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Prospective Analysis of Levels and Correlates of Physical Activity during COVID-19 Pandemic and Imposed Rules of Social Distancing; Gender Specific Study among Adolescents from Southern Croatia

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Abstract: Background: Due to the COVID-19 pandemic, global authorities have imposed rules of social distancing that directly influence overall physical activity in populations. The aim of this study was to evaluate the trends of changes in physical-activity levels (PALs) in adolescents and factors that may be associated with PALs among the studied boys and girls. Methods: Participants in this prospective study comprised 388 adolescents (126 females; mean age: 16.4 ± 1.9 years) from southern Croatia who were tested at a baseline (before the imposed rules of social distancing) and at a follow-up measurement (three weeks after the initiation). Baseline testing included anthropometric variables, variables of fitness status (done at the beginning of the school year), and PALs. At the follow-up, participants were tested on PALs. PALs were evaluated over an online platform using the Physical Activity Questionnaire for Adolescents. Results: A significant decrease of PALs was evidenced for the total sample (t-test = 3.46, $p < 0.001$), which was primarily influenced by a significant decrease of PALs in boys (t-test = 5.15, $p < 0.001$). The fitness status (jumping capacity, abdominal strength, aerobic endurance, and anaerobic endurance) was systematically positively correlated with PALs at the baseline and follow-up among boys and girls, with the most evident association between aerobic and anaerobic endurance capacities and PALs. Correlations between anthropometric and fitness variables with changes in physical activity (e.g., the difference between baseline and follow-up PALs) were negligible. Conclusions: Differences in PAL changes between genders were probably related to the fact that PALs among boys were mostly related to participation in organized sports. Correlations between baseline fitness status and PALs indicated the importance of overall physical literacy in preserving PALs in challenging circumstances, such as the COVID-19 pandemic observed here.

Keywords: physical activity; pandemic; COVID-19; puberty; fitness; physical literacy

1. Introduction

Physical activity provides numerous benefits, including those directly related to the prevention of cardiovascular diseases, type II diabetes, colonic cancer, and obesity [1–3]. Therefore, reaching the appropriate physical-activity levels is an important public-health concern, while some forms of physical activity are proven to be beneficial for persons with severe health conditions [1,4–6]. Knowing the problems related to the lack of regular physical work (due to technological advancements) and

reduced active transportation (mostly because of a busy daily schedule and distances that cannot practically be covered by active transportation), reaching an appropriate level of physical activity is an important global topic [7,8]. The negative influence of reduced physical activity is generally expected in late adulthood. However, knowing that practically all human behaviors related to health are developed and formed in childhood and adolescence, these periods of life are of the upmost importance for the promotion of physical activity [9,10]. Not surprisingly, studies have frequently investigated the level of physical activity and factors that influence physical-activity levels in various age groups, including adolescents [11–13]. Indeed, the period of adolescence is particularly interesting, as there is a growing body of evidence showing that daily physical activity rapidly decreases in this period of life [13]. Contextual factors that result in such trends are numerous, and include sociocultural, school-related, sport-related, and familial factors [14,15]. However, irrespective of the specific causes for changes in physical-activity levels, the importance of physical activity remains an important issue in global public-health efforts.

The problem of the decrease of physical-activity levels (PALs) in adolescents from Croatia and the surrounding countries had not been systematically studied until recently. However, negative trends in motor competences and a decrease in physical fitness had been evidenced for quite some time, while recent studies confirmed global negative trends of an alarming decrease in PALs [13,16]. Specifically, Stefan et al. studied adolescents from the Croatian capital of Zagreb, and evidenced a significant decrease of PALs in both boys and girls between the first and second grades of high school (approximately from 15 to 17 years of age) [16]. In brief, total energy expenditure was reduced by 13 kcal/kg/day on average, with a significant decline of moderate and vigorous physical activity [16]. Supportive of this, a recent study confirmed a significant decrease of PALs in Bosnian and Herzegovinian adolescents between 16 and 18 years [13].

The current coronavirus disease (COVID-19) is causing global health concerns. With almost 2.5 million confirmed cases and more than 130,000 deaths (as of 16 April 2020), COVID-19 has had an impact on the majority of the world's population, and there is practically no region that is not directly or indirectly impacted by this threat [17]. Although most people infected with the COVID-19 virus experience a mild to moderate respiratory illness and recover without any special treatment, some people (i.e., older individuals and those with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer) are more likely to develop a serious illness. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose, and therefore measures of so-called social distancing are considered an important epidemiological preventive tool. Following the suggestions from the World Health Organization, in most countries with confirmed COVID-19 cases, authorities introduced some form of social distancing for their citizens in order to prevent the spread of the virus through social contact [18].

