

Article

# Levels and Changes of Physical Activity in Adolescents during the COVID-19 Pandemic: Contextualizing Urban vs. Rural Living Environment

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**Featured Application:** The study findings can be applied in the development of modalities and strategies aimed at the preservation of physical activity levels during crises similar to the COVID-19 pandemic.

**Abstract:** The COVID-19 pandemic and the social distancing implemented shortly after influence physical activity levels (PALs). The purpose of this investigation was to evaluate the changes in PAL and factors associated with PALs among Croatian adolescents while considering the impact of community (urban vs. rural living environment). The sample included 823 adolescents (mean age:  $16.5 \pm 2.1$  years) who were tested on baseline (from October 2019 to March 2020; before COVID-19 pandemic in Croatia) and follow-up (in April 2020; during the COVID-19 pandemic and imposed rules of social distancing). Baseline testing included anthropometrics, physical fitness status, and evaluation of PALs, while follow-up included only PALs (evaluated by a standardized questionnaire through an internet application). The results showed a significant influence of the living environment on the decrease of PAL, with a larger decrease in urban adolescents. Logistic regression showed a higher likelihood for normal PALs at baseline in adolescents who had better fitness status, with no strong confounding effect of the urban/rural environment. The fitness status of urban adolescents predicted their PALs at follow-up. The differences between urban and rural adolescents with regard to the established changes in PALs and relationships between the predictors and PALs are explained by the characteristics of the living communities (lack of organized sports in rural areas), and the level of social distancing in the studied period and region/country.

**Keywords:** exercise; predictors; puberty; SARS-CoV-2; lockdown

## 1. Introduction

Physical activity is described as the total amount of time spent engaged in daily life activities, work and school activities, recreational and sports activities, and other activities that increase the energy expenditure of the body [1]. Tracking the physical activity levels (PALs) is important research

interest in public health, as having sufficient PALs is associated with higher health-related quality of life [2–5]. Despite the conclusive evidence of the importance of physical activity at all ages, the problem is particularly important in youth, since the PALs in youth over the past few decades have significantly declined [6]. More specifically, 81% of the youth aged 11–17 years do not meet the recommended daily physical activity guideline of 60 minutes of moderate-to-vigorous physical activity [6,7]. It is approximated that PALs in adolescents decline with age by a mean of  $-7\%$  a year [8,9]. Therefore, there is a global consensus of the importance of tracking the changes in the trends of PALs and related influential factors [10].

Numerous factors influence PALs, with the emphasis on biological, psychological, social, and environmental factors [11]. Over the last decade, interest has risen in the investigation of the factors that directly or indirectly influence PALs in children and youth [12,13]. However, studies confirmed the importance of the living environment on lifestyle and consequently its influence on PAL [14,15]. For example, an international study confirmed that adolescents who live only a few kilometers from urban centers have a significantly different lifestyle from their peers who live in urban communities [16]. This is indirectly confirmed in studies conducted with Italian, Polish, Austrian, Cyprus, Portuguese, Spanish, and Slovak children and adolescents [14,17–22]. Children and adolescents living in urban vs. rural communities regularly differ not only in PAL (with higher PALs in urban adolescents) but also in fitness status and anthropometric/body built indices [15,21,23,24].

Although PALs are generally known to be influenced by certain personal (individual) characteristics (i.e., motivation, self-esteem, and conative facets), considering the established differences in PALs between rural and urban communities, it is expected that some specific factors associated with a community also determine the PALs among adolescents [22]. Indeed, the availability of equipment and public spaces for leisure activities (e.g., bike paths, squares, and courts), participation in the labor market, time spent outdoors, and perceived neighborhood safety, among other factors, were shown to be important determinants of PAL [15,25]. Logically, adolescents from urban communities are more involved in organized sports activities, whereas those who live in rural communities are more engaged in unstructured outdoor physical activities (e.g., free play and walking) [19,26].

Coronavirus disease 2019 (COVID-19), which was recognized in December 2019, was classified as a worldwide pandemic. The United Nations stated that the “COVID-19 pandemic is the defining global health crisis of our time and the greatest challenge we have faced since World War II”. Due to detrimental health consequences, COVID-19 should be observed as a serious security threat. Most of the countries with confirmed cases of COVID-19 infections imposed certain measures of social distancing, including lockdowns [27,28]. In addition to other measures of social distancing (e.g., the closing of shopping centers, schools, universities, and places of worship), lockdown measures included the closing of sports facilities (e.g., gyms, recreational centers, and sport-clubs) [29]. Therefore, a significant reduction in PAL was expected [30]. The claims about a decline of PALs as a result of the COVID-19 pandemic were indirectly proven by the globally popular Fitbit company, which produces activity tracking devices (Fitbit, Inc., San Francisco, CA), where data from more than 30 million users were collected. In brief, the decrease in PALs (as measured by the average number of steps per day) was 7%–38% when compared to the same period for 2019 [31]. Additionally, during the COVID-19 pandemic, schools were closed, and physical education classes were inaccessible. Therefore, the decrease in PALs would be particularly evident in children and adolescents [32].

