Primenjena psihologija
Vol. 15, No. 2, pp. 149-178, 2022

Research Article

Establishing physical functioning, quality of life and well-being during the first wave of the COVID-19 pandemic in Croatia

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ABSTRACT

The sudden emergence of COVID-19 has led to the confinement of people in homes around the world. In Croatia as well, people were in self-isolation and stayed at home. Since confinement conditions may greatly affect physical and mental health, we investigated the scope of physical activity (PA), well-being and quality of life. A total of 580 adults were surveyed online about PA and health-related quality of life during the lockdown in Croatia. The results have shown that men are more involved in vigorous-intensity PA and have better physical and mental health in almost all domains. When comparing respondents regarding categories of PA, participants with high levels of PA function better physically, have fewer role limitations due to emotional problems and have higher levels of emotional well-being, vitality, and general health. Males, participants with lower BMI, fewer role limitations due to emotional problems, greater vitality and better social functioning have better physical health. Participants who consider that their PA is adequate and engage more in PA, who have fewer role limitations due to physical health, less physical pain, and better general health have better mental health. The results provide insights into the physical and mental components of health during the pandemic. This supports the premise that physical and mental health are highly dependent, and that there is a need to promote the importance of PA, especially for women and those who are less physically active in pandemic times.

Keywords: physical activity, quality of life, emotional functioning, well-being, COVID-19 pandemic

UDC: 371.78:578.834(497.5)
DOI: 10.19090/pp.v15i2.2350
Received: 28.07.2021.
Revised: 12.12.2021.
Accepted: 13.01.2022.

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Introduction

The phenomenon of coronavirus disease represents a threat to health, but it also has negative consequences on people's mental health. Croatia had the most stringent restrictions and measures to reduce infection with the new coronavirus. Measures of social distancing were introduced - public and religious gatherings and sports events were forbidden, restaurants, shops and border crossings were also closed. Such measures have led to people being able to move less and consequently less able to engage in physical activity. A new theoretical framework describes an unexpected situation of COVID-19 in the context of the lack of control and high level of risk that can seriously affect health and well-being, and can be increased by isolation (Amanzio et al., 2020). Confinement measures caused negative emotions and psychological distress that can lead to sleep disorders, muscle tension, pain, and digestive and circulatory disorders (Liu et al., 2020). The positive relation between physical activity and exercise with physical and mental health is well-recorded (Bird et al., 2021). Physical activity increases hormone levels that can make people less stressed, happier and improve their ability to overcome difficulties more easily (Anderson & Shivakuma, 2013).

Unlike the medical model that defines health as the absence of disease or difficulties, the World Health Organization determines health as "a state of complete physical, mental and social well-being" (World Health Organization, 2001). The concept of well-being encompasses assessments of social, health, material, and subjective domains of quality of life (Diener et al., 2018). The emotional component of well-being represents a dimension of subjective well-being, which is defined as the experience of positive and negative affect (Keyes, 2000). Due to the conceptual ambiguity, the wellness model defines health as an internal experience or emotion that people enjoy or lack (Larson, 1999). The wellness model emphasizes a permanent feeling and state of mental health that positively affects and improves physical health (Larson, 1997). According to the environmental model, which arose from systems theory, health is considered as people's continuous adjustment to their environment (Gochfeld & Goldstein,

1999). Health-related quality of life contains functioning and well-being in the physical, mental, and social aspects of people's lives (Larson, 1997).

Recent research confirmed the negative psychological impact of movement restrictions (Brooks et al., 2020; Lauri Korajlija & Jokić-Begić, 2020). It has been shown that greater subjective well-being benefits health (Lyubomirsky et al., 2005). Also, physical activity positively affects the quality of life (Kurklu et al., 2015). During confinement, people could not exercise or maintain supporting social relations. As a result, there was a decrease in emotional well-being (Stieger et al., 2021). Furthermore, people's vitality may be decreased when they are less active and productive (Arslan, 2021). Regarding gender, existing findings in other countries (Italy, Austria) show that women have worse mental health during pandemics (Pieh et al., 2020; Rossi et al., 2020).

In general, physical inactivity is one of the major public health problems (World Health Organization, 2018) and could be a risk for disease morbidity (Hallal et al., 2012). Such a negative lifestyle can automatically increase sedentary behaviour (Ammar et al., 2020). Regular physical activity (PA) contributes to physical health indicators, positive mental health, and well-being (Chekroud et al., 2018). Follow-up data shows that females are generally less involved in physical activities than males (Telama, 2009). The reasons can be attributed to major life transitions and changes that have a greater impact on women's physical activity. Restriction measures on physical distancing, outdoor activities and confinement have led to major changes in physical activity (Đogaš et al., 2020). Consequently, there was an increase in sedentary behaviour, which poses a risk for gaining weight, cardiovascular problems, and high blood pressure (Balanzá–Martínez et al., 2020).