While COVID-19 causes detrimental health consequences by itself, it is also clear that social distancing negatively influences the PALs of all age groups. Indeed, Chen et al., in early February 2020, just after the outbreak of the disease, precisely identified an almost certain increase of sedentariness due to the on-going virus and consequent stay-at-home politics [19]. Naturally, in the following period, several papers highlighted the problem of physical activity in such a situation, the necessity of physical activity and its importance for overall health and well-being, and suggested models of physical exercises that can be performed at home during the COVID-19 pandemic [20–22]. However, there is an evident lack of studies that directly examine changes in PALs during the COVID-19 pandemic. To the best of our knowledge, no study has so far reported changes in PALs among adolescents and factors that may be associated with changes in PALs induced by the COVID-19 pandemic in this age group.

This prospective study aimed to evaluate the level of changes in PALs among adolescents from southern Croatia, specifically for boys and girls. We also explored factors that may be associated with PALs, and changes in PALs, for the studied adolescents. We hypothesized that the PALs of adolescents would be significantly reduced as a consequence of the COVID-19 pandemic and the imposed social-distancing measures

2. Materials and Methods

2.1. Participants and Design

Participants in this prospective study were adolescents from a Croatian coastal region—specifically, from Split-Dalmatia County. During the course of the study, all participants were attending high school in this region, and the majority of them were residentially located in urban regions. At the study's baseline, they were 16.4 ± 1.9 years of age (from 15 to 18 years). All participants were healthy, meaning that they regularly participated in physical education classes 2 times a week, while some of them were involved in extracurricular sporting activities. Specifically, 35% of the studied participants reported involvement in organized sport activities at the study's baseline (i.e., when the fitness variables were collected at the beginning of the school year—please see later for the study's design), and the majority of that 35% reported involvement in competitive sports (e.g., football/soccer, handball, and martial arts). This study was originally initiated as part of another investigation ("The influence of sport and physical activity on substance use and misuse in adolescents from Croatia and Bosnia and Herzegovina; a prospective study"). Therefore, all participants were previously informed about the study aims, risks, and benefits, and parental consent was obtained before the study's baseline (please see later in the text for the study's design). The original study was approved by the Ethical Board of the University of Split, Faculty of Kinesiology (EBO: 2181-205-05-02-05-20-004).

The current study included two measurements, baseline (done before the imposed measures of social distancing), and follow-up (done during the period of social distancing). Baseline-tests included anthropometrics, fitness status, and baseline PALs (PAL-BL—please see below for details on variables). For the purpose of this study, it is important to note that in this period, the COVID-19 pandemic was not directly translated into changes in the school schedule and duties in the territory of Croatia. There were also no travel bans or limitations with regard to sporting and social activities in the country's territory, although people with a confirmed COVID-19 infection were placed in self-isolation, quarantined (detained), and/or hospitalized. The follow-up measurement included the testing of PALs (PAL-FU). In this period, numerous measures related to control over the COVID-19 pandemic had already been implemented. Schools and universities were closed in March 2020, while as of 20 March, the government of Croatia implemented other extensive social-distancing measures, including banning public gatherings and the closure of cafes, restaurants, shopping centers, sports and fitness centers, cinemas, theaters, and places of worships (e.g., churches and temples). However, grocery stores, gas stations, pharmacies, and similar businesses remained open with the implementation of measures of social distancing. At the time of the follow-up testing, local authorities were also entitled to close open playgrounds and parks, which was the case in the region from where the sample was drawn (Split-Dalmatia County). Meanwhile, there was no strict prohibition of different forms of individual training (e.g., running, cycling). The study's design and the characteristics of the periods of time when the study was done are presented in Figure 1.

