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Effects of a Three-Month COVID-19 Lockdown on Body Mass and Nutritional Status of Lebanese Students Who Study Physical Education

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Abstract: This study investigated the effects of a three-month COVID-19 lockdown on the body mass of Lebanese students who study physical education and whether these changes reflected in distribution changes in underweight, normal weight, and overweight/obese status. Furthermore, the study investigated whether lockdown affected physical activity behavior and if students who reduced the frequency of training sessions were more likely to increase their body mass. Body mass and body height were assessed in 174 Lebanese physical education students immediately before and at the end of COVID-19 lockdown. Their training routine was assessed using by questionnaire. Wilcoxon signed-rank order assessed the effects of lockdown on body mass, while Chi square test tested the differences in distribution of underweight, normal weight, and overweight/obese status before and after the lockdown. In general, there was a significant ($p < 0.001$) small increase in body mass. However, about 27% of participants had a moderate to major increase in body mass. This was reflected in a significant shift in nutritional status as the number of overweight/obese students increased by 5.2%. In addition, students who reduced their training frequency due to lockdown were three times more likely to increase body mass than those who remained active (i.e., 38 vs. 5 with moderate to major increase). Given that an increase in body mass increases all health risks, remaining physically active is of high importance for health prevention, especially considering all other positive effects of physical activity on cardio-respiratory and muscle function.

Keywords: physical activity; sustainable health; education; obesity

1. Introduction

COVID-19 was identified in China in 2019 and led to worldwide pandemic in 2020 [1] which resulted in major health problems and the dramatic loss of human lives around the world [2]. Up until today, it presents an unprecedented challenge to public health as it negatively affects people of all ages and all health conditions [3–6]. Governments around the world imposed lockdown measures to tackle the spread and flatten the curve of the virus as initially it seemed an effective solution from the epidemiological science point of view [7]. However, as time passed and scientific evidence has been gathered from different domains of life, some negative lockdown effects on healthy behavior were found as well [5,6,8,9].

Physical activity level and nutrition were certainly one of the most affected of people's behaviors, which often may be reflected in increments in body mass induced by accumulation of body fats [10–13]. Luciano et al. [11] investigated changes in physical activity, sedentary, and sleep behavior among medical students and found a significant decrease in physical activity, while the sedentary and sleep time increased. Robinson et al. [12] investigated the obesity, eating behavior, and physical activity during COVID-19 lockdown

in UK adults and found that about 56% of participants reported snacking more often and problems with motivation and food control. These trends were more pronounced in people with higher body mass index (BMI), whereby BMI was also associated with lower levels of physical activity. Pérez-Rodrigo et al. [14] reported pattern changes in dietary habits and physical activity during the COVID-19 lockdown in Spain. They defined three clusters of changes, a cluster of those who reported to be less active than usual, a cluster of those who reported to be more active than usual, and a cluster of people who reported to be as active as usual. Moreover, they found that people who were less active before the lockdown were more likely to report an increase in physical activity during lockdown, while people who were more active before the lockdown reported reduced activity level during the lockdown.

Considering the obesity epidemic that has been among the leading health concerns since long before COVID-19, lockdown consequences from reduction in physical activity are even more concerning [15,16]. Ammar et al. [17] investigated the effects of COVID-19 home confinement on eating behavior and physical activity on a large international sample of respondents to the ECLB-COVID19 questionnaire. Authors found that COVID-19 home confinement had a negative effect on all physical activity intensity levels, while daily sitting time increased from 5 to 8 h per day. It has been well established that people tend to gain body mass over the years, mainly due to an increase in body fatness [18]. In addition, people tend to lose skeletal muscle mass as they get older [19], which amplifies the negative effects of obesity on functionality and health. There is a large body of evidence that sufficient physical activity helps in the maintenance of skeletal muscle mass and body fatness [20–22], as well as health and well-being [23–25]. Therefore, it is in individual and public health interest to mitigate the negative trends in physical activity and negative effects related to it starting from earlier ages by developing more sustainable systems of health prevention. Physical education is the main pillar supporting the sustainability in physical activity behavior for health [26,27], while physical education teachers and professors should be the frontline examples. However, the COVID-19 lockdown was a great test for them, as well as for physical education students who are in the process of becoming examples to others.

