

## ORIGINAL SCIENTIFIC PAPER

# Levels of Distress and Physical Activity of Adolescents during the Covid-19 Pandemic

Danijela Kuna<sup>1</sup>, Ivana Duvnjak<sup>1</sup>, Iva Sklempe Kokic<sup>1</sup>

<sup>1</sup>Josip Juraj Strossmayer University of Osijek, Faculty of Kinesiology Osijek, Osijek, Croatia

## Abstract

The importance of physical activity, as one of the crucial resources for maintaining and improving physical health, was diminished during the Covid-19 pandemic. Except for the impact it has on physical health, physical activity may have various psychological benefits, especially during the development period of adolescence. The current findings of physical activity show that adolescents are more physically inactive during the pandemic than usual. Also, there are increasingly negative psychological outcomes in adolescents. The purpose of this study was to explore the levels of physical activity, negative affectivity, coping and preoccupation with the pandemic in an adolescent sample. The study involved 2409 adolescents (53.5% girls, 46.5% boys) from elementary and high schools aged 10 to 19. The Depression, Anxiety and Stress Scale (DASS-21) was applied, and information about levels of physical activity, coping and preoccupation with pandemic and isolation measures were collected. Participants answered on a Likert-type scale. Findings of this research show that on average male adolescents are more likely to engage in physical activities than females. Also, a relation of physical inactivity distress and preoccupation was obtained for adolescent girls. No similar finding was found for males. However, very high physical activity (five or more times a week) was a protective factor for coping and preoccupation with coronavirus infection. The conclusion of this research indicates that levels of physical activity have a different effect on male and female adolescents during the Covid-19 pandemic. It can be concluded that female adolescents that are less physically active are more at risk of depression, anxiety and stress.

**Keywords:** *distress, negative affectivity, levels of physical activity, Covid-19*

## Introduction

The outbreak of the Covid-19 pandemic has put the human population's health at risk to the extent that nobody could have predicted. The usual people's lifestyle has significantly changed (Bajramovic et al., 2020). To prevent the spread of Covid-19 worldwide, including in the Federation of Bosnia and Herzegovina (B&H), restrictive measures such as isolation, mobility restrictions and confinement were imposed on people older than 65 and juveniles. Besides the previously mentioned measures, distance learning has significantly increased the time that pupils spend in front of screens. Physical exercise, movement, social contacts and interactions have been minimized. Drastic lifestyle changes of all pupils have increased the sedentary lifestyles (Caroppo et al., 2021). Consequently, their instinctive biological need for movement,

physical exercise and social interaction, as one of the main preconditions for normal emotional and physical development, preservation of mental health and quality of life, has been threatened and neglected (Ravens-Sieberer et al., 2022). Children and youth have missed some of the most important moments of their lives, including making friendships and pursuing hobbies, due to school closures and lack of sports and cultural events. The usual sports activities and training have been cancelled. The occurrence of risk factors was increased – health issues such as hypokinesia, cardiovascular diseases, excessive stress (hyper stress), anxiety, depression, and many other psychosomatic symptoms as a result of irregular physical exercise and movement (Biddle & Mutrie, 2007).

The improvement of specific anthropological characteristics which are expressed through morphologically positive changes



Correspondence:

D. Kuna

Josip Juraj Strossmayer University of Osijek, Faculty of Kinesiology, Drinska 16a, 31000 Osijek, Croatia

E-mail: dkuna@kifos.hr

and the impact on the functional and motor abilities is common for all aspects of physical exercise (Cattuzzo et al., 2016). This results in many positive psychological changes, a decrease of somatic and cognitive tension, increased self-confidence and perception of one's capabilities (Bungić & Barić, 2009). Physical activity has many positive effects, not only on physical but also on psychological well-being (Edwardson, Gorely, Pearson, & Atkin, 2013). It can be assumed that physical activity and organized physical exercise programs directly improve an individual's quality of life (Mandolesi et al., 2018). Physical activity encompasses all aspects of children's and adolescents' lives and has a positive effect on their physical and psychological well-being (Biddle & Asare, 2011). Children and youth are very sensitive to the influence of sudden stressors during their developmentally vulnerable period, which consequently negatively affects their psychological well-being (Asmundson et al., 2013).

Current findings show that the occurrence of coronavirus infection could be a trigger for various psychological difficulties, such as anxiety and depression (Qiu et al., 2020). Anxiety, depression, distractibility, and fear of infection for family members are the most common problems among youth during the coronavirus pandemic (Jiao, 2020). Likewise, a sedentary lifestyle during the pandemic has led to an increase in negative physical

and mental health outcomes (Cheval et al., 2021). According to the assessment of children and adolescents in the UK, poorer mental health occurred and a lack of support in a stressful situation of the coronavirus (Lee, 2020). Stress is moderately related to youth physical activity during the coronavirus pandemic. Hence, adolescents who exercise more often have lower levels of stress and loneliness (Ellis, Dumas, & Forbes, 2020).