2.2. Variables and Measurements

The variables in this study included basic sociodemographic characteristics (age and gender—both collected by regular school evidence and diaries), anthropometrics (body height and mass and the calculated body mass index, BMI = mass (kg)/height^2 (m)), variables of physical fitness, and PALs.
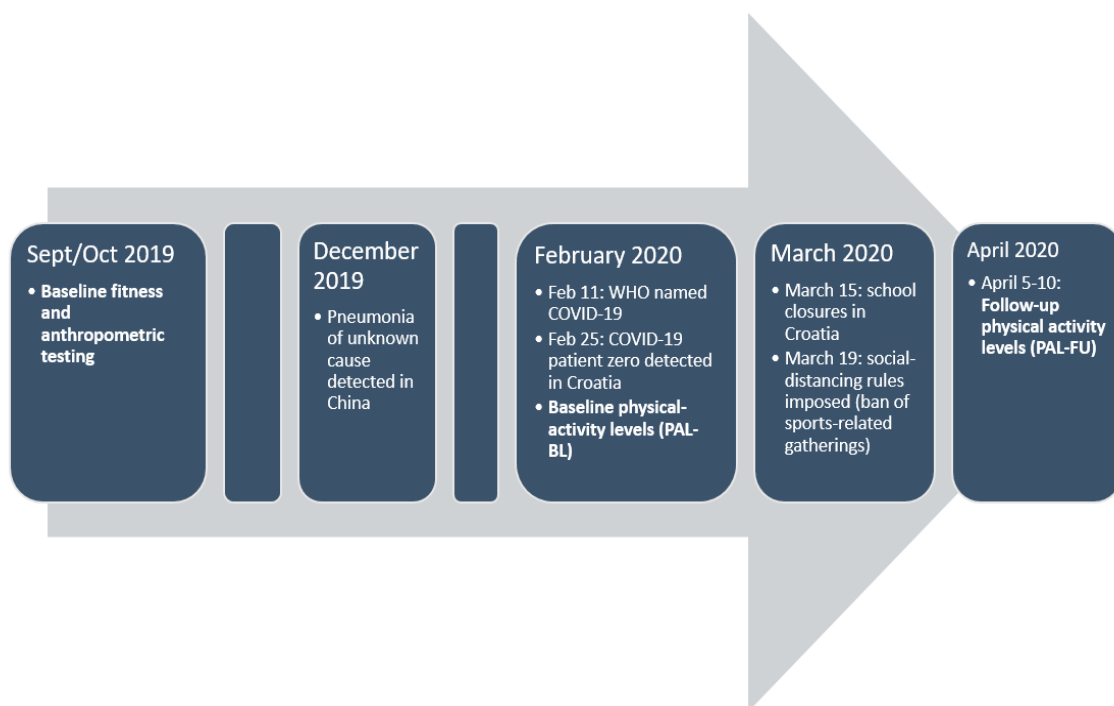
Figure 1. Study design, time frames, and indicators related to the COVID-19 pandemic for the study period.

PAL-BL and PAL-FU were measured by the Physical Activity Questionnaire for Adolescents (PAQ-A), and data were collected through the Internet-based SurveyMonkey platform (SurveyMonkey Inc., San Mateo, CA). The PAQ-A has already been confirmed to be a valid test for the evaluation of PALs in similar samples of participants from Croatia and the surrounding countries, with reliability indicated by a Cronbach's Alpha value of 0.763 [13,23,24]. This questionnaire consists of nine items asking participants to report a seven-day recall. The theoretical score ranged from 0 (minimal) to 5 (maximal physical-activity level). The first 8 items were scored on a 5-point scale and included questions on different types of physical activity (i.e., activity during sports, physical education, active transportation, and free play); the ninth item did not contribute to the overall score and it was only used for the selection of participants whose results should not be observed as reliable and valid (e.g., evidencing participants who suffered a sort of injury/illness, and whose physical activity was therefore reduced). For the purpose of the study, three scores obtained by PAQ-A were evidenced: (i) PAL-BL; (ii) PAL-FU; and (iii) the delta score (PALΔ), calculated as the difference between PAL-BL and PAL-FU as previously suggested [13], providing evidence of the magnitude of change in physical activity that occurred as a consequence of the imposed rules of social distancing because of the COVID-19 pandemic.

Physical fitness was evidenced by variables mostly included in the mandatory fitness panel in the Croatian educational system. Therefore, in this study we evaluated broad jumps (broad-jump), the maximal number of sit-ups performed in 60 s (sit-ups), a static hold in hanging with bent arms (bent-arm-hang), a sit-and-reach test (sit-and-reach), a 400 meter run (run-400m), and a multilevel endurance fitness test (multilevel-test). All tests were measured by experienced evaluators—physical education teachers.