To that end, physical education students in Lebanon were an affected group because they were not able to engage in physical exercise and daily training in sports facilities. This is of importance considering that physical education students are preparing for the career where they are required to provide an exemplary behavior and teach about sustainable exercise habits for nutritional status and health [28,29]. The rationale for this study lies in our belief that physical education should be emphasized more than it is now, especially at the university level. Many if not most universities do not have physical education in any form but students are left to be physically active on their own. However, they often do not have logistical support (gym, equipment, outdoor workout spots) from the university, municipality, or government. Therefore, if physical education students reduce the physical activity level and increase body mass, it is highly likely that students and other adults, whose intrinsic and extrinsic motivation for exercise are low, will be affected to a higher degree. For instance, Kalajas-Tilga et al. [30] reported that intrinsic motivation was positively associated with moderate-to-vigorous physical activity. In addition, recent research has pointed out that the restrictions of COVID-19 might contribute to a negative association between intention and physical activity [31].

Considering this, the aim of this study was to examine the effects of a three-month COVID-19 lockdown on the body mass of Lebanese physical education students, and how it was reflected in changes in their nutritional status. In addition, we investigated whether changes in training behavior had an effect on the nutritional status of students. It was hypothesized that the lockdown would have a significant effect on students' body mass, which would be reflected in a significant shift of distribution of nutritional status categories towards overweight and obese. In addition, we hypothesized that the shift in nutritional status distribution would be larger in those who reduced the training frequency compared to those who retained their exercise habits during the lockdown.

2. Materials and Methods

2.1. Participants

This was a rare longitudinal study that assessed training frequency and body mass of students before and at the end of the lockdown, thus providing direct insights into general and individual effects of lockdown. The invitation for the study was sent to all physical education students of all three universities in Lebanon that have physical education program: the Lebanese University (public university), the University of Balamand (private university), and the Antonine University (private university). Invitation included the explanation of the study design and the aim followed by a written consent form. There were no exclusion criteria, other than failure to fully complete the questionnaire or not show up for both assessments. A total of 174 physical education students aged 18 to 29 years (mean age = 22 ± 3 years) enrolled in this study. Direct measures of body height and body mass took place in a private gym located in Beirut. The same testers conducted all measurements. Specific precautions were applied to eliminate any risk of COVID-19 infection (e.g., wearing gloves and masks was obligatory, subjects were booked and assessed one by one). The first measurement was taken from 25 December 2020 to the 3 January 2021, four days before the first day of lockdown. The second measurement was taken immediately after the first day of lockdown (29 March 2021 to 8 April).

2.2. Anthropometrics

Body height was measured to the nearest 0.1 cm using a Seca[®] Stadiometer 208 (Seca[®], Hamburg, Germany). The subjects were barefoot, minimally dressed (shorts and T-shirts), and the head was positioned using the Frankfurt method (Frankfurt plane parallel to the floor). Body mass was measured to the nearest 0.1 kg using the pre-calibrated portable weighting scale Tanita[®] Inner Scan BC 587 (Tanita Europe GmbH, Sindelfingen, Germany). For estimating the prevalence of obesity, body mass index (BMI) was calculated ($\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$). According to WHO classification for adults, subjects were categorized into three groups based on BMI: underweight $\leq 18.5 \text{ kg/m}^2$; normal weight $18.5\text{--}24.9 \text{ kg/m}^2$; or overweight/obese group $\geq 25 \text{ kg/m}^2$. Previous studies commonly categorized weight gain as an increase greater than 5% of body mass from baseline/5.0–10.0% of body weight from baseline as moderate weight gain, and >10.0% of body weight as high weight gain [32] or categorized weight gain as an increase of approximately 3 kg above baseline [33]. Shorter term (several days to 3 weeks) fluctuations in body weight generally range from 1 to 2 kg [34,35]. Considering this, we categorized subjects into four groups: increase of less than 2 kg—no significant change; increase of 2.0 to 2.9 kg—small increase; increase of 3.0 to 3.9 kg—moderate increase; and increase of more than 3.9 kg—major increase.