Despite the global projections for a decrease in PALs among adolescents due to the COVID-19 pandemic and related lockdowns and social distancing, studies empirically demonstrating this are lacking. In the recent investigation, Sekulic et al. confirmed a higher decrease of the PALs in boys than in girls, which was explained by the alarming low levels of PALs in girls before the COVID-19 pandemic, and highlighted the necessity for further studies that take into account the possible influence of various environmental factors on changes in PALs [33]. However, to the best of our knowledge, no study has examined the changes in PALs while also considering the community type (i.e., urban vs. rural environment). In this study, we aimed to explore the changes in PALs that occurred as a result

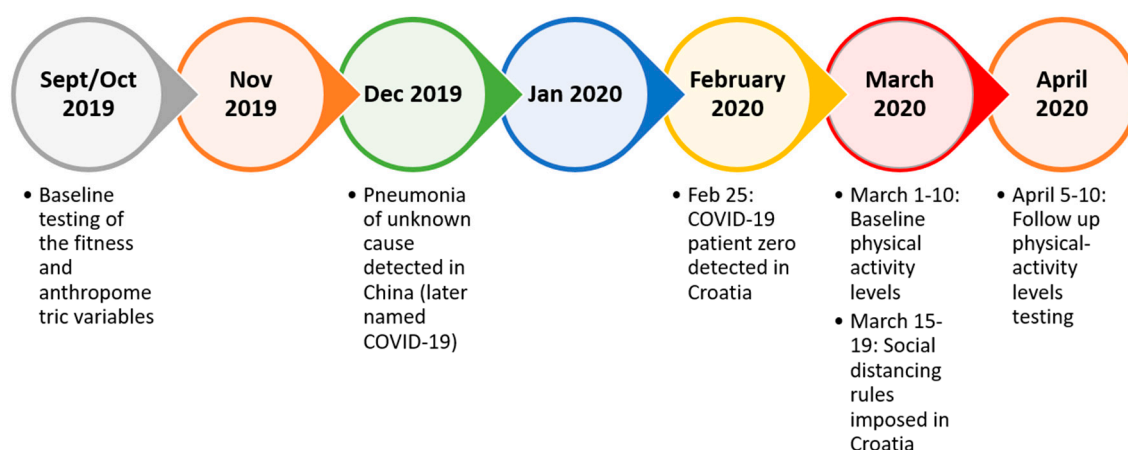
of COVID-19 and social distancing measures in urban and rural adolescents from Croatia. We also examined the possible associations between fitness status and PAL before and during the COVID-19 pandemic, as already suggested [33]. We hypothesized that the decrease in PALs as a result of the COVID-19 pandemic will be lower in adolescents living in rural communities than those living in urban communities.

## 2. Materials and Methods

### 2.1. Participants and Study Design

The participants in this prospective study were 823 adolescents from a Croatian coastal region. During the study, all participants were attending high school, and, at the study baseline, they were  $16.5 \pm 2.1$  years of age. All participants were healthy, meaning that they regularly participated in physical education, and some of them were involved in extracurricular sporting activities. Since the study was originally initiated as part of another investigation (“Physical activity, substance misuse, and factors of influence in adolescence”), all participants were previously informed about the study aims, risks, and benefits, and parental consent was obtained before the study baseline (the outline of the study is provided in later sections). 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).

This prospective study included two measurements: Baseline (done before the implementation of social distancing) and follow-up (done during the period of social distancing), as shown in Figure 1.



**Figure 1.** Study design and most important time frames.

Throughout baseline testing, participants were tested on anthropometrics, fitness status (during late October and early September 2019), and baseline PALs (early March 2020). During the baseline period, the COVID-19 pandemic had not affected the school schedule and duties in Croatia. There were also no travel bans or limitations for sporting and social activities in the country, although people with a confirmed COVID-19 infection were placed in self-isolation, quarantined (detained), and/or hospitalized. Follow-up testing of PAL was conducted in April 2020 and included only online testing of the PALs. In this period, numerous measures related to the control of the COVID-19 pandemic were already implemented. Schools and universities were closed starting mid-March 2020, and as of 19 March, 2020, the government of Croatia implemented other extensive social distancing measures, including the banning of 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 social distancing.

