54.32±17.30
Depression	5.98±.5.82	6.51±5.45	6.96±5.71*	5.62±5.35*	7.67±5.95	6.14±5.67	6.26±5.22	8.00±6.72
Anxiety	5.91±5.87	6.26±5.04	6.89±5.43**	5.31±5.11**	7.72±5.99	5.90±5.16	6.09±5.36	7.26±5.87
Health	3.61±.88	3.50±.80	3.58±.85	3.49±.80	3.61±.85	3.63±.81*	3.44±.83	3.11±.88*
Intention to be PA	5.65±1.51*	5.29±1.73*	5.33±1.71	5.50±1.60	4.61±.85	4.63±.81*	4.44±.83	4.11±.83*

Notes. M: mean; SD: standard deviation; BMI: Body Mass Index; LPA: low physical activity; MPA: moderate physical activity; VPA: vigorous physical activity; MVPA: moderate to vigorous physical activity; PA: physically active; *p ≤ .05; **p < .01: ***p < .001.

Table 4. Means, standard deviations and significant differences on the examined variables between days in the gym and number of minutes spent in MVPA daily

Variables	1 to 3 days/week at gym (M±SD)	4 to 7 days/week at gym (M±SD)	0 to 29 min/day MVPA (M±SD)	30 to 59 min/day MVPA (M±SD)	≥ 60 min/day MVPA (M±SD)
BMI	23.89±3.59	23.68±3.43	23.99±3.72	23.83±3.89	23.60±3.05
LPA (days/week)	2.48±1.82	2.20±2.06	2.16±1.67	2.44±1.90	2.50±2.16
LPA (min/day)	32.33±21.95	33.71±27.74	-	-	-
MPA (days/week)	1.55±1.62*	1.91±1.70*	.74±1.30***	1.99±1.45***	2.38±1.69***
MPA (min/day)	24.05±21.88**	31.52±28.15**	-	-	-
VPA (days/week)	.73±1.15***	1.81±1.89***	.18±.58***	1.04±1.38***	2.20±1.73***
VPA (min/day)	13.74±22.42***	30.63±32.25***	-	-	-
MVPA (min/day)	37.79±36.38***	62.15±49.13***	-	-	-
Sedentariness (hours/day)	7.10±3.74	6.58±3.64	7.30±3.99	6.69±3.36	6.63±3.65
Healthy eating behaviors	4.52±1.19	4.92±1.23	4.53±1.27	4.67±1.13	4.85±1.22
Positive energy	2.64±.85	2.97±.92	2.47±.78***	2.71±.87***	3.11±.91***
Negative arousal	2.40±1.05	2.25±.96	2.32±.97	2.40±1.00	2.31±1.07
Well-being	59.67±20.89	67.87±25.15	59.01±20.85***	60.90±22.55***	68.32±24.49***
Depression	6.68±5.68	5.82±5.41	6.85±5.79	6.68±5.81	5.59±5.15
Anxiety	6.19±5.19	6.08±5.54	6.57±5.66	6.59±5.18	5.43±5.08
Health	3.40±.84***	3.74±.78***	3.40±.82***	3.37±.87***	3.78±.76***
Intention to be PA	5.02±1.72***	5.96±1.40***	5.17±1.68*	5.38±1.68*	5.66±1.61*

Notes. M: mean; SD: standard deviation; BMI: Body Mass Index; LPA: low physical activity; MPA: moderate physical activity; VPA: vigorous physical activity; MVPA: moderate to vigorous physical activity; PA: physically active; *$p \leq .05$; **$p < .01$: ***$p < .001$.

3.3 Group Differences

Separate independent samples t-test revealed significant differences on MPA (days/week; t_{364} = 2.532, p < .05), VPA (days/week; t_{364} = 5.288, p < .001), VPA (min/day; t_{364} = 2.383, p < .05), MVPA (t_{364} = 2.617, p < .01), intention to be physically active (t_{364} = 1.965, p = .05) and BMI (t_{364} = 5.156, p < .001) between males and females.