Well-being refers to optimal psychological functioning (Ryan & Deci, 2001), which requires the realization of basic psychological needs - personal growth, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2017). Movement restrictions can aggravate satisfying basic psychological needs due to disabling socializing. Failure to satisfy basic psychological needs is related to impaired physical and mental health (Reis et al., 2000). In addition, restrictions

during a pandemic have led to a lack of social interaction, and consequently to a decrease in well-being (Son et al., 2020).

The purpose of this empirical research was to investigate the relation of physical and mental health with the physical activity habits of Croatian adults during COVID-19. Previous studies established a tight relation between physical and mental health and show that they are also distinguishable constructs (Farivar et al., 2007; Hays et al., 1994). According to the study aim, we hypothesized that men would engage more in physical activity and have better physical and mental health than women. Further, it is assumed that those who exercise more will have better physical and mental health, due to the general fact about the benefits of physical activity. Also, dimensions of physical health will predict mental health, and vice versa (Lins & Carvalho, 2016).

Method

Sample and procedure

Study included 580 working-age adults residing in Croatia between 18 and 69 years (*M* = 34.56, *SD* = 11.39). There were 171 male and 409 female participants in the sample, and two-thirds of them were employed (63.30%). Table 1 summarized participants' characteristics by gender since men and women generally differ in physical appearance. Male participants had a higher body mass index (BMI) than females. Although BMI is under criticism because it does not give accurate information regarding body composition it is still widely used to indicate the level of risk for morbidity and mortality.

Table 1

Participants' characteristics regarding gender

	Males (*n* = 171)				Females (*n* = 409)			
	Min	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*
Age	18	64	35.34	10.57	18	69	34.24	11.71
BMI (kg/m^2)	18.31	43.39	27.39	4.71	15.78	44.62	23.86	4.23

Note: BMI - Body mass index.

A cross-sectional study using an online self-administered questionnaire was performed. The participants were invited to participate between 14th and 21st May 2020, during the first wave of the COVID-19 pandemic in Croatia using a virtual snowball sampling method over social networks. Authors shared information regarding the research using Facebook and asked their contacts to participate and to further share the survey over social networks. This was the most convenient way of collecting data due to the partial lockdown in Croatia and the closure of most facilities. Our inclusion criteria were having residence in Croatia during specified period and understanding of Croatian language. Our exclusion criterion was being minor. Participation was voluntary and anonymous, and each participant had given consent to take part in the survey.

Instruments

The web-based survey questionnaire included demographic data and self-reported PA levels, health-related quality of life, and level of agreement with the statement „*My level of physical activity is adequate*".

Demographic data

Demographic data included age, gender, self-reported body height and body mass, level of education and employment status. Body mass index was calculated using a standard equation. The level of agreement with the statement "My level of physical activity is adequate" was assessed on a Likert-type scale of 1-5. Value 1 represented the answer *"strongly disagree*", while value 5 represented the answer *"strongly agree*".

International Physical Activity Questionnaire – Short Form (IPAQ-SF)

Physical activity was assessed with the Croatian version of *the International Physical Activity Questionnaire – Short Form (IPAQ-SF)* (Craig et al., 2003). The questionnaire is publicly available, used worldwide, and free to use. It aims to identify the frequency and duration of several domains of physical activity: walking, physical activity of moderate-intensity, physical activity of vigorous-intensity, as well as sedentary behaviour. Data were processed using official guidelines (IPAQ Group, 2005). Physical activity was quantified and

presented as MET-minutes per week, where 1 MET represents the rate of energy expenditure while sitting at rest. For most people, this approximates an oxygen uptake of 3.5 millilitres per kilogram per minute (Physical Activity Guidelines Advisory Committee, 2018). MET-minutes per week of specific activity are calculated by multiplying the MET value of specific activity with the duration of that activity in minutes. The following values of the intensity of physical activity were recommended by the official guidelines for data processing and used in the analysis: 3.3 METs for walking, 4.0 METs for physical activity of moderate intensity, 8.0 METs of physical activity of vigorous-intensity (e.g., 8.0 * walking days * walking minutes). Average time spent in sedentary behaviour was also calculated and presented in hours.