The broad-jump was used as a measure of jumping (power) capacity. This test was performed in the gym, from a standing position using standardized equipment (Elan, Begunje, Slovenia). Regular instructions were given to the participants that allowed them to begin the jump with bent knees and to swing their arms to assist in the jump. The test was performed three times within approximately 20 s, and the best result (in cm) was used as the final achievement.

Sit-ups were measured in the gym in order to evaluate the strength of the abdominal region. The test was done with palms locked behind the head and knees bent under 90 degrees. The participants' feet were fixed during the test execution (partner sitting on the feet and holding the examiner's lower legs with two hands), and one testing trial was done with a number of completed repetitions in a 1 min period.

The bent-arm-hang was used as a test of static upper-body strength. The test was performed in the gymnasium over one trial. Participants were helped to perform one pull-up on a standard horizontal bar. When the arms were maximally bent (chin over the bar), a participant had to hold this position for as long as possible. The test result was expressed in seconds.

Sit-and-reach was performed in the gymnasium as a test of flexibility. The test was done using a standard measuring box. Participants sat on the floor with legs stretched out straight ahead. Shoes were removed. The soles of the feet were placed flat against the box, with both knees locked and pressed flat to the floor. With the palms facing downwards and the hands on top of each other or side by side, participants reached forward along the measuring line placed on the box as far as possible and held that position for 1–3 s while the distance was recorded. The test was done over three trials, and the best result (in cm) was recorded.

Run-400m consisted of running a distance of 400 m at a concrete handball playground of standard dimensions (40 × 20 meters; 3 full circles + 40 m). The test was performed as a measure of anaerobic capacity, and the results were recorded in seconds.

The multilevel-test of aerobic endurance included running continuously between two points that were 20 m apart [25]. Runs of 20 m distance were synchronized with a prerecorded sound signal that beeped at the set intervals. At the beginning of the test, two consecutive beeps were separated by 9 s, and as the test proceeded, the interval between beeps decreased (with an approximately 10% increase in tempo per minute). Consequently, participants had to increase their running speed over the course. The test was finalized when participants were not able to keep in sync with the sound signal. Specifically, one missed lap was allowed, but the tester recorded the time (in minutes and seconds) of the second missed lap as the final result for each participant.

2.3. Statistical Analyses

The parametric nature of the variables was checked with the Kolmogorov-Smirnov test for distribution normality, and all variables were confirmed to be normally distributed. Therefore, means and standard deviations were reported for all variables but gender.

To demonstrate the differences between PAL-BL and PAL-FU, and the possible effect of gender on those differences, repeated measure factorial analysis of variance (ANOVA; gender × measurement) with *t*-test post hoc analyses was calculated. To evaluate the effect sizes, the partial eta squared values (η2) were also reported (small effect size (ES): >0.02; medium ES: >0.13; and large ES: >0.26).

In order to evidence the association between the anthropometric and fitness variables and PALs, univariate and multivariate correlation analyses were applied. First, correlations between the variables were evaluated by Pearson's correlation coefficients. Next, multivariate associations were evaluated by multiple regressions. Prior to the multiple-regression calculation, predictors were checked for multicollinearity, and due to a high-variance inflation factor, the BMI was not included in the multiple regressions. The analyses were calculated for the total sample and stratified for gender.

For all statistical analyses, a *p*-value of 95% was applied, and the statistical package Statistica ver. 13.5 (Tibco Inc., Palo Alto, CA) was used for all calculations.

3. Results

Descriptive statistics for the anthropometric and fitness variables with differences between genders are presented in Supplementary Table S1. In brief, boys were taller, heavier, and achieved significantly better results in most of the fitness variables than girls. Girls performed better than boys in the flexibility test (sit-and-reach). No significant differences between genders were found in BMI and run-400m.

Significant ANOVA effects for PALs were evidenced for the main effects "measurement" (F-test = 4.29, $p < 0.05$; small effect size), "gender" (F-test = 9.47, $p < 0.001$; small effect size), and for interaction (F-test = 12.01, $p < 0.001$; small effect size) (Table 1).

Table 1. Repeated measurement factorial analysis of variance – ANOVA results (F-test, *p*-level of significance, η^2-effect size).