## 2.2. Variables and Testing

Apart from age and sex, variables in this study were: community of residence (urban vs. rural), anthropometrics (body height, mass, and calculated body mass index), indices of fitness status, and PAL as measured by the Physical Activity Questionnaire for Adolescents (PAQA) [34–36].

The PAQA was used for measuring PALs at baseline and follow-up. Participants completed the questionnaire on the online platform Survey Monkey (SurveyMonkey Inc., San Mateo, CA, USA). Similar samples of respondents from Croatia and neighboring countries were assessed using the PAQA before, and it was shown to be a valid test for evaluating PAL [34,35]. Participants had to recall the past seven days and report it through nine items in the questionnaire. The first eight sections included questions about types of physical activity (i.e., activities during free play, sports, physical education classes, and active transportation). The ninth item was not considered in the final score but was used for noting participants who had some injuries or illnesses that could cause reduced activity. The first eight items were scaled from 0 to 5, and the overall score ranged from 0 to 5, representing the minimum and maximum PAL, respectively. The scores were categorized as baseline-PAL, follow-up-PAL, and the “delta score”, which represented the difference between baseline-PAL and follow-up-PAL and provided the range of change in PAL that occurred due to the regulations of social distancing during the COVID-19 pandemic. For statistical analyses (described later in detail), the baseline-PAL and follow-up-PAL were dichotomized. Specifically, scores below 2.73 were considered low-level-PAL, while scores above 2.73 were considered normal-level-PAL as suggested in previous studies [35,36].

Measures of physical fitness were measured only during the baseline testing, and included six tests: (i) Standing broad-jump test (broad-jump), (ii) hanging on the bar with bent arms (bent-arm-hang), (iii) sit-and-reach (sit-and-reach), (iv) multilevel fitness test (multilevel-test), (v) 400-m run (run-400m), and (vi) sit-ups for 60 s (sit-ups). These tests are regularly used in the Croatian educational system and were measured by experienced physical education teachers [37,38].

The standing broad-jump test was used to assess power (jumping) capacity. The test was performed using standardized equipment (Elan, Begunje, Slovenia) in the gym. Participants started from a standing position with feet placed shoulder-width apart and performed the test by bending their knees and swinging their arms to perform a maximal forward jump. Participants had three test trials with 20–30 s of rest in between, and the best (the longest) jump was used as the final score.

The bent-arm-hang test was used to measure static upper-body strength. The test was conducted once in the gymnasium. Participants were assisted to reach the position with bent arms and with their chin over the horizontal bar. Participants were instructed to hold that position as for long as they could. The maximal recorded time in seconds was the test result.

The sit-and-reach test was used to assess flexibility. It was performed in the gymnasium using a standardized box. Participants were sitting on the floor with both legs maximally extended at the knees and with the soles of their bare feet placed flat on the box. Participants were instructed to reach forward as far as possible on the measuring line positioned on the box and to hold that position for 1–3 s. Participants had three trials, and the best score, measured in centimeters, was recorded.

The multilevel endurance test was used to test aerobic endurance [38]. Participants had to continuously run between two lines set 20 m apart according to the sound signals on the pre-recorded audio track. For the start of the test, participants were standing behind one line and facing the second line, and began to run on the sound signal (“beep”). Participants were instructed to turn after each signal and run back to the starting line until the completion of the test. At the beginning of the test, the running pace was slower, and the first two beeps were nine seconds apart. The interval between beeps progressively decreased each minute of the test. The participants had to increase their speed to reach the line before the beep sounded. The test was over when the participant failed to reach the line before the beep two consecutive times. The final result was the recorded time (in minutes:seconds) after the second missed beep.

The 400-m run was used to assess anaerobic capacity. The test was performed at a handball playground (40 × 20 m), where participants had to run three full circles and an additional 40 m. Each participant had one trial, and the result was recorded in seconds.

Sit-ups were used to evaluate the strength of the muscles in the abdominal region. The participants started the test by lying on their backs. They had their knees bent under 90 degrees, palms locked behind their neck, and feet fixed by a partner sitting on them and holding their legs with two hands. Participants had to lift their torso toward their knees. The result of the test was the number of correct repetitions in 60 s.

### 2.3. Statistics

The Kolmogorov–Smirnov test was used to check the normality of the distribution. As a result, means and standard deviations were calculated for numerical variables (i.e., PAQA scores, fitness tests, and anthropometric variables).