Participants were classified into three categories of physical activity. They were classified in the category of high PA if they performed a PA of vigorous-intensity on at least three days of the week, while achieving at least 1500 MET-minutes per week of total PA, or had seven days a week of any combination of walking, moderate-, or vigorous-intensity PA, while achieving at least 3000 MET-minutes per week of total PA.

Respondents were classified in the category of moderate PA if they performed three or more days of PA of vigorous-intensity of at least 20 minutes per day, or PA of moderate-intensity or walking at least 30 minutes per day, or five or more days in the week of any combination of walking, moderate- and vigorous-intensity PA, achieving at least 600 MET-minutes per week. Participants not meeting the criteria for moderate and high PA categories were classified as being in the category of low PA.

Short-Form Health Survey (SF-36)

Participants' health-related quality of life was assessed using the Croatian version of *the 36-Item Short-Form Health Survey (SF-36)*. The survey consists of 36 items grouped into 8 main domains of health (Jureša et al., 2000; Maslić Seršić & Vuletić, 2006; Ware & Sherbourne, 1992; Ware et al., 1993). The questionnaire is free to use. Each category is scored on a scale of 0-100. Value 0 represents the worst overall health status, and value 100 represents the best overall health status. The physical health component consists of the domains

physical functioning, role functioning/physical, bodily pain, and general health. The domain of physical functioning refers to the levels and types of performing all physical activities. Role functioning is defined with health-related limitations in the amount or type of work. Bodily pain determines the discomfort with everyday activities caused by pain. Item example includes: "How much bodily pain have you had during the past 4 weeks?". Personal beliefs about the quality of health represent the general health domain. The mental health component consists of the domain's vitality, social functioning, role functioning/emotional, and emotional well-being. Vitality includes energy level and fatigue. The domain of social functioning refers to the impact of physical health or emotional problems on normal social activities. Role functioning/emotional measures the levels of problems with daily activities or work due to emotional problems. Emotional well-being represents a subjective evaluation of satisfaction and happiness, and dimensions of anxiety, depression, loss of emotional control and psychological well-being ("How much of the time during the past 4 weeks have you felt so down in the dumps nothing could cheer you up?"). The physical health component and the mental health component can be combined into physical component summary (PCS) and mental component summary (MCS) scores. Data processing and scoring of the survey were performed according to official guidelines (Ware et al., 1994; Ware et al., 1993). The survey was tested on a representative sample of the Croatian adult population and acceptable psychometric characteristics were recorded (Jureša et al., 2000). The reliability of domains in this research was estimated, and all Cronbach alphas are above .70 (Cronbach alphas were high for domains of physical functioning and emotional well-being, $\alpha \geq .90$).

Statistical analyses

Descriptive statistical parameters were calculated for physical activity and health subscales. Reliability was calculated using Cronbach's alpha test. Differences were estimated with t-tests and Cohen's d effect size, ANOVA's and Welch test, and Games-Howell post-hoc test for unequal groups and variances. A series of hierarchical multiple linear regression analyses were conducted to

determine the predictors of PA levels and health-related quality of life domains on PCS and MCS scores. Statistical analyses were performed using SPSS 25.0 (IBM Corp. Released 2017).

Results

Descriptive statistics were calculated for all elements of PA and health survey subscales (Table 2). All measured variables show satisfactory reliability, and indicators of skewness and kurtosis suggest that there are no major deviations of distributions (Kline, 2011). Participants' mean values of BMI in our sample are at the upper recommended limit according to the World Health Organization classification for the European population (M = 24.89, SD = 4.66). Respondents estimate that they are moderately physically active (M = 3.15, SD = 1.34).

Table 2
Descriptive statistics and reliability coefficients (N = 580)