Since stressful life situations lead to various negative outcomes of physical and psychological health, the relation between physical activity and levels of stress, anxiety and depression in males and females during the Covid-19 pandemic has been explored.

## Methods

### Participants

A total of 2409 male and female pupils from nine elementary and nine secondary schools in the Canton 10 of the Federation of B&H participated in the research. Age ranged from 10 to 19 years ( $M=15.12$ ,  $SD=2.25$ ). A total of 1211 males (46.5%) and 1288 female (53.5%) attended elementary schools from 6th to 9th grade ( $n=1149$ , 47.7%) and secondary schools from 1st to 4th grade ( $n=1260$ , 52.3%). The gender and age structure of the sample are shown in Table 1.

**Table 1.** Structure of the sample regarding gender and age (N=2409).

		Males (n=1121)		Females (n=1288)	
		n	%	n	%
Elementary school	6th grade	127	11.3	131	10.2
	7th grade	114	10.2	144	11.2
	8th grade	175	15.6	166	12.9
	9th grade	143	12.8	149	11.6
High school	1th grade	163	14.5	187	14.5
	2th grade	167	14.9	186	14.4
	3th grade	147	13.1	194	15.1
	4th grade	85	7.6	131	10.2

### Instruments

Within socio-demographic characteristics, data regarding gender, age, grade and school were collected information. Individual questions regarding the frequency of physical activity are formulated according to Zhang's et al. (2022) model of work. The frequency of physical activities was examined with the additional question ("How often have you engaged in a sports activity in the last week?"). The frequency of physical activity was assessed on a four-point scale (0 - inactivity-not once a week, 1 - moderate-1 or 2 times a week, 2 - high-3 or 4 times a week, 3 - very high-5 and more times a week).

Bogdan et al. (2020) published an edition on psychological aspects related to the coronavirus, based on which we designed questions to examine coping and preoccupation. Coping with a stressful situation, specifically dealing with isolation measures, was also examined ("How do you deal with isolation measures?"). Pupils were responding on a Likert-type scale (1 - very poor, 2 - poor, 3 - acceptable, 4 - good, 5 - very good) where the lower the score indicates that pupils are less able to cope with isolation measures. The level of preoccupation about the potential coronavirus infection was also examined ("Are you concerned that you might be infected with the coronavirus?"), and pupils rated their preoccupation on a scale: 0

- no, I don't think about it, 1 - rarely, 2 - occasionally, 3 - often, 4 - every day. A higher score indicates greater preoccupation.

### Depression, Anxiety and Stress Scale (DASS-21)

The DASS-21 scale (Lovibond & Lovibond, 1995) consists of 21 items that are divided into three scales. Each scale contains seven items and assesses the level of negative emotional states - depression, anxiety and stress. The scale of depression includes symptoms of dysphoria, hopelessness, self-depreciation, apathy, and lack of interest. The anxiety scale assesses the excitability of the autonomic system and situational anxiety. The stress scale involves levels of chronic, nonspecific arousal, relaxation difficulties, disturbance and impatience. Participants answer by circling the appropriate number on a Likert-type scale, from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). A higher score indicates greater distress. The scale is suitable for the assessments of adolescents and adults in the non-clinical population. The Cronbach's alpha reliability coefficients are 0.82 for depression, 0.79 for anxiety, and 0.86 for stress.

### Procedure

Before conducting the research, the approvals of the Ethics Committee of The Ministry of Science, Education,

Culture and Sports of the Canton 10 (Approval number: 06-01-39-673/20, 13.4.2020), school principals, parents and pupils were obtained. The research was conducted via the internet using a Google web form. A letter and an e-mail with instructions, the purpose of the study and a link to research were sent to The Ministry of Science, Education, Culture and Sports and all principals. Schools forwarded an e-mail with a link to research with accompanying detailed instructions and purposes of the research to all pupils from 6th to 9th grade in elementary schools and from 1st to 4th grade in secondary schools. The participation was anonymous and voluntarily in the period from April 21 to May 15, 2020. To participate, pupils first had to obtain parental consent to meet the ethical principles. Since the research was voluntary and anonymous, pupils could withdraw from participation at any time.

#### Statistical analysis

Conditions for the parametric statistics have been examined. The distributions of the results of depression, anxiety and stress vary from the normal distribution as expected ( $p < 0.01$ ), which is consistent with the studies of depression and anxiety on non-clinical samples. These distributions were verified

by the Kolmogorov-Smirnov test. Visual inspection of the histograms shows that they are negatively asymmetric. Since there is a situational sensitivity of these measures, it is understandable that the distribution of results and stress scales are also asymmetrical. Such finding is not surprising, since the research was conducted during the coronavirus pandemic, as a new threatening situation. According to the values of the skewness and kurtosis index are acceptable, asymmetrical distributions can be included in the parametric data analysis (Kline, 2015). Results are shown with descriptive statistical parameters. Chi-square tests and analysis of variance were used. Data were analysed using the statistical package SPSS version 20.0 (IBM, Armonk, USA).