2.3. Demographics and Physical Activity Behavior

An online demographic survey accessible through any device with an Internet connection was conducted from 5 to 13 April 2021. The survey included questions regarding the number of training sessions per week (e.g., What is the number of training sessions that you perform during one week?). The questionnaire was filled on two occasions, before the lockdown and at the end of lockdown. In addition, the type of training that students practiced was collected. Regarding the frequency of training sessions per week, we monitored whether changes occurred during lockdown and classified participants into two groups: decrease and no decrease in number of training sessions per week. We also categorized them by type of training they reported to perform as aerobic, anaerobic, and mixed group. According to the American College of Sports Medicine, aerobic exercise is any activity that uses large muscle groups that can be maintained continuously and is rhythmic in nature and anaerobic exercise is intense physical activity of very short duration and strength training in the gym [36].

The study protocol was approved by the Ethical Committee of the University of Belgrade, Faculty of Sport and Physical Education (protocol No. 02-3199-21-1).

2.4. Statistical Analysis

Data were analyzed descriptively for mean, minimum (Min), maximum (Max), standard deviation (St. Dev.), frequency, and relative frequency (%). Normality of data distribution was tested using the Kolmogorov–Smirnov test. After finding that the normality of distribution was violated, Wilcoxon signed-rank test was used to determine the effects of lockdown on body mass. Chi-square test was used to test whether distribution in nutritional status was changed at the end of lockdown compared to before the lockdown. The significance level was set to $p < 0.05$. Density and frequency analyses were employed to provide numeric and visual representation of lockdown effects. Statistical analyses were conducted in SPSS version 22 and R stats Version 4.1.0.

3. Results

The descriptive statistics of the sociodemographic characteristics of this study are presented in the Table 1. Around two thirds of the samples (60.3%) were males whereas 39.7% were females. Lebanese physical education students who participated in this survey reported that 40.2% practice anaerobic exercises, 38.5% aerobic training, and 21.3% practice both. Half of the respondents (50%) decreased the number of trainings during the lockdown.

Table 1. Descriptive statistics for gender and age of physical education students.

Variables	Min	Max	Mean	St.Dev.	Frequency (n)	Percent (%)
Gender						
Female					69	39.7
Male					105	60.3
Age						
20 year and younger					66	38
21–25 years					88	50
26 years and older					21	21
Body height (cm)						
Male	160	197	179	0.55		
Female	152	180	166	0.55		
Body mass before lockdown (kg)						
Male	57.1	107	74.4	8.73		
Female	42.4	81.5	55.9	6.86		
Body mass after lockdown (kg)						
Male	57.3	110.2	76.3	9.03		
Female	44	85.2	57.9	7.2		
Type of training						
Aerobic					67	38.5
Anaerobic					70	40.2
Mixed training					37	21.3

Body mass of the participants increased on average by 1.9 kg in male students and 2.0 kg in female students during the three months of COVID-19 lockdown. Paired sample *t*-test determined a significant ($t = -11.956$, $p < 0.001$) but trivial (mean difference = 1.94 kg (2.6%), Cohen's $d = 0.15$) effect of pandemic lockdown on the body mass of men and significant ($t = -13.733$, $p < 0.001$) but small (mean difference = 1.99 kg (3.6%), Cohen's $d = 0.3$) effect in women students. The analysis of individual changes in body mass revealed a small to major increase in body mass in 96 (55.2%) participants (Figure 1). The rate of participants who did not substantially increase body mass was higher in females (47.8%) than in males (42.9%). A small increase occurred in 28 males (26.7%) and 21 female students (30.4%). A moderate increase occurred in 28 males (26.7%) and 14 females (20.3%), while a major increase occurred in 4 male (3.8%) students and 1 female (1.4%) student.