ANOVA	Main Effects						Interaction		
Effects	Gender			Measurement			Gender × Measurement		
Variables	F-test	*p*	η^2	F-test	*p*	η^2	F-test	*p*	η^2
PAL	9.47	0.001	0.05	4.29	0.04	0.03	12.01	0.001	0.07

Post-hoc analysis evidenced a significant decrease of PALs over the course of the study for the total sample of participants (2.99 ± 0.70 and 2.67 ± 0.60 for PAL-BL and PAL-FU, respectively; *t*-test = 3.46, $p < 0.001$). When differences were separately calculated for gender, the decrease of PALs was significant for boys (3.10 ± 0.78 and 2.79 ± 0.82 for PAL-BL and PAL-FU, respectively; *t*-test = 5.15, $p < 0.001$), but no significant differences were found for girls (2.71 ± 0.66 and 2.59 ± 0.90, respectively; t-test = 0.61, p > 0.05). Boys and girls significantly differed in PAL-BL (*t*-test = 4.30, $p < 0.01$) and PAL-FU (*t*-test = 2.11, $p < 0.05$), with higher PALs among boys (Figure 2). Of all the components of the PAQ-A, the most evident decrease was found for sub-scores related to physical education classes (from an average result of 3.1 evidenced at the baseline, to 1.0 (minimum PALs) at the follow-up).
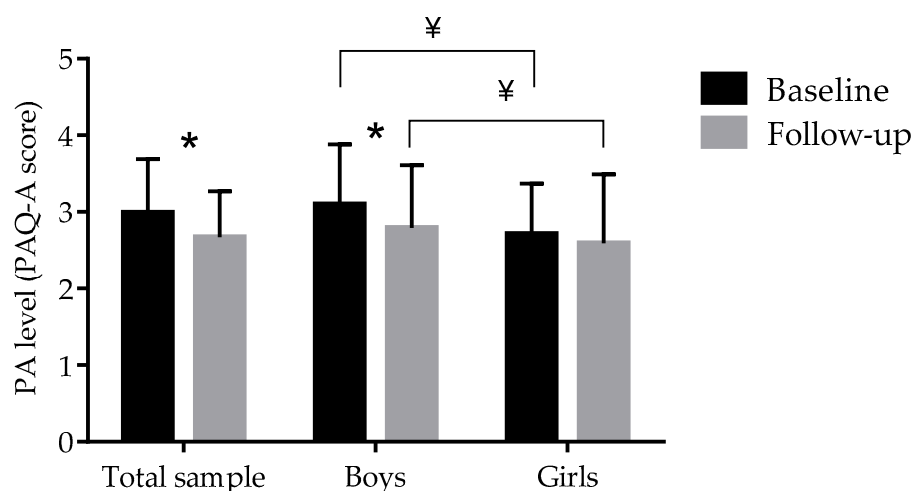

Figure 2. Physical-activity levels for the total sample, and gender stratified, with indicated significant differences between groups (¥) and within groups (*).

Correlations between the anthropometric and fitness variables with physical-activity values for the total sample, and stratified for gender, are presented in Tables 2–4. When observed for the total sample, PAL-BL was correlated with body height, body mass, BMI, the broad jump, sit-ups, the bent-arm-hang, and the multilevel-test. When gender stratified, the PAL-BL was correlated with sit-ups, the bent-arm-hand, and the multilevel-test among boys. Among girls, significant correlates of PAL-BL were the broad-jump, sit-and-reach, bent-arm-hang, and run-400m (Table 2).

Table 2. Pearson's product moment correlations between anthropometric and fitness variables, and physical activity for the total sample and separately for boys and girls at the baseline.

Variables	Total (n = 401) Pearson's R	Boys (n = 271) Pearson's R	Girls (n = 130) Pearson's R
Physical activity at baseline			
Body height	0.23 ***	0.01	0.08
Body mass	0.21 ***	0.04	0.07
Body mass index	0.11 *	0.05	0.02
Broad-jump	0.29 ***	0.05	0.24 **
Sit-ups	0.27 ***	0.12 *	0.17
Sit-and-reach	0.03	−0.09	0.25 **
Bent-arm-hang	0.32 ***	0.17 **	0.23**
Run-400m (-)	0.04	0.07	−0.22 *
Multilevel-test	0.36 ***	0.28 ***	0.19*

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, (−) indicates opposite metrics of run-400m, with better achievement evidenced as a lower numerical value

Table 3. Pearson's product moment correlations between anthropometric and fitness variables, and physical activity at the follow-up for the total sample and separately for boys and girls.