## Results

### Descriptive analysis

Descriptive data for all measured variables were calculated and presented in Table 2. A descriptive analysis of the frequency of physical activity showed that 36.7% of pupils engage in some physical activity five or more times a week (very high physical activity). Furthermore, 29.4% of pupils engage in physical activity three or four times a week (high physical activity), while 27.6% of pupils engage once or twice a week

**Table 2.** Descriptive statistics and coefficients of internal consistency of measured variables.

Variable	k	Min	Max	M	SD	IS	ISk	$\alpha$
Depression	7	0	21	2.97	3.78	1.95	4.35	0.82
Anxiety	7	0	21	2.24	3.23	2.35	6.96	0.79
Stress	7	0	21	4.62	4.53	1.23	1.23	0.86
Coping	1	1	5	2.98	1.29	0.02	-1.07	-
Preoccupation	1	0	4	0.72	1.02	1.42	1.41	-
Physical activity	1	0	3	1.97	0.94	-0.38	-1.00	-

Note. k=number of particles, Min-the lowest result, Max-the highest result, IS-skewness index, ISk-kurtosis index,  $\alpha$ =internal consistency coefficient Cronbach alpha

(moderate physical activity), and 6.1% of them do not engage in physical activity at all (physical inactivity).

Examination of the descriptive results showed that pupils are highly physically active, and they engage on average three to four times a week in physical activities ( $M=1.97$ ).

Comparing negative affectivity, respondents are under the highest level of stress ( $M=4.62$ ), less depressed ( $M=2.97$ ) and anxious ( $M=2.24$ ). Adolescents cope well with isolation measures ( $M=2.98$ ) and generally are not preoccupied that they may become infected with coronavirus ( $M=0.72$ ).

**Table 3.** Differences in physical activities regarding gender.

Gender		Physical activity				Total
		Inactivity	Moderate activity	High activity	Very high activity	
Males	Frequencies	85	252	321	459	1117
	Expected frequency	68.8	308.5	329.4	410.3	1117.0
	%(gender)	7.6%	22.6%	28.7%	41.1%	100.0%
	Standardized residuals	2.8	-5.2	-0.8	4.1	
Females	Frequencies	63	412	388	424	1287
	Expected frequency	79.2	355.5	379.6	472.7	1287.0
	%(gender)	4.9%	32.0%	30.1%	32.9%	100.0%
	Standardized residuals	-2.8	5.2	0.8	-4.1	
Total	Frequencies	148	664	709	883	2404
	Expected frequency	148.0	664.0	709.0	883.0	2404.0
	%(gender)	6.2%	27.6%	29.5%	36.7%	100.0%
Chi-square results					$\chi^2(3)=37.71, p < 0.001$	

*Physical activity regarding gender*

To examine the differences in the levels of physical activity regarding gender, a Hi-square test was performed and standardized residuals were analysed (Table 3). The results of the Hi-square test show that there is a significant difference in the level of physical activity regarding gender ( $\chi^2(3)=37.71$ ,  $p<0.001$ ). For the analysis, a stringent significance level was used ( $p<0.01$ ). The values of standardized residuals above 2.6 show significant differences.

There are significantly more males in the category of very high activity than expected, but also in the category of inactivity. There are significantly fewer of those who engage in physical activity moderately. On the other hand, there are significantly more girls who are moderately engaged in physical activities, and significantly fewer girls who are characterized by very high levels of activity, but also inactivity.

*Differences in depression, anxiety, stress, coping and preoccupation regarding the level of physical activity*

Table 4 shows the differences between the four groups of pupils regarding the level of physical activity (inactivity, moderate activity, high activity and very high activity) in depres-

sion, anxiety and stress, as well as coping and preoccupation of males and females. Analysis of variance and post-hoc tests were performed. A statistically significant difference was obtained for depressive symptoms ( $F_{(3,1238)}=4.82$ ,  $p<0.01$ ) – girls who are inactive and those who are moderately active show significantly more symptoms than girls who are highly physically active. Female pupils who are inactive show significantly higher levels of anxiety ( $F_{(3,1238)}=3.35$ ,  $p<0.05$ ) and stress ( $F_{(3,1238)}=4.79$ ,  $p<0.01$ ) than girls who are highly physically active. Girls who are engaged in very high physical activity are significantly better coping with isolation measures than inactive and moderately active girls, and highly active girls cope significantly better than inactive girls ( $F_{(3,1238)}=8.94$ ,  $p<0.01$ ).