	k	*Min*	*Max*	*M*	*SD*	*Sk*	*Ku*	α
Body mass index (BMI) (kg/m^2)	1	15.78	44.62	24.89	4.66	1.26	2.17	-
Attitude towards reaching appropriate levels of PA	1	1.00	5.00	3.15	1.34	-0.13	-1.29	-
IPAQ-SF								
Vigorous-intensity PA (MET-min/week)	1	0.00	10080.00	2091.46	2281.96	1.44	1.63	-
Moderate-intensity PA (MET-min/week)	1	0.00	5040.00	1203.07	1265.83	1.30	0.99	-
Walking (MET-min/week)	1	0.00	4158.00	1585.18	1283.09	0.77	-0.59	-
Total PA (MET-min/week)	1	0.00	19278.00	4879.75	3767.05	1.16	1.04	-
Sedentary behaviour (h/day)	1	0.00	16.00	5.64	2.91	0.36	-0.54	-
SF-36 Health Survey								
Physical functioning	10	0.00	100.00	86.72	20.95	-2.09	3.83	.92
Role limitations due to physical health	4	0.00	100.00	75.60	35.74	-1.18	-0.13	.85
Role limitations due to emotional problems	3	0.00	100.00	66.03	41.85	-0.66	-1.30	.86
Vitality/Energy	4	0.00	100.00	55.97	18.67	-0.39	-0.02	.85
Emotional well-being	5	0.00	100.00	64.39	18.42	-0.72	0.32	.90
Social functioning	2	0.00	100.00	71.38	24.71	-0.72	-0.13	.70
Bodily pain	2	10.00	100.00	79.25	21.08	-0.97	0.20	.85
General health	5	10.00	100.00	69.91	18.02	-0.73	0.49	.77
PCS	21	20.00	100.00	77.87	17.71	-1.05	0.43	.89
MCS	14	3.00	100.00	64.44	21.15	-0.61	-0.51	.91

Note: k – number of items; *Min/Max* – minimal and maximal score; *Sk* - skewness; *Ku* - kurtosis; *α* - Cronbach alpha reliability coefficient; PA - physical activity; MET - metabolic equivalent; PCS - physical component summary; MCS - mental component summary.

Regarding PA, our respondents are highly physically active (*M* = 2091.46 MET-min/week). They walk a little less (*M* = 1585.18 MET-min/week), and engage in moderate-intensity PA at least (*M* = 1203.07 MET-min/week). In average, they sit over five hours a day.

Participants estimate their physical functioning as the highest of all subscales related to the quality of life (*M* = 86.72, *SD* = 20.95), and energy level the lowest (*M* = 55.97, *SD* = 18.67). They have more role limitations due to emotional problems (*M* = 66.03, *SD* = 41.85) than physical health (*M* = 75.60, *SD* = 35.74; greater result means better health and functioning). In general, respondents rate their overall physical health and functioning on average better (*M* = 77.87, *SD* =17.71) than their overall mental health (*M* = 64.44, *SD* = 21.15) in our sample.

Physical activity, sedentary behaviour, health-related quality of life and gender

Participants' level of PA, sedentary behaviour, and health-related quality of life by gender are shown in Table 3.

Table 3

Gender differences in physical activity levels, sedentary behaviour, and health-related quality of life

	Males (*n* = 171)		Females (*n* = 409)		*t*	*Cohen's d*
	M	*SD*	*M*	*SD*		
Attitude towards reaching appropriate levels of PA	3.23	1.33	3.11	1.35	0.97	-
IPAQ-SF						
Vigorous-intensity PA (MET-min/week)	2497.59	2353.79	1921.66	2232.33	2.79**	0.25

Moderate-intensity PA (MET-min/week)	1303.63	1315.67	1161.03	1243.64	1.24	-
Walking (MET-min/week)	1503.53	1299.02	1619.32	1276.43	-0.99	-
Total PA (MET-min/week)	5304.79	3890.64	4702.05	3704.56	1.76	-
Sedentary behaviour (h/day)	5.98	3.11	5.49	2.81	1.81	-
SF-36 Health Survey						
Physical functioning	88.51	21.86	85.97	20.54	1.33	-
Role limitations due to physical health	82.02	30.11	72.92	37.56	2.81**	0.27
Role limitations due to emotional problems	75.05	37.59	62.27	42.99	3.38**	0.32
Vitality/Energy	60.73	18.43	53.97	18.44	4.03**	0.37
Emotional well-being	67.86	17.24	62.93	18.72	2.96**	0.27
Social functioning	77.41	20.58	68.86	25.86	3.85**	0.37
Bodily pain	83.46	19.23	77.48	21.58	3.14**	0.29
General health	73.36	15.58	68.47	18.78	3.00**	0.28
PCS	81.84	15.42	76.21	18.35	3.52**	0.33
MCS	70.26	19.17	62.01	21.48	4.35**	0.41

Note: ** $p < 0.01$; PA - physical activity; MET - metabolic equivalent; PCS - physical component summary; MCS - mental component summary.