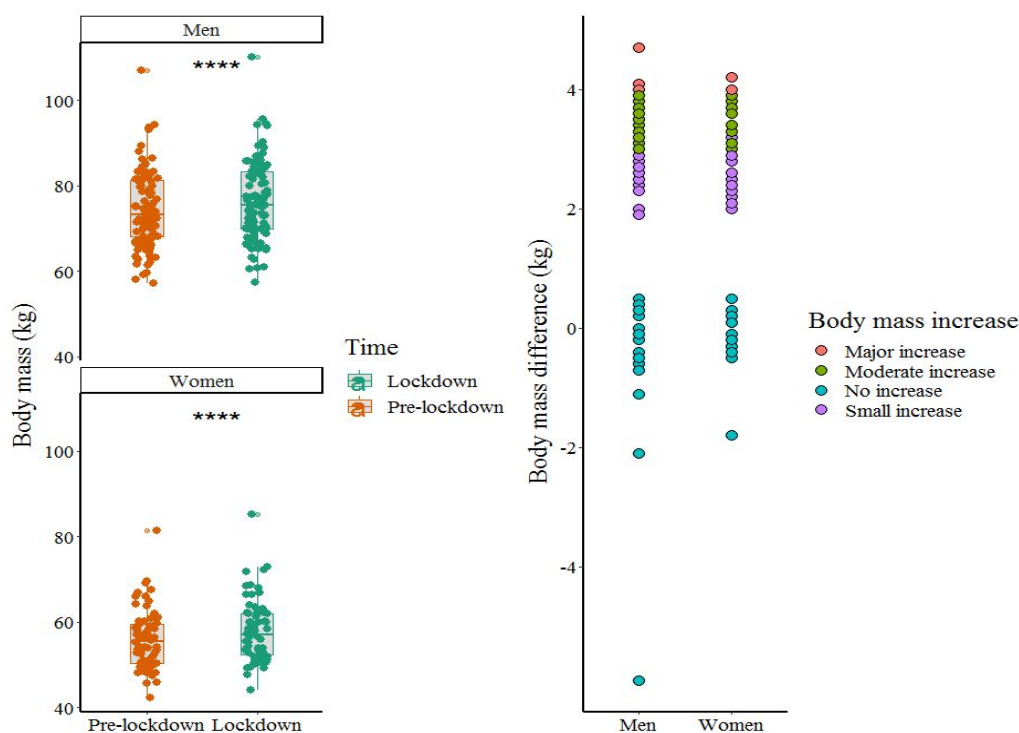


Figure 1. Effects of lockdown on body weight and distribution of increment sizes. Note: **** Significant at $p < 0.001$.

Individual changes in body mass resulted in significant changes in distribution of nutritional status of students (χ^2 (df = 4, 174) = 195, $p < 0.01$) caused by lockdown (Figure 2). There were significantly fewer girls in the overweight/obesity group compared to boys, both before lockdown (χ^2 (df = 2, 174) = 23.86, $p < 0.01$) and after lockdown (χ^2 (df = 2, 174) = 20.75, $p < 0.01$). Before the lockdown, 10 (5.7%) students were categorized as underweight, 138 (79.3%) students as having normal weight, and 26 (14.9%) students as overweight/obese. After the lockdown, 7 (4.0%) students were underweight, 132 (75.9%) students had normal weight, while 35 (20.1%) students were overweight/obese.