Multifactorial analysis of variance for repeated measures (baseline testing vs. follow-up testing), with “sex” (male vs. female) and “environment” (urban vs. rural) used as grouping variables (ANOVA), was used to calculate and provide evidence for the effects of PAL changes that occurred as a result of the COVID-19 pandemic. Consecutive t-test analyses were calculated as post hoc analyses when ANOVA results were statistically significant.

Pearson’s product–moment correlation coefficients were calculated to evidence the associations between studied variables. The mixed model logistic regression (with gender as random factor) was applied to identify the associations between predictors and the binomial criterion (PAL observed as low-level-PAL (coded as “1”) vs. normal-level-PAL (coded as “2”)), logistic regressions were calculated, with an odds ratio (OR) and corresponding 95% confidence interval (CI) reported. The model fit was checked by the Hosmer–Lemeshow test (statistically significant test indicates that the model does not adequately fit the data). Two regression models were calculated: Model 0 (non-controlled for covariate environment) and model 1 (controlled for covariate environment (urban vs. rural community)).

A *p*-value of 0.05 was applied and the statistical package Statistica ver. 13.0 (Statsoft, Tulsa, OK, USA) was used for all calculations.

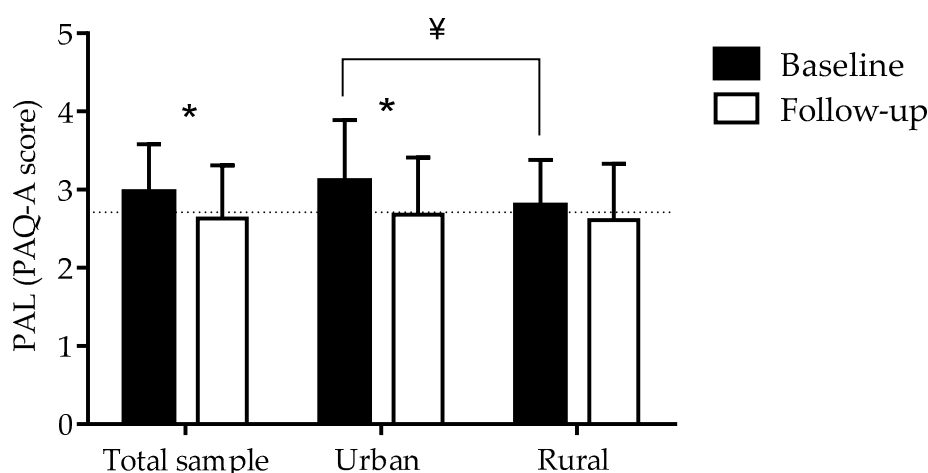
### 3. Results

ANOVA results were significant for both main effects (“environment” and “measurement”), and for their interaction (Table 1).

**Table 1.** Factorial analysis of variance for repeated measures.

Variables	Main Effects				Interaction	
	Environment		Measurement		Environment x Measurement	
	<i>F</i> -test	<i>p</i>	<i>F</i> -test	<i>p</i>	<i>F</i> -test	<i>p</i>
PAL	4.11	0.01	4.29	0.04	2.98	0.05

Post hoc analyses revealed a decrease in PAL for the total sample (from 2.97 ± 0.61 to 2.63 ± 0.68, *p* < 0.01) and urban adolescents (from 3.11 ± 0.64 to 2.68 ± 0.67, *p* < 0.001). Significant differences (*p* < 0.01) between adolescents living in urban and rural environments were observed for baseline-PAL, with higher baseline-PAL in urban adolescents (3.11 ± 0.64 and 2.82 ± 0.58, for urban and rural adolescents, respectively) (Figure 2).



**Figure 2.** Descriptive statistics for physical activity levels at baseline (before the COVID-19 pandemic), and at follow-up (during the COVID-19 pandemic) with significant *t*-test differences (¥ indicates significant ( $p < 0.05$ ) differences between groups, \* indicates significant ( $p < 0.05$ ) differences within groups); dotted line presents normal PAL.

Pearson product–moment coefficients reached statistical significance for associations between most of the anthropometric and physical fitness variables with baseline PAL. The number of significant coefficients was lower when anthropometrics and physical fitness variables were correlated with follow-up-PAL (Table 2). In general, better physical fitness was associated with higher PAL in both testing waves. The correlations between the anthropometric values and physical fitness with differences in PAL were negligible, showing a low influence of baseline anthropometric values and physical fitness on changes in PAL that occurred as a result of COVID-19 and social distancing.