Regarding PA, the only gender difference was found for vigorous-intensity PA ($t = 2.79$, $p < .01$, *Cohen's d* = 0.25), where male participants accumulated higher levels of vigorous-intensity PA in comparison to female participants. Significant differences were found in all eight-health domains in favour of males, except physical functioning where there are no gender differences. Males have fewer role limitations due to physical health ($t = 2.81$, $p < .01$, *Cohen's d* = 0.27) and emotional problems ($t = 3.38$, $p < .01$, *Cohen's d* = 0.32),

and less bodily pain (t = 3.14, p < .01, *Cohen's d* = 0.29) in comparison to females. They have more vitality/energy (t = 4.03, p < .01, *Cohen's d* = 0.37), emotional well-being (t = 2.96, p < .01, *Cohen's d* = 0.27) and better general health (t = 3.00, p < .01, *Cohen's d* = 0.28) than females. Also, males estimate that they function better socially (t = 3.85, p < .01, *Cohen's d* = 0.37).

Health-related quality of life and physical activity

Three groups of participants were compared in health-related quality of life using an analysis of variance (Table 4). Welch test and Games-Howell post-hoc test was used due to unequal sample sizes in groups regarding PA.

Table 4

Differences in health-related quality of life between participants with low, moderate and high physical activity

	Low PA (n = 42)		Moderate PA (n = 142)		High PA (n = 396)		*Welch's F*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Attitude towards reaching appropriate levels of PA $_{(L, M, H)}$	1.71	0.92	2.45	1.19	3.55	1.22	95.24**
SF-36 Health Survey							
Physical functioning $_{(L, H)}$	79.05	21.56	84.79	20.04	88.22	21.02	4.29*
Role limitations due to physical health	65.48	39.79	71.83	37.41	78.03	34.45	3.02
Role limitations due to emotional problems $_{(M, H)}$	60.32	44.93	53.05	43.52	71.29	39.87	9.97**
Vitality/Energy $_{(L, M, H)}$	40.00	18.64	47.82	17.81	60.58	17.01	44.41**
Emotional well-being $_{(L-H, M-H)}$	55.33	22.69	59.27	18.16	67.18	17.32	13.89**
Social functioning $_{(M, H)}$	66.07	27.78	65.40	25.81	74.08	23.54	7.07**
Bodily pain	74.35	25.96	77.54	20.69	80.38	20.57	1.81
General health $_{(L-H, M-H)}$	60.36	18.85	64.29	18.45	72.94	16.95	18.05**
PCS $_{(L-H, M-H)}$	69.81	18.75	74.61	17.71	79.89	17.22	8.94**
MCS $_{(L-H, M-H)}$	55.43	22.84	56.39	20.83	68.29	20.00	20.99**

Note: * $p < 0.05$; ** $p < 0.01$; PCS - physical component summary; MCS - mental component summary; L – low physical activity group; M – moderate physical activity group; H – high physical activity group.

Welch test shows differences in attitudes about appropriate levels of PA in these three groups (W = 95.24, p < .01). Respondents with high PA estimate their level of PA more adequate than respondents with low and moderate PA. Also, participants with moderate PA estimate the level of PA more adequate than respondents with low PA.

It was found in the subsample that those with high PA physically function better, have higher emotional well-being, better general health and overall physical (PCS) and mental health (MCS) than those with low PA. Participants with high PA have significantly more vitality/energy than those with moderate and low PA. Adults with moderate PA have significantly more role limitations due to emotional problems, they function worse socially, have poorer health, and overall physical (PCS) and mental health (MCS) than those with high PA.

Predictors of physical and mental health

The Short-Form-36 Health Survey is a very well-known instrument, which has long been in use and measure two components: a physical dimension represents the physical component summary (PCS) and mental dimension represents the mental component summary (MCS). Recent finding shows that physical and mental health constructs are strongly interrelated, unlike earlier views (Ware et al., 1994). Hence, all domains contribute to both measures of PSC and MCS in different proportions (Lins & Carvalho, 2016).

To determine predictors of physical and mental health components, hierarchical regression analyses (HRA) were performed. In the first step of the HRA, age and gender were entered, BMI, attitudes about adequate levels of PA, and PA was added in the second step, and health-related quality of life domains in the third step. Prior to HRA intercorrelations were calculated (see Appendix). It is found that all predictors correlate with PCS and MCS, except between body mass index and MCS.