More specifically, males' gym participants reported higher scores on all the aforementioned variables compared to females' gym exercisers (Table 3). In contrast, there were no significant differences on LPA (days/week; t_{364} = -.901, p = .368), LPA (min/day; t_{364} = -.112, p = .911), MPA (min/day; t_{364} = .498, p = .06), sedentariness (t_{364} = 1.153, p = .470), and healthy eating behaviors (t_{364} = -1.218, p = .224) between males and females gym exercisers. No significant differences emerged on positive energy (t_{364} = .940, p = .348), negative arousal (t_{364} = -.073, p = .942), well-being (t_{364} = 1.586, p = .114), depression (t_{364} = -.854, p = .394), anxiety (t_{364} = -.596, p = .552), and health (t_{364} = 1.219, p = .224) between males and females gym exercisers (Table 3).

Similarly, separate independent samples t-test revealed significant differences on VPA (min/day; t_{364} = 2.086, p < .05), BMI (t_{364} = -5.162, p < .001), depression (t_{364} = 2.318, p < .05), and anxiety (t_{364} = 2.847, p < .001) between younger (15 to 33 years old) and older age gym exercisers (34 to 59 years old). More specifically, younger age gym participants reported higher scores on VPA (min/day), depression, and anxiety and lower scores on BMI compared to older age gym exercisers (Table 3). On the other hand, there were no significant differences on LPA (days/week; t_{364} = -.278, p = .781), LPA (min/day; t_{364} = -.551, p = .582), MPA (min/day; t_{364} = -1.264, p = .207), MPA (days/week; t_{364} = -1.057, p = .291), VPA (days/week; t_{364} = 1.037, p = .300), MVPA (t_{364} = .734, p = .464), sedentariness (t_{364} = 1.406, p = .161), intention to be physically active (t_{364} = -1.004, p = .316), healthy eating behaviors (t_{364} = -.354, p = .723), positive energy (t_{364} = -1.110, p = .268), negative arousal (t_{364} = 1.462, p = .145), well-being (t_{364} = -.075, p = .940), and health (t_{364} = 1.025, p = .306) between younger and older age gym exercisers (Table 3).

Furthermore, separate one-way ANOVA revealed no significant differences on LPA (days/week; $F_{3,356}$ = .322, p = .809), LPA (min/day; $F_{3,356}$ = .469, p = .704), MPA (days/week; $F_{3,356}$ = .548, p = .650), MPA (min/day; $F_{3,356}$ = 1.380, p = .249), VPA (days/week; $F_{3,356}$ = .506, p = .678), VPA (min/day; $F_{3,356}$ = 1.072, p = .361), MVPA ($F_{3,356}$ = 1.493, p = .216), sedentariness ($F_{3,356}$ = .940, p = .421), intention to be physically active ($F_{3,356}$ = 1.133, p = .336), healthy eating behaviors ($F_{3,356}$ = 1.635, p = .181), positive energy ($F_{3,356}$ = .136, p = .939), negative arousal ($F_{3,356}$ = .618, p = .604), well-being ($F_{3,356}$ = .965, p = .409), depression ($F_{3,356}$ = .991, p = .397), and anxiety ($F_{3,356}$ = .963, p = .410) among the BMI groups (Underweight: < 18.5; Normal BMI: 18.5 to 24.99; Overweight: 25 to 29.99; Obese: > 30; WHO, 2000). In contrast, there were significant differences on health ($F_{3,356}$ = 3.179, p < 05) among the BMI groups. Post hoc analysis with Sidak test revealed that gym exercisers with normal BMI reported higher scores in health compared to obese gym participants (Table 3).

Results also showed significant differences on MPA (days/week; t_{364} = -2.019, p < .05), MPA (min/day; t_{364} = -2.856, p < .01), VPA (days/week; t_{364} = -6.744, p < .001), VPA (min/day; t_{364} = -5.910, p < .001), MVPA (t_{364} = -5.449, p < .001), intention to be physically active (t_{364} = -5.507, p < .001), healthy eating behaviors (t_{364} = -3.106, p < .01), positive energy (t_{364} = -3.557, p < .001), well-being (t_{364} = -3.397, p < .01), and health (t_{364} = -3.879, p < .001) between those who exercise less days per week in the gym (1to 3 days/week) and those who exercise more days per week in the gym (4 to 7 days/week). More specifically, participants with more days per week in the gym reported higher scores on all the aforementioned variables compared to those with fewer days per week in the gym (Table 4). In contrast, there were no significant differences on LPA (days/week; t_{364} = 1.371, p = .171), LPA (min/day; t_{364} = -.532, p = .595), sedentariness (t_{364} = 1.327, p = .185), BMI (t_{364} = .557, p = .578), negative arousal (t_{364} = 1.418, p = .157), depression (t_{364} = 1.459, p = .145), and anxiety (t_{364} =.188, p = .851) between those who exercise less days per week in the gym and those who exercise more days per week in the gym (Table 5).