There are no significant differences in the level of physical activity in depression, anxiety and stress for males. However, significant differences in coping and preoccupation were found. Very highly active males cope with isolation measures significantly better than inactive and moderately active males ( $F_{(3,1113)}=6.44$ ,  $p<0.01$ ). Furthermore, males who are very highly active are significantly less preoccupied with possible coronavirus infection than those males who are moderately and highly active ( $F_{(3,1113)}=5.49$ ,  $p<0.01$ ).

**Table 4.** Descriptive data and results of analysis of variance for depression, anxiety and stress regarding the level of physical activity.

Variable	Level of physical activity	n	Males				Females				
			M	SD	F	df	n	M	SD	F	df
Depression	Inactivity	85	3.22	4.62	2.50	3, 1113	63	4.76	5.37	4.82**	3, 1283
	Moderate activity	252	2.62	3.69			412	3.79	4.21		
	High activity	321	2.23	2.84			388	3.01	3.62		
	Very high activity	459	2.27	3.29			424	3.37	3.93		
Anxiety	Inactivity	85	2.07	3.97	1.57	3, 1113	63	3.92	5.19	3.35*	3, 1283
	Moderate activity	252	1.73	2.54			412	3.02	3.69		
	High activity	321	1.61	2.39			388	2.55	3.32		
	Very high activity	459	1.45	2.46			424	2.67	3.45		
Stress	Inactivity	85	3.94	4.77	0.21	3, 1113	63	6.98	6.43	4.79**	3, 1283
	Moderate activity	252	3.75	3.78			412	5.74	4.99		
	High activity	321	3.59	3.78			388	4.83	4.31		
	Very high activity	459	3.75	4.02			424	5.42	4.79		
Coping	Inactivity	85	2.81	1.42	6.44**	3, 1113	63	2.33	1.29	8.94**	3, 1283
	Moderate activity	252	2.86	1.26			412	2.76	1.25		
	High activity	321	2.99	1.28			388	2.99	1.24		
	Very high activity	459	3.25	1.35			424	3.06	1.24		
Preoccupation	Inactivity	85	0.42	0.95	5.49**	3, 1113	63	0.73	1.19	1.79	3, 1283
	Moderate activity	252	0.65	0.95			412	0.97	1.16		
	High activity	321	0.65	0.91			388	0.88	1.02		
	Very high activity	459	0.43	0.82			424	0.82	1.07		

Note. \* $p<0.05$ ; \*\* $p<0.01$

**Discussion**

The findings of this study indicate that adolescents are physically active three to four times a week. Results from earlier studies show similar results for adolescents' frequency of physical activity. Most of them exercise two to four times a week, regardless of the level of physical activity (Delisle, Werch, Wong, Bian, & Weiler, 2010). Other reports that most

adolescents exercise two to three days per week (approximately 70%), and about 30% of them are physically active just one day or less per week (Moljord, Eriksen, Moksnes, & Espnes, 2011). The recommendations of various relevant institutions state that children and adolescents should be involved for at least 60 minutes a day in physical activity of moderate or high intensity (Rhodes, Janssen, Bredin,

Warburton, & Bauman, 2017). Data on the prevalence of adolescents' physical activity show that 81% of young people in Europe and North America are insufficiently physically active at this age (Currie et al., 2012). The Republic of Croatia has been involved in international research on pupils' health behaviour since 2002. Similar trends on the prevalence of physical inactivity were reported among pupils in Croatia - 85% of insufficient physical activity among elementary and secondary school pupils. According to the Health Behavior in School-Aged Children (HBSC) system, the physical activity of Croatian 15-year-olds decreases over time (Pavić et al., 2020). The highest recorded rate of physically active pupils at this age was 33.5% in 2002, and in 2014 it reduced to 25.4%, and in 2018 to 21.4%. Due to the outbreak of the Covid-19 pandemic and confinement measures, it is expected that data on the physical activity of children and youth around the world will be significantly devastating.

It should be emphasized that the obtained average values for depression, anxiety and stress are significantly lower in our study than the average for the population (Lovibond & Lovibond, 1995). The first studies of anxiety and depression levels during the Covid-19 pandemic reported an increase in these symptoms (Cao et al., 2020). Deng et al. (2020) confirmed the relation between habits and frequency of physical activity with levels of stress, anxiety, and depression (DASS-21). Those who were physically active regularly and maintained the habit of physical exercise, more than one to two times a week, more than an hour a day and had more than 2000 average walking steps during the Covid-19 pandemic, had significantly lower levels of stress, anxiety and depression. The obtained data indicate that regular physical activity which lasts long enough is associated with a lower risk of developing mental disturbances. This is in accordance with the results of our research and the results of previous studies which confirmed a positive effect on the quality of life (Moljord et al., 2011; Brière et al., 2018; Chekroud et al., 2018).