Variables	Total (n = 401) Pearson's R	Boys (n = 271) Pearson's R	Girls (n = 130) Pearson's R
Physical activity at follow-up			
Body height	0.06	0.08	−0.01
Body mass	0.03	0.04	−0.06
Body mass index	−0.02	−0.01	−0.07
Broad-jump	0.11 *	0.03	0.22 *
Sit-ups	0.15 *	0.11	0.16
Sit-and-reach	0.07	−0.04	0.18 *
Bent-arm-hang	0.13 *	0.07	0.17
Run-400m (-)	0.07	−0.12 *	−0.22 *
Multilevel-test	0.12 *	0.13 *	0.13

Note: * $p < 0.05$, (-) indicates opposite metrics of run-400m, with better achievement evidenced as lower numerical value.

Table 4. Pearson's product moment correlations between anthropometric and fitness variables, and physical activity difference between the baseline and follow-up for the total sample and separately for boys and girls.

Variables	Total (n = 401) Pearson's R	Boys (n = 271) Pearson's R	Girls (n = 130) Pearson's R
Physical activity difference between baseline and follow-up			
Body height	0.17 ***	−0.10	0.09
Body mass	0.18 ***	0.00	0.13
Body mass index	0.13 **	0.06	0.10
Broad-jump	0.17 ***	0.02	−0.02
Sit-ups	0.10 *	0.00	−0.02
Sit-and-reach	−0.05	−0.05	0.03
Bent-arm-hang	0.18***	0.10	0.03
Run-400m (-)	−0.04	−0.08	0.04
Multilevel-test	0.23 ***	0.15 *	0.04

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, (−) indicates opposite metrics of run-400m, with better achievement evidenced as a lower numerical value.

The broad-jump, sit-ups, bent-arm-hang, and multilevel-test were correlated with PAL-FU for the total sample. The run-400m and multilevel-test were positively correlated with PAL-FU in boys, while the broad-jump and run-400m were correlated to PAL-FU among girls (Table 3).

The changes in PALs (e.g., the decrease of PALs between the baseline and follow-up) were associated with the anthropometric and fitness variables, but only in the total sample. The multilevel-test was correlated to PALΔ among boys, but no significant correlations between the anthropometric/fitness variables measured at the baseline and PALΔ were evidenced in girls (Table 4).

When calculated for the total sample of participants, the bent-arm-hang and multilevel-tests were significant predictors of PAL-BL (11% of the explained variance), sit-ups were partially significantly associated with PAL-FU (2% of the explained variance), while the multilevel-test was the single significant predictor of PALΔ (6% of the explained variance). Among boys, PAL-BL was determined by body mass and the multilevel-test (16% explained variance), with better PAL-BL for boys who were heavier and had better aerobic endurance. Further, aerobic endurance as evidenced by the multilevel-test was a significant predictor of PAL-FU in boys (6% of the explained variance). The achievement at sit-and-reach and the bent-arm-hang were partial predictors of PAL-BL in girls (9% of the explained variance). No significant multivariate associations were established between the studied predictors and PAΔ when participants were stratified for gender (Table 5).

Table 5. Forward stepwise multiple regression results between anthropometric and fitness predictors and physical-activity levels criteria for the total sample and stratified for gender and community.

Criteria/Predictors	Total (n = 401)	Boys (n = 271)	Girls (n = 130)
	Beta	Beta	Beta
Physical activity at baseline			
Body height	−0.19	−0.25	
Body mass	0.22	0.38 **	0.15
Sit-and-reach		−0.16	0.18 *
Bent-arm-hang	0.19 *	0.19	0.22*
Run-400m (-)		0.12	
Multilevel-test	0.25 **	0.39 **	
Multiple R	0.38 **	0.43 *	0.31 *
Physical activity at follow-up			
Broad-jump			0.11
Sit-ups	0.15 *	0.10	
Sit-and-reach			0.12
Run-400m (-)		−0.14	−0.17
Multilevel-test		0.30 *	
Multiple R	0.14 *	0.25*	0.29 *
Differences in physical activity between baseline and follow-up			
Body height	0.10		
Body mass			0.13
Multilevel-test	0.18 *	0.15	
Multiple R	0.25 **	0.14	0.12

Note: * $p < 0.05$, ** $p < 0.01$, (−) indicates opposite metrics of run-400m, with better achievement evidenced as a lower numerical value.