Finally, separate one-way ANOVA revealed no significant differences on LPA (days/week; $F_{3,363}$ = 1.105, p = .332), sedentariness ($F_{3,363}$ = 1.291, p = .276), BMI ($F_{3,363}$ = .424, p = .655), healthy eating behaviors ($F_{3,363}$ = 2.353, p = .096), negative arousal ($F_{3,363}$ = .284, p = .753), depression ($F_{3,363}$ = 1.998, p = .137), and anxiety ($F_{3,363}$ = 2.001, p = .137) among those participants who spent different amount of minutes per day in MVPA (0 to 29 min/day, 30 to 59 min/day, 60 or more min/day). On the other hand, there were significant differences on MPA (days/week; $F_{3,363}$

= 42.586, $p < .001$), VPA (days/week; $F_{3,363} = 77.997$, $p < .001$), intention to be physically active ($F_{3,363} = 3.008$, $p < .05$), positive energy ($F_{3,363} = 19.267$, $p < .001$), well-being ($F_{3,363} = 6.203$, $p < .01$), and health ($F_{3,363} = 10.419$, $p < .001$) among those who spent different amount of minutes in MVPA daily. Post hoc analysis with Sidak test revealed that gym exercisers who spent 60 or more minutes per day in MVPA reported higher scores in all the aforementioned variables compared to those who spent less minutes per day in MVPA (0 to 29 min/day and 30 to 59 min/day, respectively; Table 4).

4. Discussion

The present study offers significant insights into the multifactorial effects of the COVID-19 pandemic and the associated lockdown on PA, dietary behaviors, and psychological well-being among gym users. In line with earlier studies (Stockwell *et al.,* 2021; Violant-Holz *et al.,* 2020), the current findings indicated a decline in PA during lockdown among gym users, with a a significant increase in sedentary behaviors, which were associated with adverse psychological outcomes, such as heightened depression and anxiety, as similarly observed by relevant studies (Choi *et al.,* 2020; Wilke *et al.,* 2022).

Approximately half of the participants reported engaging in MPA once daily, while 67.5% engaged in MVPA up to once weekly, well below the WHO's (2020) recommended levels. These results correspond with broader trends reported in Greece (WHO, 2021), suggesting that the pandemic exacerbated pre-existing inactivity patterns. This general reduction in PA on all intensity levels and the rise in sedentary behavior are consistently documented in the literature (Ammar *et al.,* 2020; Gallo *et al.,* 2020; Stockwell *et al.,* 2021). Our findings, demonstrate that the "social distancing" measures implemented to protect citizens, have had a negative impact on other aspects of their health.

A central finding was the predictive role of MVPA and healthy eating in promoting psychological well-being and positive energy. This supports prior work highlighting the mental health benefits of regular exercise and balanced nutrition (Marconcin *et al.,* 2022; Maugeri *et al.,* 2020). Notably, sedentary behavior and poor dietary habits were linked to increased negative arousal, indicating their influence on emotional regulation. The inverse relationship between healthy eating and negative emotions points to a protective effect against distress. These results are consistent with Morres *et al.* (2021), who reported similar findings, especially among adolescents during lockdown, highlighting the positive effect of MVPA on mental health. Similarly, in the study by Maugeri *et al.* (2020), participants who continued or replaced gym training with home exercises reported better mental health. The continuity of exercise, even in adapted formats, appears to serve as a buffer against pandemic-related stress. These findings advocate for the development of effective public health strategies to support active lifestyles during crises.

Age differences were also observed. Younger participants (15–33 years) reported higher levels of vigorous PA but also increased symptoms of depression and anxiety, along with lower BMI compared to older adults (34–59 years). These findings suggest that although younger individuals may have been more physically active, they were more psychologically affected by disruptions to routine and social isolation. The increased vulnerability of younger populations is supported by Pieh *et al.* (2020) and Karapounaki *et al.* (2020), who found similar age-related trends in mental health during the pandemic.