The results of our study are in accordance with the results of numerous previous studies that showed that males are generally more physically active than girls in various measured areas (Sallis, 1993; Norman et al., 2006; Duncan, Duncan, Strycker, & Chaumeton, 2007; Pearson, Atkin, Biddle, Gorely, & Edwardson, 2009). Most males who participated in this research stated that they engage in some physical activities five or more times a week, and significantly fewer of them are engaged once or twice a week. However, there are significantly more girls who engage in physical activity once or twice a week, and significantly fewer girls who never engage in physical activity, as well as those who exercise five or more times a week. There is a trend of increasing physical inactivity with age in adolescence. Data shows that 78.3% of females and 49.9% of males in eighth grade and 86.2% of girls and 66.8% of males in third grade in Croatian high schools are insufficiently physically active (Jureša, Musil, Majer, & Petrović, 2010). Many reasons contribute to this, including the social environment, biological or puberty, type and level of motivation (Edwardson et al., 2013). Girls, children and young people should be encouraged to exercise as much as possible due to the high prevalence of insufficient physical activity of girls compared to males (World Health Organization, 2013), vulnerable adolescent period and negative consequences of distress and maturation.

Physical activity of children and young people is crucial due to its multiple positive health effects, positive long-term

effects on adults' health, as well on adopting the habit of regular physical exercise later in life (Boreham & Riddoch, 2001). Physical activity is a protective factor for the occurrence of stress, reduces stress and facilitates coping (Heaney, Carroll, & Phillips, 2014; Grošić & Filipčić, 2019). Our study examined the differences in depression, anxiety and stress regarding the level of physical exercise of males and females. Significant differences were obtained for depression, anxiety, and stress regarding the level of physical exercise in girls. Inactive and less physically active girls have higher levels of depression, anxiety, and stress. These findings are consistent with other studies conducted during the Covid-19 which indicate that girls are at higher risk for developing depression and anxiety (Chen et al., 2020; Sniadach, Szymkowiak, Osip, & Waszkiewicz, 2021; Živčić-Bećirević, Smojver-Ažić, Martinac Dorčić, & Birovljević, 2021). Youth often stayed home alone during the pandemic, which resulted in higher levels of depression and anxiety (Ellis et al., 2020). In addition, physical exercise has been shown as a protective factor in adolescents' mental health earlier before the pandemic (Chekroud et al., 2018). Numerous studies on the impact of various previous pandemics and epidemics confirm the negative impact on psychological health, examined through depression, fear, anxiety, preoccupation and risky behaviours of children and youth (difficulties in social relations, use of addictive substances, education problems) (Dubey et al., 2020; Imran, Zeshan, & Pervaiz, 2020; Meherali et al., 2021; Zhou et al., 2020). Female adolescents are significantly more depressed and lonelier than adolescent males (Ellis et al., 2020). Those adolescents who spent a lot of time online and on social media during the pandemic had high levels of stress and depression compared to those who spent less time online (Duan et al., 2020). There is no relation between the level of physical exercise and the occurrence of depression, anxiety, and stress for males in our study. This is consistent with findings of lower levels of depression and anxiety in males than females (Ellis et al., 2020).

Physical activity is a strong positive predictor of mental health improvement and well-being during a coronavirus pandemic (Wright, Williams, & Veldhuijzen van Zanten, 2021). The same is confirmed in our study – females and males who are more physically active estimate that they cope better with isolation measures than those who are less physically active or inactive. Higher levels of physical activity are related to lower preoccupation in males in our study. In general, the more adolescents engage in physical activity, the lower their levels of stress, anxiety, depression, and greater well-being are (Rodriguez-Ayllon et al., 2019; Gianfredi et al., 2020).

The findings of our study indicate the benefits of physical activity that can reduce the negative factors caused by the coronavirus. The advantage of this research is that it encompasses a large sample of participants, both males and females. The study limitations relate to the measure of physical activity, which is in the conducted research examined with one question, so it is not comparable with the recommendation for physical activity in youth. Furthermore, only the frequency of exercise was examined, but not included daily length and the intensity level to compare with other data. Results from this study imply the need for further systematic investigations which in turn may be beneficial for clarifying the effects of the coronavirus. Practical implications manifest in guidelines for experts and legislators on the importance of effective and timely interventions to protect adolescents' mental health.

## Conclusion

The results of this study show that adolescents engage in some physical activity on average three to four times a week. Males exercise more frequently than girls. Most girls exercise moderately, and most males exercise five or more times a week. Girls' physical inactivity is related to negative affectivity,

## Acknowledgments

There are no acknowledgments.

## Conflict of Interest

The author declares that there is no conflict of interest.