Table 5
Hierarchical linear regression for the physical and mental health component

	PCS (β)			MCS (β)		
Step	1.	2.	3.	1.	2.	3.
Predictors						
Age	-.12**	-.05	-.06	-.01	.02	.04
Gender	-.15**	-.18**	-.08*	-.18**	-.16**	-.07*
Body mass index (BMI)		-.13**	-.11**		-.01	.04
Attitude towards reaching appropriate levels of PA		.24**	.09*		.28**	.14**
Physical activity (PA)		.05	-.03		.11*	.08*
Role limitations due to emotional problems			.16**			-
Vitality/Energy			.33**			-
Emotional well-being			-.05			-
Social functioning			.22**			-
Physical functioning			-			-.05
Role limitations due to physical health			-			.27**
Bodily pain			-			.16**
General health			-			.26**
ΔR^2	.04*	.10**	.22**	.03**	.12**	.25**
R^2	.04*	.14**	.36**	.03**	.15**	.40**

Note: * p <0.05; ** p < 0.01; PCS - physical component summary; MCS - mental component summary; *Tol* < 1; *VIF* < 2.

Data in Table 5 shows that gender, body mass index, and domains: role limitations due to emotional problems, vitality/energy, and social functioning contributed to the explanation of 36% of the variance of PCS. Males, participants with smaller BMI, fewer role limitations due to emotional problems, more energy, and better social functioning have significantly greater PCS. The strongest predictor is vitality/energy ($\beta = .33$, $p < .01$). Significant predictors for MCS are attitudes toward adequate levels of PA, physical activity, and domains: role limitations due to physical health, bodily pain and general health, which explain 40% of the variance. Participants who are adequately and highly physically active, have fewer role limitations due to physical health, less physical pain, and better general health have significantly greater MCS. Attitudes toward PA and PA itself explained 12% of the variance of MCS.

Discussion

The worldwide spread of the COVID-19 caused by the SARS-CoV-2 virus led to unprecedented measures of social distancing and other anti-epidemic measures such as working from home, closing of schools and universities, entertaining and sporting facilities, public transport closures and restrictions of the free movement worldwide, including Croatia.

The main findings of the study showed that higher levels of PA are associated with better physical and emotional functioning, as well as well-being. This study extends our knowledge regarding the association between PA and quality of life and offers some new insights regarding the possible use of PA in minimizing the harmful effects of confinement during the pandemic, especially in the domain of emotional and mental health. To our knowledge, this is the first such study carried out on the Croatian adult population during the first wave of the COVID-19 pandemic.

Most of our respondents were classified in the category of high physical activity. Our sample was engaged in approximately 37 minutes of vigorous-intensity PA, 43 minutes of moderate-intensity PA and 69 minutes of walking daily which exceeds current recommendations regarding optimal levels of PA (World Health Organization, 2010). Confinement allowed more time for domestic

and recreational activities, which could have contributed to higher levels of PA (Hammami et al., 2020). Other studies reported lower levels of PA than our study (Ozdemir et al., 2020; Qi et al., 2020). In Croatia, anti-epidemic measures did not include major restrictions on sports and recreation outdoor activities, and limitations in the time spent outside which could at least partially explain rather high levels of PA recorded.

In our sample males accumulated higher levels of vigorous-intensity PA compared to females, 45 min/day vs. 34 min/day. The study conducted on the Chinese population also reported higher levels of PA among males (Qi et al., 2020), and pre-pandemic studies are also reporting higher levels of PA in the male population (Bauman et al., 2009; Jurakić et al., 2009). Findings about lifestyle during COVID-19 in Croatia show that women exercised less frequently and spent less time exercising during the pandemic than males and in comparison, prior to the COVID-19 (Đogaš et al., 2020).

Males reported higher health-related quality of life almost in all health domains. This was not the case in a similar Chinese study (Qi et al., 2020), where no gender differences were reported regarding PCS and MCS. Some pre-pandemic studies also reported lower scores in domains of health-related quality of life among female participants (Messina et al., 2016; Pekmezović et al., 2011). Emotional well-being was adversely affected by the epidemic outbreak (Yang & Ma, 2020). It is interesting to see that there has been a decrease only in social functioning and role limitation due to emotional problems during COVID-19 in comparison to domains of health-related quality of life in pre-pandemic (Maslić Seršić & Vuletić, 2006).

Participants classified as highly physically active had better emotional well-being, general health, PCS, and MCS in comparison to those with a low level of PA. Furthermore, those with a high level of PA had the most energy. Those in the subgroup of moderate PA had more role limitations due to emotional problems, lower level of social functioning, poorer health, and lower PCS and MCS scores in comparison to a subgroup of individuals with high PA.