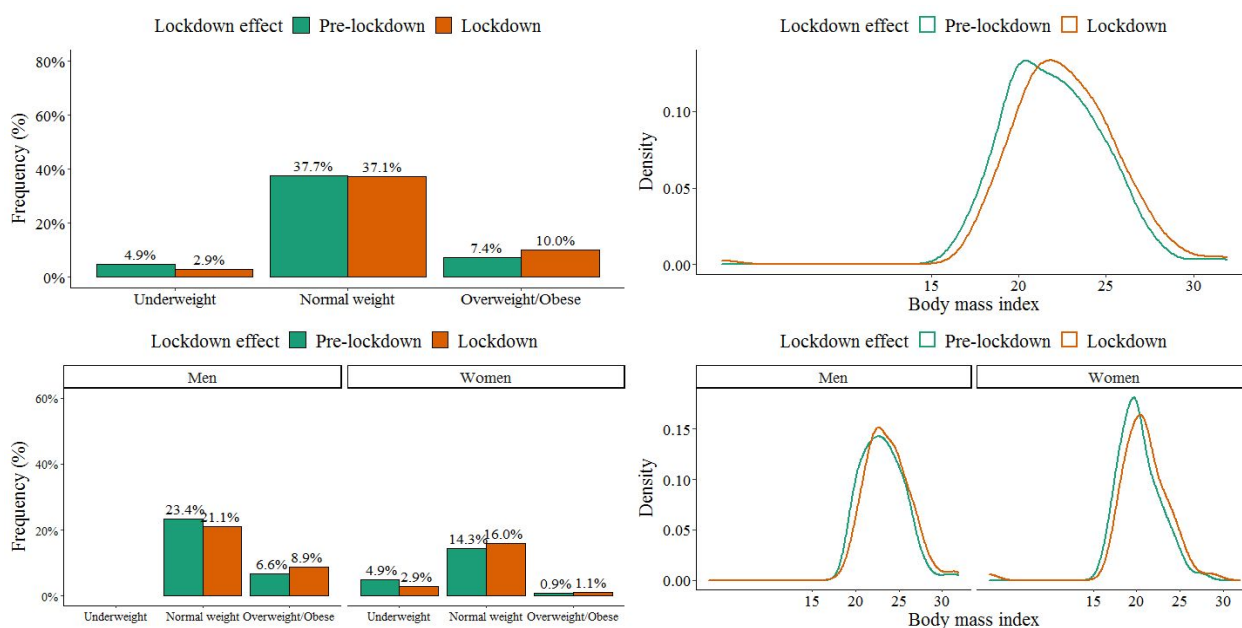


Figure 2. Distribution changes caused during the lockdown.

There was no significant difference in the weight gain according to gender (χ^2 (df = 3, 174) = 1.95, p = 0.58). However, the results suggest that the increase in weight gain could be affected by physical activity habits as fewer subjects with no decrease in training habits increased body mass (Table 2). Among students who retained their level of physical activity, 15 had small change in body mass and 9 had moderate change in body mass, while among the subjects who decreased physical activity during lockdown, 15 showed no change, 34 small, 33 moderate, and 5 subjects had a major increase in body mass. There was a statistically significant difference in the weight gain, between participants who did not decrease the number of training sessions and those who decreased the number of training sessions (χ^2 (df = 6, 174) = 55.9, p < 0.01). There was no statistically significant difference in the body mass increase according to type of training (χ^2 (df = 6, 174) = 11.1, p = 0.07).

Table 2. Increase in body mass related to changes in training behavior.

Body Mass Increase	Decreased	No Decrease	Total
No change	15	62	77
Small increase	34	15	49
Moderate increase	33	9	42
Major increase	5	0	5

4. Discussion

The main findings of this study showed that COVID-19 lockdown had a significant negative effect on body mass of physical education students of both sexes. Although the effect size analysis showed trivial to small changes in body mass on a group level, observing the individual changes revealed a significant number of participants who had a moderate to major increase in body mass. This reflected in shifting the distribution of nutritional status towards overweight/obese on a general level as the prevalence of overweight/obese students significantly increased in both male and female students. This could partially be attributed to reduced physical activity, given that about 50% of students reported a reduction in training frequency during the lockdown. Moreover, among those who reported a reduction in training frequency, 72 had a small to major increment in body mass, which was three times larger number of students than in those who claimed to continue with the same training frequency. In addition, in the no decrement in training frequency group, no student had a major increment in body mass. Therefore, maintaining physical activity behavior despite lockdown seems to have mitigated the negative effects of lockdown on body mass such as increment in body fatness.

The obtained results are in line with previous studies [37,38]. In a study conducted on 628 students of the University of Al-Ahsa, Saudi Arabia, 32% increased their body mass, 22% reduced their body mass, and 46% maintained the same body mass during COVID-19 lockdown [37]. Furthermore, 26% and 26.9% of their students were overweight (i.e., BMI = 25–29 kg/m²) before and after the lockdown, respectively, which was a smaller increase than in our study (from 14.9% before to 20.1% after the lockdown). A study in the academic community in northern Italy showed that more than two thirds of participants perceived changes in body mass after two months of home isolation (i.e., 43.3% perceived a body mass increase and 26.6% a body mass reduction) [38]. Overall, 57.0% of their sample was characterized by high levels of sedentary activities, and those who were sedentary noticed a higher gain in body mass compared to those less sedentary. This is in line with our findings on differences between those who reduced training frequency and who did not, thus providing further evidence that physical activity could be an effective approach to battling body weight gain during lockdown. Indeed, good physical activity behavior mitigates body weight gain not only during the lockdown but in general as well [13,39,40]. Considering this, physical education plays an important role in preparing youth and students to be physically active adults, which is why physical education, next to fun, should include learning as well [41]. Increase in the level of knowledge about health and health education results in an increase in pro-health behaviors [42].