**Received:** 15 March 2022 | **Accepted:** 18 January 2023 | **Published:** 01 February 2023

## References

- Asmundson, G.J.G., Fetzner, M.G., DeBoer, L.B., Powers, M.B., Otto, M.W., & Smits, J.A.J. (2013). Let's get physical: A contemporary review of the anxiolytic effects of exercise for anxiety and its disorders. *Depression and Anxiety*, 30, 362-373. <https://doi.org/10.1002/da.22043>
- Bajramovic, I., Redzepagic, S., Bjelica, D., Krivokapic, D., Jeleskovic, E., & Likic, S. (2020). Level of active lifestyle and exercise approach among sports-active female students of the University of Sarajevo during the Covid-19 pandemic. *Journal of Anthropology of Sport and Physical Education*, 4(4), 33-36. <https://doi.org/10.26773/jaspe.181006>
- Biddle, S.J., & Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *British Journal of Sports Medicine*, 45(11), 886-895. <https://doi.org/10.1136/bjsports-2011-090185>
- Biddle, S.J.H., & Mutrie, N. (2007). *Psychology of physical activity: Determinants, well-being & interventions*. Abingdon: Routledge. <https://doi.org/10.4324/9780203019320>
- Bogdan, A., Ajduković, D., Ajduković, M., Apostolovski, D., Bacinger Klobučarić, B., & Bandić, I. (2020). Koronavirus i mentalno zdravlje: Psihološki aspekti, savjeti i preporuke. *Hrvatska psihološka komora*, Zagreb. [http://psiholoskakomora.hr/static/documents/HPK-Koronavirus\\_i\\_mentalno\\_zdravlje.pdf](http://psiholoskakomora.hr/static/documents/HPK-Koronavirus_i_mentalno_zdravlje.pdf)
- Boreham, C., & Riddoch, C. (2001). The physical activity, fitness and health of children. *Journal of Sports Sciences*, 19, 915-929. <https://doi.org/10.1080/026404101317108426>
- Brière, F.N., Yale-Soulière, G., Gonzalez-Sicilia, D., Harbec, M.J., Morizot, J., Janosz, M., & Pagani, L.S. (2018). Prospective associations between sport participation and psychological adjustment in adolescents. *Journal of Epidemiology and Community Health*, 72(7), 575-581. <https://doi.org/10.1136/jech-2017-209656>
- Bungić, M., & Barić, R. (2009). Tjelesno vježbanje i neki aspekti psihološkog zdravlja. *Hrvatski Športsko Medicinski Vjesnik*, 24(2), 65-75.
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research*, 287, 112934. <https://doi.org/10.1016/j.psychres.2020.112934>
- Caroppo, E., Mazza, M., Sannella, A., Marano, G., Avallone, C., Claro, A. E., ... & Sanì, G. (2021). Will nothing be the same again?: changes in lifestyle during COVID-19 pandemic and consequences on mental health. *International Journal of Environmental Research and Public Health*, 18(16), 8433. <https://doi.org/10.3390/ijerph18168433>
- Cattuzzo, M.T., Dos Santos Henrique, R., Ré, A.H., de Oliveira, I.S., Melo, B.M., de Sousa Moura, M., de Araújo, R.C., & Stodden, D. (2016). Motor competence and health related physical fitness in youth: A systematic review. *Journal of Science and Medicine in Sport*, 19(2), 123-129. <https://doi.org/10.1016/j.jsams.2014.12.004>
- Chekrou, S.R., Gueorguieva, R., Zheutlin, A.B., Paulus, M., Krumholz, H.M., Krystal, J.H., & Chekrou, A.M. (2018). Association between physical exercise and mental health in 1- 2 million individuals in the USA between 2011 and 2015: A cross-sectional study. *The Lancet Psychiatry*, 5(9), 739-746. [https://doi.org/10.1016/S2215-0366\(18\)30227-X](https://doi.org/10.1016/S2215-0366(18)30227-X)
- Chen, F., Zheng, D., Liu, J., Gong, Y., Guan, Z., & Lou, D. (2020). Depression and anxiety among adolescents during COVID-19: A cross-sectional study. *Brain, Behavior, and Immunity*, 88, 36-38. <https://doi.org/10.1016/j.bbi.2020.05.061>
- Cheval, B., Sivaramakrishnan, H., Maltagliati, S., Fessler, L., Forestier, C., Sarrazin, P., ... & Boisgontier, M.P. (2021). Relationships between changes in self-reported physical activity, sedentary behaviour and health during the coronavirus (COVID-19) pandemic in France and Switzerland. *Journal of Sports Sciences*, 39(6), 699-704. <https://doi.org/10.1080/02640414.2020.1841396>
- Currie, C., Zanotti, C., Morgan, A., Currie, D., De Looze, M., Roberts, C., ... &

but not in males. Girls that are less physically active have higher levels of depression, anxiety and stress. Coping and preoccupation in males are related to the level of physical exercise, so male adolescents who exercise five or more times a week are less preoccupied about being infected and cope better with isolation measures.