**Table 2.** Pearson’s product moment correlation coefficients between anthropometric, physical fitness, and physical-activity-level variables (\* indicates significant correlation at  $p < 0.05$ ).

	Total (n = 823)	Rural (n = 381)	Urban (n = 442)
Physical activity at baseline			
Body height	0.21 *	0.28 *	0.19 *
Body mass	0.17 *	0.19 *	0.21 *
Body mass index	0.13 *	0.05	0.14 *
Broad jump	0.23 *	0.35 *	0.26 *
Sit-ups	0.21 *	0.28 *	0.25 *
Sit-and-reach	0.01	−0.03	0.06
Bent-arm-hang	0.28 *	0.27 *	0.35 *
Run-400 m	0.02	−0.31 *	0.07
Multi-level-test	0.39 *	0.32 *	0.38 *
Physical activity at follow-up			
Body height	0.07 *	0.13 *	0.01
Body mass	0.03	0.05	0.01
Body mass index	−0.04	−0.04	−0.01
Broad jump	0.16 *	0.05	0.16 *
Sit-ups	0.19 *	0.08	0.19 *
Sit-and-reach	0.11 *	0.09	0.05
Bent-arm-hang	0.11 *	0.05	0.18 *
Run-400 m	0.09	−0.05	0.08
Multi-level-test	0.11 *	0.04	0.17 *

Table 2. Cont.

	Total (n = 823)	Rural (n = 381)	Urban (n = 442)
Physical activity difference between baseline and follow-up			
Body height	0.04	0.13 *	0.20 *
Body mass	0.05	0.13 *	0.23 *
Body mass index	0.10 *	0.09	0.18 *
Broad jump	0.10 *	0.17 *	0.07
Sit-ups	0.05	0.08	0.03
Sit-and-reach	-0.05	-0.11 *	0.00
Bent-arm-hang	0.16 *	0.11 *	0.12 *
Run-400 m	-0.04	-0.10 *	-0.04
Multi-level-test	0.28 *	0.25 *	0.20 *

The higher likelihood of normal PAL at baseline (baseline PAQA score above 2.71) was evidenced for urban adolescents (Model 0: OR: 1.41, 95%CI: 1.23–1.87), adolescents who were taller (Model 0: OR = 1.54, 95% CI: 1.21–1.87; Model 1: OR: 1.65, 95% CI: 1.11–1.98), heavier (Model 0: OR = 1.34, 95% CI: 1.01–1.45), who had better aerobic endurance (Model 0: OR = 1.67, 95% CI: 1.44–1.95; Model 1: OR: 1.61, 95% CI: 1.20–2.01), anaerobic endurance (Model 0: OR = 0.61, 95% CI: 0.41–0.89; Model 1: OR: 0.71, 95% CI: 0.56–0.89), static strength (Model 0: OR = 2.01, 95% CI: 1.45–2.57; Model 1: OR: 1.97, 95% CI: 1.31–1.2.41), and dynamic strength (Model 0: OR = 1.87, 95% CI: 1.11–2.44; Model 1: OR: 1.88, 95% CI: 1.10–2.50) (Figure 3).