Compared to obesity prevalence of the university sample of Lebanon where it was found that 24% of the sample were overweight and 4% were obese [43], in our study the percentage of students in the overweight/obesity group was lower. In addition, compared to students from the study on Saudi students [37], our sample had a lower prevalence of overweight/obese. This is expected because this specific sample of students does not represent the overall student population of Lebanon but only physical education students whose physical fitness is assessed every year as the entry exam to the faculty. It is also interesting to note that there were statistically significant differences in nutritional status related to the gender of the respondents before and after the lockdown. Although a smaller number of female respondents were in this sample, it could be noticed that most female students who opted to be a physical education teacher in the future do not have a problem with overweight/obesity, unlike male students (85.7% in overweight/obese group is males). This result is similar to the data obtained in a more diverse student population where the prevalence of obese male students larger than in females [43,44], which suggests that female students may be more perceptive of the importance of maintaining good body weight and more likely to be self-disciplined.

Considering the training frequency, our results are in contrast to Romero-Blanco et al. [45] who reported an increase in physical activity of health sciences students during COVID-19 confinement. However, they had a larger subsample of female students compared to male students, which was in contrast to our sample. This could partially explain the opposite trends in physical activity behavior given that men but not women are more motivated with elements related to the environment, such as competition or social recognition, while weight control was found to be the main motivation for women [46]. Our results are in line with the findings of Ammar et al. [17] who reported a significant decrement in all types of physical activity (i.e., vigorous, moderate, and walking intensity) during COVID-19 home confinement. Of note is that Romero-Blanco et al. [45], next to an increment in physical activity, reported an increment in sitting behavior as well. Remaining within their homes with discontinued daily life activities may unintentionally increase sedentary behavior, decrease physical activity, and inflict negative health consequences [47,48]. Therefore, it is of importance to find the ways and motivation to stay active while taking precautions [49].

The density plot clearly shows increase in number of obese students on account of the reduction in number of underweight and normal weight participants. Although the sample size was not large and represents only a specific group of students, these changes provide an insight into the epidemiology of obesity in case of lockdown. It is likely that these changes would be even larger in samples other than physical education students, older people, people with underlying health problems, or already obese. In contrast, these data also suggest the need for implementation of physical education for health at all universities so students increase the level of physical activity during their studies but also increase their knowledge of how physical activity improves their health and prevents negative impacts. This, with other governmental and local initiatives and policies, could have a positive impact on individual and public health.

Strengths and Limitations

This study employed a longitudinal design, which adds to the body of literature, as not many studies were able to do so. Public and private universities in Lebanon were targeted and the design of the online questionnaire used was simple and easy to be filled. In addition, body mass and height were measured directly, and not obtained by self-assessment. However, this study is not without limitations. The sample could have consisted of students from different fields of study to better reflect the student population of Lebanon. The sample size could be larger. Body composition could have been assessed along with body mass to provide an insight into tissue changes. There were no inclusion/exclusion criteria for this study so we could not control whether someone reduced exercise frequency due to reasons other than lockdown (i.e., was infected by COVID-19). Finally, we did not study

the eating habits during these three months, which is among the major influencing factors on body mass.

5. Conclusions

COVID-19 lockdown significantly impacted the body mass of physical education students. The impact was small when observed in the whole sample, but the analysis of individual cases revealed that a significant number of students had a moderate to major increase in body mass. This was reflected in a significant shift in distribution of nutritional status towards overweight/obese because students whose body mass was in normal ratio with their body height increased sufficiently to pass into the overweight/obese group. One important mechanism that partially explains these changes in body mass could be attributed to changes in physical activity behavior of students as half of them reduced the training frequency. Moreover, students who reported a decrease in training frequency were more likely to have moderate to major increase in body mass compared to students who retained their exercise routine. Indeed, access to gyms, sports, and training facilities was obstructed but the fact that the other half of students retained their training frequency shows that being physically active is possible even in lockdown conditions. Even more so, it shows that maintaining a training routine hinders the negative effects of lockdown on body mass. Given that an increase in body mass increases all health risks including development of a serious reaction to coronavirus infection, remaining physically active is of high importance. Considering all other positive effects of physical activity on cardio-respiratory and muscle function, it is clear that physical activity should be implemented in health prevention. Future research should investigate more closely the effects of physical education on the public health system. Furthermore, the effects of implementing physical education at universities on students' motivation and ability to engage in exercise programs or a physically active life need to be investigated.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are available upon request from ivana.milanovic@fsfv.bg.ac.rs.

Conflicts of Interest: The authors declare no conflict of interest.

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