- Barnekow, V. (2012). *Social determinants of health and well-being among young people. Health Behaviour in School-aged Children (HBSC) study: International report from the 2009/2010 survey*. Copenhagen, WHO Regional Office for Europe.
- Delisle, T.T., Werch, C.E., Wong, A.H., Bian, H., & Weiler, R. (2010). Relationship between frequency and intensity of physical activity and health behaviors of adolescents. *Journal of School Health*, 80(3), 134-140. <https://doi.org/10.1111/j.1746-1561.2009.00477.x>
- Deng, C.H., Wang, J.Q., Zhu, L.M., Liu, H.W., Guo, Y., Peng, X.H., ... & Xia, W. (2020). Association of web-based physical education with mental health of college students in Wuhan during the COVID-19 outbreak: Cross-sectional survey study. *Journal of Medical Internet Research*, 22(10), e21301. <https://doi.org/10.2196/preprints.21301>
- Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in china during the outbreak of COVID-19. *Journal of Affective Disorders*, 275, 112-118. <https://doi.org/10.1016/j.jad.2020.06.029>
- Dubey, S., Biswas, P., Ghosh, R., Chatterjee, S., Dubey, M. J., Chatterjee, S., ... & Lavie, C. J. (2020). Psychosocial impact of COVID-19. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(5), 779-788. <https://doi.org/10.1016/j.dsx.2020.05.035>
- Duncan, S.C., Duncan, T.E., Strycker, L.A., & Chaumeton, N.R. (2007). A cohort-sequential latent growth model of physical activity from ages 12 to 17 years. *Annals of Behavioral Medicine*, 33(1), 80-89. [https://doi.org/10.1207/s15324796abm3301\\_9](https://doi.org/10.1207/s15324796abm3301_9)
- Edwardson, C.L., Gorely, T., Pearson, N., & Atkin, A. (2013). Sources of activity-related social support and adolescents' objectively measured after-school and weekend physical activity: Gender and age differences. *Journal of Physical Activity and Health*, 10(8), 1153-1158. <https://doi.org/10.1123/jpah.10.8.1153>
- Ellis, W.E., Dumas, T.M., & Forbes, L.M. (2020). Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19 crisis. *Canadian Journal of Behavioural Science*, 52(3), 177-187. <https://doi.org/10.1037/cbs0000215>
- Gianfredi, V., Blandi, L., Cacitti, S., Minelli, M., Signorelli, C., Amerio, A., & Odone, A. (2020). Depression and objectively measured physical activity: a systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 17(10), 3738. <https://doi.org/10.3390/ijerph17103738>
- Grošić, V., & Filipčić, I. (2019). Tjelesna aktivnost u poboljšanju psihičkog zdravlja. *Medicus*, 28(2), 197-203.
- Heaney, J.L., Carroll, D., & Phillips, A.C. (2014). Physical activity, life events stress, cortisol, and DHEA: Preliminary findings that physical activity may buffer against the negative effects of stress. *Journal of Aging and Physical Activity*, 22(4), 465-473. <https://doi.org/10.1123/JAPA.2012-0082>
- Imran, N., Zeshan, M., & Pervaiz, Z. (2020). Mental health considerations for children & adolescents in COVID-19 Pandemic. *Pakistan Journal of Medical Sciences*, 36(COVID19-S4), S67. <https://doi.org/10.12669/pjms.36.COVID19-S4.2759>
- Jiao, W.Y., Wang, L.N., Liu, J., Fang, S.F., Jiao, F.Y., Pettoello-Mantovani, M., & Somekh, E. (2020). Behavioral and emotional disorders in children during the COVID-19 epidemic. *The Journal of Pediatrics*, 221, 264-266. <https://doi.org/10.1016/j.jpeds.2020.03.013>
- Jureša, V., Musil, V., Majer, M., & Petrović, D. (2010). Prehrana i tjelesna aktivnost kao čimbenici rizika od srčanožilnih bolesti u školske djece i mladih. *Medicus*, 19, 35-40.
- Kline, R. B. (2015). *Principles and practice of structural equation modelling*. Guilford publications.
- Lee, J. (2020). Mental health effects of school closures during COVID-19. *The Lancet Child & Adolescent Health*, 4(6), 421. [https://doi.org/10.1016/S2352-4642\(20\)30109-7](https://doi.org/10.1016/S2352-4642(20)30109-7)
- Lovibond, P.F., & Lovibond, S.H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33(3), 335-343. [https://doi.org/10.1016/0005-7967\(94\)00075-U](https://doi.org/10.1016/0005-7967(94)00075-U)
- Mandolesi, L., Polverino, A., Montuori, S., Foti, F., Ferraioli, G., Sorrentino, P., & Sorrentino, G. (2018). Effects of physical exercise on cognitive functioning and wellbeing: Biological and psychological benefits. *Frontiers in Psychology*, 9, 509. <https://doi.org/10.3389/fpsyg.2018.00509>