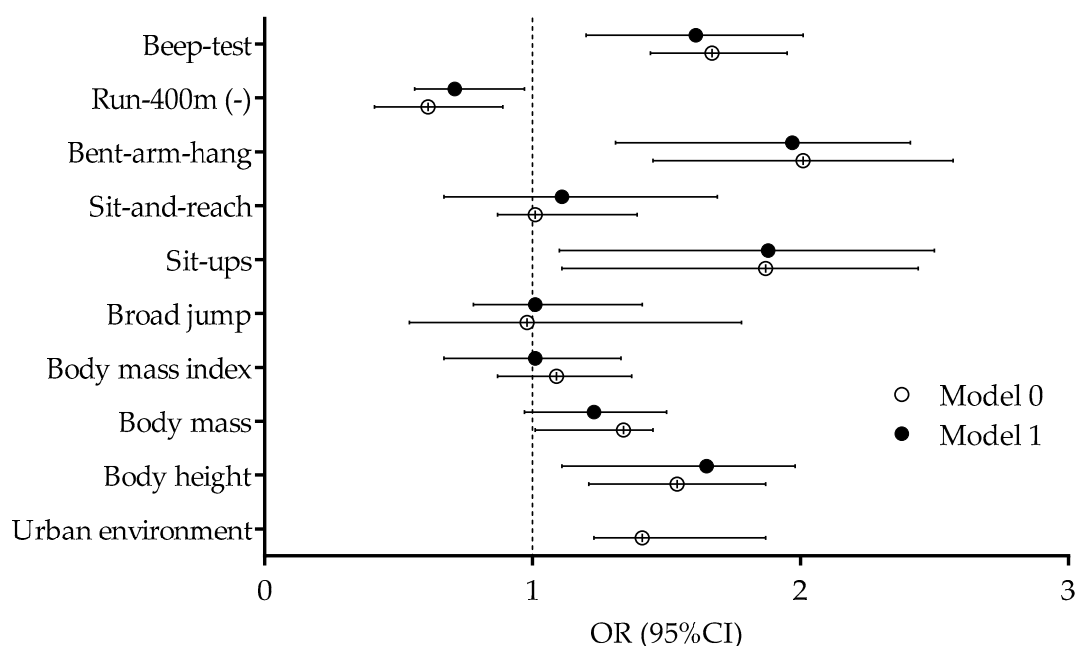
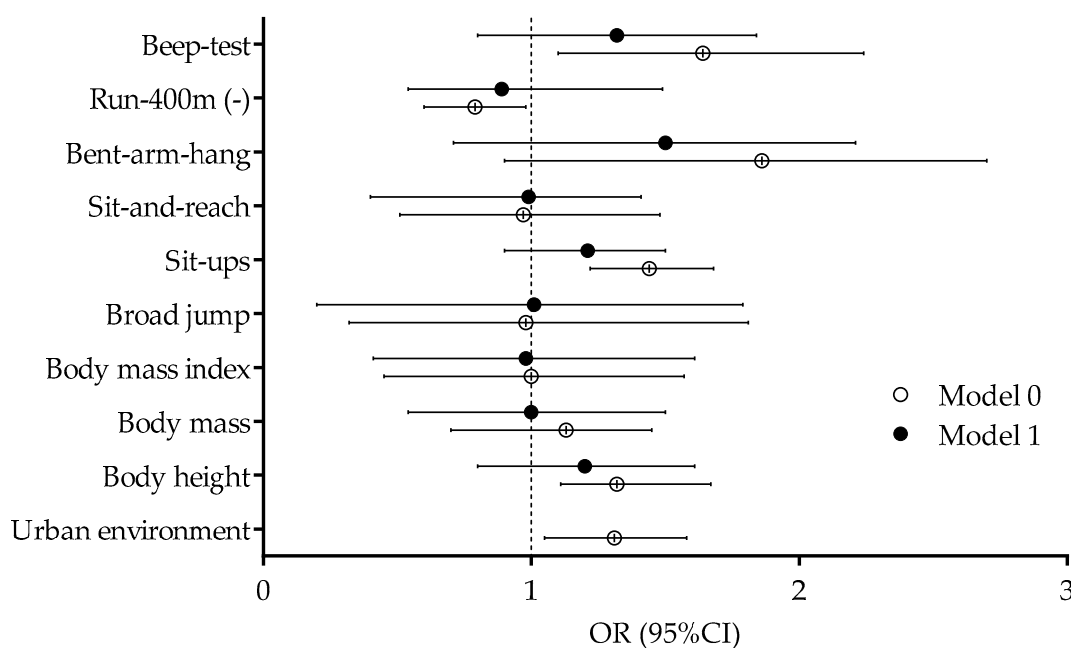


Figure 3. Predictors of normal physical activity levels at baseline (model 0 – crude logistic regression, model 1 – logistic regression controlled for urban/rural environment as confounding factor).

Dynamic strength (measured by sit-ups; OR: 1.44, 95% CI: 1.22–1.68), aerobic endurance (measured by multi-level-test; OR: 1.64, 95% CI: 1.10–2.24), and anaerobic endurance measured by the 400-m run test (OR: 0.79, 95% CI: 0.60–0.980) were positively correlated with a normal-PAL at follow-up in the logistic regression model non-controlled for the urban/rural environment. However, when the urban/rural environment was included in the logistic regression calculation as a covariate (Model 1), no significant correlation between predictors and PAL was evidenced (Figure 4).



**Figure 4.** Predictors of normal physical activity levels at follow-up (Model 0 – crude logistic regression, Model 1 – logistic regression controlled for urban/rural environment as confounding factor).

#### 4. Discussion

There are several most important findings of the study. First, the PALs of studied adolescents significantly decreased, but this was mostly influenced by a large decrease of PALS in urban adolescents. Second, fitness status was related to baseline-PALs, while the associations between baseline fitness status and follow-up-PALs were strongly influenced by the factor of the living environment. Therefore, we may support our initial study hypothesis.