This is in accordance with other studies carried out during the first wave of the COVID-19 pandemic which reported that higher moderate to vigorous PA

levels are associated with less depressive, and fewer anxiety symptoms, as well as with overall better mental health (Jacob et al., 2020; Meyer et al., 2020; Schuch et al., 2020). PA status positively affected the quality of life and mental health in the Turkish population during the COVID-19 outbreak (Ozdemir et al., 2020). Higher PA is protecting factor from mental health problems during COVID-19 as well in the Portuguese population (Silva Moreira et al., 2021). Reduction of total physical activity is related to worse status of psychological well-being (Maugeri et al., 2020).

Our results showed that age, gender, BMI, attitudes about adequate levels of PA, PA, health-related quality of life domains all correlate with PCS and MCS (except BMI which did not correlate with MCS). Minimally active and health-enhancing PA groups had better physical, psychological, social and environmental domains scores in comparison to the inactive group (Slimani et al., 2020). These positive correlations between PA and physical and mental domains of quality of life were also reported in the pre-pandemic period (Shibata et al., 2007; Stewart et al., 2003; Wendel-Vos et al., 2004).

Being male, having lower BMI, fewer role limitations due to emotional problems, having more energy and better social functioning led to significantly greater PCS in this research. Being adequately and highly physically active, having fewer role limitations due to physical health and less bodily pain, and having better general health led to significantly greater MCS. Associations between lower levels of moderate-to-vigorous PA and poor mental health and well-being were also found in the UK population (Jacob et al., 2020). It is important to note that PA was a significant predictor of the mental component summary score in our study; however, it did not play a significant role in predicting the physical component summary score.

Numerous studies showed beneficial effects of regular PA on mental health and reduction of the risk of depression and anxiety (Physical Activity Guidelines Advisory Committee, 2018). Recent studies performed in the period of COVID-19 pandemic also established significant relation between physical exercising and a reduced stress response (Popov et al., 2021). In their study, they reported that the level of physical exercise during the lockdown situation was a

predictor of better mental health, regardless of the level of physical activity of the respondents before the state of emergency was introduced (Popov et al., 2021). Another recent research reported that elite athletes and those with high level of physical activity experienced the lowest distress and that prolonged physical inactivity had negative effects of mental health (Sokić et al., 2021).

Furthermore, significant gender differences in mental health during COVID-19 pandemic were found in this study. Recent study found out that women experienced more depression symptoms and disorders while men had more anxiety symptoms and disorders (Vloo et al., 2021). Another research performed during lockdown in Italy reported that women had lower level of physical activity before the institution of lockdown and lower tendency to reduce physical activity levels during the lockdown than men (Orlandi et al., 2021). Care for family members, especially children in the environment of online education could have prevented many women from engaging in physical activities.

Regarding these facts on beneficial effects of regular PA and relation to the quality of life, it seems reasonable to advise to maintain healthy lifestyle routines including appropriate levels of PA even during the pandemic and to develop behavioural strategies for staying active in appropriate way, respecting social distancing and other anti-epidemic measures. This is even more important because the long-term impacts of the pandemic on physical and mental health are unknown, as well as it is unknown and impossible to predict when the pandemic will finally end. It seems that PA could have some protective effects on some of the harmful aspects of pandemic and confinement.

The strength of the study is the use of valid and reliable questionnaires used worldwide which allowed comparison of results with other studies. Furthermore, our study was conducted on a relatively large sample and it is the first to explore the association between PA and well-being, physical and mental functioning in the adult Croatian population. This study includes participants throughout the whole adulthood. Respecting empirical findings is necessary and can facilitate creating prevention measures in crises.

The main limitations of our study include cross-sectional design and sample, which consisted of more female participants. They were recruited by social media and the results might not be representative of the general adult Croatian population. A possible shortcoming may present an unknown balance of physical and mental dimensions because it is not recommended to express the overall score of these two dimensions on the SF-36. The information of frequency and duration of several domains of physical activity were collected with The International Physical Activity Questionnaire – Short Form (IPAQ-SF). This is a generally accepted and often used instrument but has some limitations. The vast majority of research findings show that the relationship between IPAQ-SF and objective measures of activity or fitness is lower than the acceptable standards. Moreover, as measured by objective criterion, IPAQ-SF typically overestimates physical activity in an average of 84 percent (Lee et al., 2011). Therefore, it can be assumed that the IPAQ-SF is a weak indicator of relative or absolute physical activity. Future research should be directed on preventive strategies using physical activity, especially for women, to counteract the negative effects of COVID-19 pandemic on mental health.