- Meherali, S., Punjani, N., Louie-Poon, S., Abdul Rahim, K., Das, J.K., Salam, R.A., & Lassi, Z.S. (2021). Mental health of children and adolescents amidst COVID-19 and past pandemics: A rapid systematic review. *International Journal of Environmental Research and Public Health*, 18(7), 3432. <https://doi.org/10.3390/ijerph18073432>
- Moljord, I.E.O., Eriksen, L., Moksnes, U.K., & Espnes, G.A. (2011). Stress and happiness among adolescents with varying frequency of physical activity. *Perceptual and Motor Skills*, 113(2), 631-646. <https://doi.org/10.2466/02.06.10.13.PMS.113.5.631-646>
- Norman, G.J., Nutter, S.K., Ryan, S., Sallis, J.F., Calfas, K., & Patrick, K. (2006). Community design and access to recreational facilities as correlates of adolescent physical activity and body-mass index. *Journal of Physical Activity and Health*, 3(s1), 118-128. <https://doi.org/10.1123/jpah.3.s1.s118>
- Pavić Šimetin, I., Žehaček Živković, M., Belavić, A., Ištvanović, A., Mayer, D., Musić Milanović, S., & Pejnović Franelić, I. (2020). Istraživanje o zdravstvenom ponašanju učenika–HBSC 2017/2018: Osnovni pokazatelji zdravlja i dobrobiti učenika i učenica u Hrvatskoj. Hrvatski zavod za javno zdravstvo. Retrieved from: [https://www.hzjz.hr/wp-content/uploads/2020/05/HBSC\\_2018\\_HR.pdf](https://www.hzjz.hr/wp-content/uploads/2020/05/HBSC_2018_HR.pdf)
- Pearson, N., Atkin, A.J., Biddle, S.J., Gorely, T., & Edwardson, C. (2009). Patterns of adolescent physical activity and dietary behaviours. *International Journal of Behavioral Nutrition and Physical Activity*, 6(1), 1-7. <https://doi.org/10.1186/1479-5868-6-45>
- Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations. *General Psychiatry*, 33(2), e100213. <https://doi.org/10.1136/gpsych-2020-100213>
- Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., & Otto, C. (2022). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *European Child & Adolescent Psychiatry*, 31(6), 879-889. <https://doi.org/10.1007/s00787-021-01726-5>
- Rhodes, R.E., Janssen, I., Bredin, S.S., Warburton, D.E., & Bauman, A. (2017). Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health*, 32(8), 942-975. <https://doi.org/10.1080/08870446.2017.1325486>
- Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N.E., Mora-Gonzalez, J., Migueles, J.H., ... & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sports Medicine*, 49(9), 1383-1410. <https://doi.org/10.1007/s40279-019-01099-5>
- Sallis, J.F. (1993). Epidemiology of physical activity and fitness in children and adolescents. *Critical Reviews in Food Science and Nutrition*, 33(4-5), 403-408. <https://doi.org/10.1080/10408399309527639>
- Śniadach, J., Szymkowiak, S., Osip, P., & Waszkiewicz, N. (2021). Increased depression and anxiety disorders during the COVID-19 pandemic in children and adolescents: a literature review. *Life*, 11(11), 1188. <https://doi.org/10.3390/life11111188>
- World Health Organization (2013). *Transforming and scaling up health professionals' education and training: World Health Organization guidelines 2013*. World Health Organization.
- Wright, L.J., Williams, S.E., & Veldhuijzen van Zanten, J.J. (2021). Physical activity protects against the negative impact of coronavirus fear on adolescent mental health and well-being during the COVID-19 pandemic. *Frontiers in Psychology*, 12, 580511. <https://doi.org/10.3389/fpsyg.2021.580511>
- Zhang, Y., Zhan, N., Zou, J., Xie, D., Liu, M., & Geng, F. (2022). The transmission of psychological distress and lifestyles from parents to children during COVID-19. *Journal of Affective Disorders*, 303, 74-81. <https://doi.org/10.1016/j.jad.2022.02.007>
- Zhou, S.J., Zhang, L.G., Wang, L.L., Guo, Z.C., Wang, J.Q., Chen, J.C., ... & Chen, J.X. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *European Child & Adolescent Psychiatry*, 29(6), 749-758. <https://doi.org/10.1007/s00787-020-01541-4>
- Živčić-Bečirević, I., Smojver-Ažić, S., Martinac Dorčić, T., & Birovljević, G. (2021). Izvori stresa, depresivnost i akademsko funkcioniranje studenata za vrijeme pandemije COVID-19. *Društvena istraživanja: časopis za opća društvena pitanja*, 30(2), 291-312. <https://doi.org/10.5559/di.30.2.06>