##### 4.1. Changes in Physical Activity Levels among Rural and Urban Adolescents as a Result of the COVID-19 Pandemic

The PAL decreased significantly in the total sample, but we found an influence of the living environment (i.e., urban vs. rural community) on those changes, and the decrease in PAL as a result of social distancing due to the COVID-19 pandemic was greater in urban than rural adolescents. Although these findings deserve attention, the following discussion is limited by a lack of accurate data on PALs in Croatian rural areas, especially concerning the adolescent population. Therefore, our results are mostly contextualized to the findings of studies where authors provided evidence for other indices (i.e., health-related, economic, and social factors) in Croatian rural areas.

Modern community development is focused on providing equal opportunities for rural and urban population in terms of income, living conditions, safety, health care, and other goods and services [39]. However, such intentions were not fruitful in Croatian rural areas, since studies showed that people living in rural areas regularly migrate to urban areas due to economic issues (e.g., lack of job opportunities and lower income) and the self-perception that living in rural areas means having a lower quality of life. Specifically, the perception of the quality of life among rural residents in Croatia is affected by dissatisfaction with social and health services and poorly developed infrastructure [39]. This results in an even lower likelihood of youth and adolescents engaging in organized sports in rural areas, which negatively influences the PAL among rural adolescents.

Studies previously reported that urban adults have a higher PAL compared to their rural counterparts in Croatian coastal regions, like the region observed in this study, which was at least partially associated with an increased risk for cardiovascular disease in rural areas [40]. Cross-sectional



analyses showed better fitness status among Croatian urban children/adolescents than in their rural peers [41]. The results presented in this study that show a lower baseline-PAL among rural adolescents are not surprising and are generally consistent with global reports where similar conclusions were presented [42–44]. In brief, the U.S. data also conform to these findings, i.e., that rural adults are less physically active than their urban counterparts [43,44]. Portuguese rural boys were also found to be less physically active than urban boys, but this was not confirmed in girls [42]. Although such differences have mostly been explained by considering physical and environmental factors (i.e., access to sports facilities and programs), other factors were also shown to be potentially important determinants of higher PALs among urban youth (e.g., parental educational level and socioeconomic differences) [42,45].

Considering the baseline-PAL status, it is not surprising that the PAL of urban adolescents decreased more than in rural adolescents simply because social distancing measures influenced the opportunity to practice organized sports. Specifically, although the influence of social distancing measures was probably not so pronounced for competitive sports (please see later discussion on correlates of follow-up-PAL), the fitness centers, dance centers, and gyms were closed. This logically influenced the PAL of urban adolescents to a greater extent than rural adolescents, who are generally less engaged in organized recreation [19]. Therefore, the result of a lower decrease in the PALs among rural adolescents should not be observed as being encouraging but rather as alarming. The finding that PALs among rural adolescents were not (more) significantly reduced in circumstances, such as imposed rules of social distancing, including closing the schools, is a problem in itself.

#### *4.2. Correlates of Physical Activity Levels before and during the COVID-19 Pandemic in Urban and Rural Adolescents*

Baseline PAL was correlated with most of the observed anthropometric and fitness variables, and there was no evident influence of the living environment of established relationships. A higher baseline PAL was observed in adolescents who were taller, heavier, and had a higher body mass index and who had better fitness. The baseline PAL being related to anthropometrics is a simple consequence of the higher level of PA among adolescents involved in sports. For the sports that are the most popular in the studied region (team sports such as soccer, handball, volleyball, basketball, water polo, etc.), the proper body build and height are among the main prerequisites for successful participation. Most of these sports favor adolescents who have a preferable physique and body type [46,47]. For boys, this is additionally accentuated by body height and mass in adolescence often being a consequence of advanced maturity, which directly results in better physical capacities, and a greater ability to physically train for any given sport [48]. As a result, the noted association between baseline PAL and anthropometrics is understandable because it points to adolescents who are actively involved in sports being simultaneously (i) advanced in observed anthropometric dimensions (i.e., they are tall and heavy), and (ii) physically active (because of the involvement in systematic sports training).

The associations between physical fitness variables and baseline PAL should be discussed in light of the previously discussed association between anthropometrics and baseline PAL (i.e., better fitness, and higher PALs among adolescents involved in sports). Indeed, physical fitness status was systematically correlated with baseline-PAL, regardless of the living environment. In general, positive correlations between baseline-PAL and fitness variables were almost certainly a result of a better physical fitness status among those adolescents who practice organized and/or non-formal sports [49]. Here, we are not able to discuss the causality between baseline-PAL and physical fitness due to the cross-sectional nature of this part of the investigation, and it should be investigated in the future in greater detail. However, this study expands upon previous knowledge since the correlation between physical fitness status and (baseline) PAL is not influenced by the living community, indicating that the benefits of increased PAL are likely to be similar both in urban and rural adolescents.