Conclusions

In conclusion, our research adds important information to the body of evidence regarding the association between PA and emotional well-being, quality of life, physical, and emotional functioning during the COVID-19 pandemic. The results showed that PA, besides other well-known beneficial effects on health, could offer an important contribution regarding the maintenance of mental health and well-being during the pandemic. Regarding all that, we recommend that regular PA should be encouraged and included in public health measures and guidelines during the pandemic to counteract the negative effects of confinement.

Funding

The authors were not granted any financial support for this research.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Appendix

Intercorrelations among variables

	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.Age	-.04	.33**	-.09*	.03	.04	.01	.01	-.07	.14**	-.05	-.06	-.11*	-.11**	.01
2.Gender	-	-.35**	-.04	-.07	-.14**	-.17**	-.12**	-.16**	-.06	-.12**	-.13**	-.12**	-.15**	-.18**
3. Body mass index (BMI)		-	-.14**	-.03	.05	-.04	.01	-.03	-.17**	-.03	-.07	-.15**	-.13**	.01
4.Attitude towards reaching appropriate levels of PA			-	.46**	.23**	.40**	.29**	.25**	.16**	.23**	.20**	.31**	.30**	.34**
5.Physical activity (PA)				-	.16**	.37**	.23**	.15**	.12**	.11**	.09*	.25**	.18**	.25**
6.Role limitations due to emotional problems					-	.45**	.55**	.50**	.10*	.42**	.31**	.29**	.41**	.85**
7. Vitality/ Energy						-	.78**	.50**	.16**	.36**	.44**	.56**	.51**	.76**
8.Emotional well-being							-	.58**	.13**	.33**	.40**	.48**	.45**	.83**
9.Social functioning								-	.19**	.40**	.40**	.37**	.47**	.77**
10.Physical functioning									-	.32**	.26**	.25**	.60**	.17**
11.Role limitations due to physical health										-	.53**	.36**	.85**	.48**
12.Bodily pain											-	.49**	.77**	.45**
13.General health												-	.66**	.48**
14.PCS													-	.55**
15.MCS														-

Note: * $p < 0.05$; ** $p < 0.01$; PCS - physical component summary; MCS - mental component summary

Tjelesna aktivnost, kvaliteta života i dobrobit ljudi odrasle dobi tijekom prvog vala pandemije COVID-19 u Hrvatskoj

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SAŽETAK

Iznenadnim pojavljivanjem COVID-a-19 došlo je do zatvaranja ljudi u vlastite domove u cijelom svijetu. Jednako je bilo i u Hrvatskoj - ljudi su provodili vrijeme u samoizolaciji, zatvoreni u vlastitim domovima. S obzirom da takvi uvjeti života mogu značajno utjecati na tjelesno i mentalno zdravlje, ispitana je tjelesna aktivnost (TA), dobrobit i kvaliteta života. Ukupno 580 odraslih sudionika ispunilo je online upitnik o TA i zdravstveno orijentiranoj kvaliteti života tijekom uvjeta samoizolacije u Hrvatskoj. Rezultati su pokazali kako su muški sudionici bili više uključeni u TA visokog intenziteta, kao i da su procijenili svoje tjelesno i mentalno zdravlje boljim u svim domenama. Prilikom usporedbe ispitanika s obzirom na kategoriju TA, oni s višim razinama TA funkcionirali su bolje u tjelesnom smislu, imali manje ograničenja zbog emocionalnih poteškoća, više razine emocionalne dobrobiti, vitalnosti i općeg zdravlja. Muškarci, sudionici s nižim ITM-om te manjim ograničenjima zbog emocionalnih poteškoća, vitalniji i oni s boljim socijalnim funkcioniranjem imali su bolje tjelesno zdravlje. Sudionici koji smatraju kako je njihova razina TA adekvatna i više sudjeluju u TA, oni s manjim ograničenjima zbog tjelesnog zdravlja, manjom tjelesnom boli te boljim općim zdravljem imaju bolje mentalno zdravlje. Rezultati pružaju uvid u tjelesnu i mentalnu komponentu zdravlja tijekom pandemije. Dobiveni nalazi potvrđuju pretpostavku o visokoj povezanosti tjelesnog i mentalnog zdravlja te o važnosti promicanja TA, posebno kod žena i onih koji su manje tjelesno aktivni tijekom pandemije.

Ključne riječi: tjelesna aktivnost, kvaliteta života, emocionalno funkcioniranje, dobrobit, pandemija COVID-19