4. Discussion

Although the results of the study allow a broad discussion on a problem, we next focus on the most important findings related to the study aims. First, a significant decrease of PALs was evidenced for boys. As a result, our initial study hypotheses may be partially accepted. Second, analyses evidenced a positive correlation between fitness status and physical-activity levels before and after the imposed

rules of social distancing. Specifically, strength and aerobic endurance were evidenced as the most important correlations of PALs in boys. Meanwhile, the physical-activity levels of girls were correlated with all measured fitness variables. Finally, correlations between anthropometric and fitness variables with PAL changes were generally negligible.

4.1. Changes in Physical-Activity Levels and Baseline Correlates of Physical-Activity Levels

There is global concern about PAL reduction as a result of the COVID-19 pandemic [19,20]. Therefore, our study aimed to evaluate changes in PALs among adolescents from southern Croatia that occurred as a result of social distancing imposed due to the COVID-19 pandemic. In general, the results confirmed that adolescents reduced their PALs, but the evidenced changes were gender specific. While the PALs of boys significantly decreased from the baseline to the follow-up measurement, changes were not significant for girls. Although these results may seem controversial, they can be explained by two specific reasons: (i) baseline differences in physical activity and (ii) the nature of the physical activity in the studied groups.

PAL-BL for boys was significantly greater than that in girls. This is supported by previous studies that examined similar topics in Croatia and the surrounding countries [13,16] as well as by studies from other regions where authors regularly evidenced higher PALs for boys than in girls of the same age [26]. Because of such differences, the measures of social distancing resulted in a more evident decrease of PALs in boys than in girls. Second, boys and girls also differ in the "nature" of their physical activity. In brief, investigations done in our region have regularly confirmed that boys are more often involved in competitive sports than girls [27–29]. When follow-up measurements were taken, sporting activities in sports clubs and facilities had been banned. Logically, overall physical activity among boys decreased to a greater extent than among girls.

Anthropometrics were not significantly associated with PALs in boys or in girls. On the other hand, the fitness status was significantly associated with PAL-BL both in boys and girls, with a better fitness status among adolescents with higher PAL-BL. These results may be observed as expected as studies have regularly confirmed such an association among various age groups, including adolescents [30,31]. Irrespective of some differences in associations between genders, we cannot currently specify if fitness status is the factor of influence on the baseline PALs, or if causality should be interpreted in the opposite direction (i.e., higher PALs may positively influence the fitness status). Naturally, it is possible that those adolescents who were more physically active consequently developed their fitness capacities to a greater extent than their less active peers. On the other hand, it is also understandable that adolescents with better developed fitness capacities would feel comfortable in physically demanding activities and would, therefore, report higher PAL-BL. Indeed, both specified causal directions are possible. However, for the purpose of this study, the interpretation of baseline causality is not of the upmost importance, and therefore more attention needs to be paid to the prospective analysis of the influence of the baseline fitness status on PAL-FU.

4.2. Correlates of Activity Levels in the Period of Imposed Rules of Social Distancing

The fact that baseline fitness status determined the PAL-FU both in boys and girls is one of the most important findings of this study. It probably points to the fact that boys and girls of better (initial) fitness status tended to have higher PALs, even in the period of when situations and imposed rules logically prevented them from being physically active in their usual manner (e.g., participation in organized sports and physical-education classes). In explaining these findings, some specifics of the epidemiology of physical activity, as well as factors known to be associated with physical activity, may be helpful [32]. Specifically, studies have already evaluated factors that positively and/or negatively influence PALs. Among the most important ones that could be particularly interesting to both (i) the studied adolescents here and (ii) the specifics of the study period (i.e., the COVID-19 pandemic) are: self-efficacy, an intention to exercise, enjoyment of exercise, perceived health or fitness, self-motivation, social support, the expectation of benefits from exercise, and the perceived benefits [33].