The correlations between baseline fitness and follow-up PAL were environment specific. To summarize, adolescents who had better physical fitness status at study baseline were more likely to have higher follow-up PAL but with the living environment (urban vs. rural) as a strong confounding factor. To explain these findings, we must explain the specifics of the time frame when the study was conducted. Irrespective of the fact that measures of social distancing were imposed, the follow-up testing was performed when our participants were not under a strict lockdown (i.e., an emergency protocol that prevents people from leaving the area). In Croatia, authorities provided social distancing guidelines but did not declare a rigid lockdown. Schools, sports clubs, restaurants, and places of social gatherings were closed, and public transportation was limited and was exclusively for work and emergency transport. On the other hand, it was not formally prohibited to undertake some kind of physical training, such as walking, running, riding a bicycle, or even strength training in open spaces, while maintaining social distance. In this period, police officers patrolled and prevented social gatherings of more than a couple of people, including grouping for physical training. However, authorities did not strictly enforce stay-at-home policies under any circumstances, but rather supported and proclaimed such behavior [50,51]. Collectively, if the measures of social distancing were respected (maintaining a two-meter distance in public places), there were no strict boundaries regarding physical training, even in open spaces, such as parks, forests, on the street, etc.

As we are actively involved in sports training, we are aware that most of the sport clubs and teams in the region organized some form of physical conditioning for their members and athletes. When the measures of social distancing were launched (the period we observed in the follow-up testing), physical training events for competitive athletes were still organized and coaches often joined or at least supervised their athletes. However, this opportunity for active involvement in organized training was limited to urban areas. Those adolescents who lived outside the urban areas could not participate in organized training due to the (i) distance and (ii) the limitation of public transportation.

#### 4.3. Limitations and Strengths

The most important limitation of our study was that PALs were not directly measured but instead self-reported by participants. Next, physical fitness and anthropometric variables were collected almost three months before the baseline measurement of PAL. Additionally, this study involved participants from one region in Croatia, and therefore the results are only generalizable to similar samples. The last limitation is particularly important given the climate in the studied region (Mediterranean region), and that during the observed time, the lowest temperature was rarely below 10 °C; as such, the weather was ideal for outdoor activities (that were not strictly prohibited if social-distancing was respected).

Our study is one of the rare studies where PAL and changes in PAL in the period during the COVID-19 pandemic are shown specifically for urban and rural adolescents. The physical fitness variables were tested as part of a well-organized project by experienced evaluators, and the results may be observed as plausible and objective. Therefore, we think that our results will contribute to the knowledge in our field and encourage further research.

## 5. Conclusions

In conclusion, our data showed that adolescents from both urban and rural areas decreased their PAL as a result of imposed measures of social distancing during the COVID-19 pandemic. A disturbing consequence of the measures was that both groups did not meet the recommended NPAL during the crisis. Not surprisingly, the results showed a significant influence of the living environment on the decrease of PAL, with larger negative effects in urban adolescents. Higher negative changes were not observed in adolescents from rural areas due to their low baseline PAL. Additionally, the fitness status and body indices of urban adolescents predicted their PAL during the COVID-19 pandemic, but such associations were not evidenced for rural adolescents.

In general, our findings accentuate the importance of encouraging adolescents to increase PAL irrespectively of their living environment, as PAL directly improves their fitness level. We believe that

in the situation where the measures of social distancing might remain in place for a longer period of time, policymakers should introduce strategies that would prevent a negative impact on PAL in adolescents. As our findings indirectly suggested, the preventive strategies should include free access to training facilities for adolescents from rural areas and provide organized training activities in both rural and urban areas to avoid unintended consequences related to the decreased PAL (e.g., development of chronic diseases, obesity, anxiety, depression, etc.).

In line with the aforementioned, we suggest strategies that would promote adolescents being physically active without risking infection of themselves or somebody else. The activities could be performed in smaller groups, without physical contact, keeping the recommended social distance, with constantly applied appropriate hygiene measures (e.g., using hand sanitizer to wash their hands regularly) and a permanent coach's supervision.

While this study examined one specific sample of the population (e.g., adolescents), future studies should evaluate changes in PAL for other populations and world regions. Additionally, studies examining the changes in PAL after the COVID-19 pandemic, and factors associated to such changes are warranted. In doing so, special attention should be placed on sociodemographic factors, which could influence the established relationships.

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