Gender differences emerged in PA, with males reporting higher levels of activity and stronger intentions to maintain it post-lockdown, consistent with earlier studies (Baj-Korpak *et al.,* 2023; Orlandi *et al.,* 2020; Schöttl *et al.,* 2022). However, no significant differences were observed in psychological well-being or eating behavior between genders. This partially contrasts with the findings of Nyawornota *et al.* (2024), who reported better self-perceived health in males during the pandemic. The lack of gender differences in psychological well-being in our study may reflect the unique characteristics of our gym-attending sample, as regular participation in structured PA and the associated social support may buffer psychological distress similarly across genders (Gerber & Pühse, 2009; Heaney & Israel, 2008).

Regarding BMI, participants within the normal range reported better perceived health compared to obese individuals. This aligns with previous research indicating BMI as a predictor of psychological well-being (Morres *et al.,* 2021). Similarly, Barcın-Güzeldere and Devrim-Lanpir (2022) found that individuals with higher BMI reported greater stress, weight gain, and emotional eating during quarantine.

Participants who exercised one hour daily or maintained frequent MVPA reported significantly higher levels of positive energy, intention to continue

exercising, well-being, and better perceived health, than those who exercised less frequent. These outcomes are consistent with Brand *et al.* (2020) and Chen *et al.* (2024), who found that individuals maintaining or increasing exercise levels during lockdown reported better psychological outcomes.

In sum, this study underscores the importance of regular PA and healthy eating in safeguarding mental health during periods of restricted mobility. These findings reaffirm WHO guidelines and earlier conclusions (Maugeri *et al.,* 2020), supporting structured MVPA and balanced lifestyles as key components of resilience during public health emergencies. Given the psychological toll of the pandemic, especially among younger populations, targeted interventions to promote active living are warranted.

4.1 Limitations and Future Directions

While this study offers valuable insights, there are some limitations that need to be mentioned. The cross-sectional design precludes the establishment of causal relationships between the observed variables. Future longitudinal studies would be beneficial to track changes in PA, dietary habits, and mental well-being over time. Additionally, the reliance on self-reported data may introduce recall bias, and objective measures of PA could provide more precise insights. The study population, consisting solely of gym exercisers, limits the generalizability of the findings to the broader population. Future research should include a more diverse sample, encompassing individuals with varying levels of PA engagement and from different socioeconomic backgrounds.

Future research should also delve deeper into the mediating factors that influence the relationship between PA and mental health during crises, as suggested by Ai *et al.* (2021). Exploring the effectiveness of supervised versus self-directed exercise interventions, particularly in low-resource settings, could provide actionable insights for public health initiatives. Furthermore, understanding the long-term implications of pandemic-induced lifestyle changes and the factors that influence individuals' sustained intention to engage in PA and adopt healthy lifestyles remains a critical area for continued investigation.

5. Conclusion

To sum up, this investigation sheds considerable light on the profound influence of COVID-19 lockdowns on PA patterns, eating habits, and the psychological well-being of individuals who regularly attend gyms. The findings compellingly underscore the importance of a consistent engagement in MVPA and adherence to wholesome eating practices play in fostering mental well-being, particularly during periods of widespread public health crises. Furthermore, the observed distinctions based on gender and age highlight the imperative for developing and implementing interventions that are specifically tailored to address the unique needs and challenges faced by diverse demographic groups. By integrating these valuable insights into future policy development and intervention strategies, it becomes possible to more effectively mitigate the detrimental consequences associated with prolonged periods of inactivity and to proactively cultivate healthier lifestyles in the face of comparable global challenges. This study highlights the critical role of consistent PA and healthier nutritional choices, not merely as contributors to physiological health, but as foundational pillars supporting psychological resilience and enhancing overall quality of life, particularly amidst periods of profound societal disruption.

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Author Contribution Statement

S. Skampardoni: Conceptualization, methodology, Formal analysis, investigation, writing original draft. M. Angeli: Conceptualization, methodology, investigation, writing original draft. C. Krommidas: Writing, review and editing. M. Hassandra: Writing, review and editing. E. Galanis– Writing, review and editing. Y. Theodorakis: Writing, review and editing. All the authors read and approved the final version of the manuscript.

Informed Consent

Written consent was obtained from the participant before the study began.

Ethics Approval

Approval for this study was sought from IRB.

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