Although we did not collect the data explicitly in this study, it is generally known and therefore expected that adolescents who had a better fitness status at the study's baseline actually had most of the previously specified characteristics (e.g., better self-efficacy, a higher intention to exercise) simply because a better fitness status must be observed as a consequence of systematic work (i.e., physical training). Therefore, involvement in physically demanding activities (that result in a better fitness status) positively influenced even (i) self-efficacy (as fitter adolescents are more likely to believe in their own ability), (ii) enjoyment in exercise (fitter adolescents already experienced the "positive" hormonal responses to exercise), and (iii) personal awareness of the clear benefits of physical exercising (fitter adolescents are familiar with exercise, they are aware that exercising is effective, and they expect further benefits) [34–36]. Therefore, it is more expected that adolescents who have such characteristics probably participate in a certain type of physical exercise even when settings do not support being active (e.g., in the period of social-distancing).

Further, other previously specified factors may also result in better PALs among adolescents who had better physical fitness at the baseline. For example, it is well documented that parental and peer support is a significant determinant of PALs in adolescence [37–39]. Consequently, it could be expected that adolescents with a better fitness status were properly socially supported in order to be physically active (i.e., experienced parental and peer support), which resulted in higher PAL-BA and a better fitness status. With regard to peer support, it must be stated that, although the environment changed due to the COVID-19 pandemic, social contacts were preserved, at least throughout social networks such as Facebook, Zoom, Skype, and Twitter. In the period when the follow-up measurement was done, parental influence may also have even been increased simply because adolescents were likely to spend more time at home together with their parents. Therefore, we may hypothesize that those adolescents who had experienced social support for an active lifestyle before were likely to experience social support for being physically active after social-distancing rules were employed.

The majority of the previously discussed factors that determined the influence of the baseline fitness level on follow-up PALs can be conceptualized through the term of physical literacy [40]. Specifically, physical literacy can be described as the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life. In an excellent overview of this concept, Mandigo et al. among others indicated that "physical literacy is crucial to the acquisitions by every child, young person, and adult of essential life skills that enable them to address challenges they can face in life" [41]. From our perspective, the previous citation summarizes different aspects of physical literacy that collectively resulted in the relationship between the fitness status and PALs in the current challenging times. Most specifically, adolescents with a higher level of physical literacy were able to apply and use their overall theoretical and practical knowledge even in a situation when regular physical activity was compromised. The adolescents who had better physical literacy were probably (i) well aware about the necessity and importance of physical activity, (ii) properly motivated to be physically active, and (iii) sufficiently skilled to choose and apply certain types of physical activity, even when circumstances drastically changed.

4.3. Limitations and Strengths

The most important limitation of the study comes from the fact that PALs were not objectively measured but self-reported by participants; therefore, self-reporting bias may appear. However, this limitation does not influence our findings to a great extent as similar bias can be expected for the baseline and follow-up measurement. The fitness level was exclusively observed by field testing procedures that are known to be less reliable than laboratory-based tests. Apart from the BMI, no other indices of body composition were included. Finally, our study included only few sociodemographic variables, which almost certainly limited the possibility of a comprehensive discussion.

This is one of the rare prospective studies that have examined changes in PALs occurring as a consequence of social distancing due to the COVID-19 pandemic, which is probably the most important strength of the investigation. To the best of our knowledge, this is one of the first

investigations where correlations of PAL changes were studied and reported for a relatively large sample of participants (adolescents). Knowing the overall importance of PALs in these challenging times, our study, although not the final word on the issue, contributes to knowledge in the field and will induce further investigations.

5. Conclusions

The study evidenced a significant decrease in PALs among adolescents from southern Croatia during the COVID-19 pandemic, but changes in PALs were mostly influenced by a decrease of PALs in boys. This is probably influence by the fact that the PALs of boys is generally determined by participation in formal sport and organized recreational activities (competitive sport in sports clubs and/or recreation in fitness centers and gyms), while the imposed rules of social distancing reduced their possibility to participate in such activities.

The baseline fitness status significantly influenced PALs at the baseline and follow-up, and the baseline fitness status was consistently related to higher PALs in the period when regular physical activities were limited due to the COVID-19 pandemic. These results could be observed as plausible for other situations where the standard physical-activity patterns of adolescents would be compromised and/or significantly changed (e.g., school recess, changes of place of residence, different types of personal isolation because of health-related issues, and weather conditions).

From our perspective, physical literacy is the baseline paradigm and milestone that should be conceptualized in public-health efforts targeted toward reaching an appropriate PAL in adolescence but also in the overall population.

We did not find evidence of an association between the studied fitness and anthropometric factors with changes in PALs induced by the COVID-19 pandemic. Therefore, further studies should explore other factors that could possibly influence PAL changes. In doing so special attention should be placed on the living environment.

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