PHYSICAL ACTIVITY AND THE PSYCHOLOGICAL WELL-BEING AMONG INDONESIA ADULTS DURING THE COVID-19 PANDEMIC

Nurul Muslihah, Ilmia Fahmi, Sofhin Madison Yuhasnara, Titis Sari Kusuma, Annisa Rizky Maulidiana, Nona Maharani Al Fariza and Isma Rosida Nurali

Department of Nutrition, Faculty of Health Sciences, Universitas Brawijaya, Malang, Indonesia

Abstract. Social distancing during the coronavirus disease 2019 (COVID-19) pandemic can increase sedentariness and reduce physical activity. Moreover, physical activity and exercise are coping strategies during the COVID-19 pandemic and have been associated with positive mental health, such as psychological well-being. The study aimed to investigate physical activity during the COVID-19 pandemic and its impact on psychological well-being among Indonesian adults. A self-reported cross-sectional online survey was conducted among 216 adults. The adult physical activity level was standardized using international physical activity questionnaire short form (IPAQ-SF), and the psychological well-being was assessed using the WHO-5 well-being index (WHO-5). A coping strategy was divided into two main categories based on respondent answers as problem-focused and emotion-focused coping. Independent t-tests or chi-square analyses were performed. According to the research findings, most participants (41.2%) indicated a low level of physical activity. Notably, the percentage of female adults with low physical activity levels was higher than that of their male counterparts, and this difference was statistically significant (p<0.001). Observed the average WHO-5 well-being scores across different levels of physical activity revealed distinct variations. Individuals engaging in high levels of physical activity had an average score of 78.55 (± 21.29), those with moderate levels of physical activity had a slightly higher average score of 78.68 (± 21.93), and individuals with low levels of physical activity had a notably lower average score of 70.06 (± 20.05). These differences between the groups were statistically significant (p=0.015). During the COVID-19 pandemic, adults with moderate and high physical

activity level exhibited a higher frequency indoor physical activity behavior was more frequent among adults with moderate and high physical activity levels (p<0.001). Exercise was used as a problem-focused coping strategies during the COVID-19 pandemic and was found to have been associated with psychological well-being (p<0.001). Consequently, it is imperative to implement an effective intervention that focuses on physical activity behaviors as a coping during the pandemic, which can also have a significant impact on psychological well-being.

Keywords: physical activity, pandemic COVID-19, well-being index, coping strategy

Correspondence: Nurul Muslihah, Department of Nutrition, Faculty of Health Sciences, Universitas Brawijaya, Veteran Street, Malang 65145, Indonesia
Tel: +62 81295001040 E-mail: nurul_muslihah.fk@ub.ac.id

INTRODUCTION

On 11 March 2022, the World Health Organization (WHO) proclaimed the COVID-19 outbreak a global pandemic (WHO, 2020). COVID-19 causes isolation because people should stay home to avoid infection, likely adversely impacting their physical and mental health (Banerjee and Rai, 2020). Previous studies have shown that social isolation caused by lockdown or home confinement causes people to feel bored and isolated, negatively impacting their psychological health (Brooks *et al*, 2020; Ammar *et al*, 2021).

The COVID-19 has caused significant psychological stress among those affected and physical consequences (Song, 2020). These negative effects on mental health can lead to harmful lifestyle changes, such as adopting new unhealthy habits (Hootman *et al*, 2018; Penaforte *et al*, 2019; Moynihan *et al*, 2015, Khalid *et al*, 2016) and sedentary behavior

(Van Dyk *et al*, 2019). Recent research indicates that the isolation and COVID-19 lockdown had a negative impact on eating habits and emotional processing (Cecchetto *et al*, 2021; Osimo *et al*, 2021). The physical limitations and social isolation that come with them may have unintended health consequences.

Moreover, physical activity and exercise are coping strategies during the COVID-19 pandemic and have been associated with positive mental health, such as psychological well-being. Social distancing during the COVID-19 pandemic can increase sedentariness and reduce physical activity. As a result, these social distancing measures may negatively impact the population's daily physical activity (Woods *et al*, 2020; Pecanha *et al*, 2020; Ammar *et al*, 2020; Lesser *et al*, 2020; Meyer *et al*, 2020; Stanton *et al*, 2020).

Regular and adequate physical activity levels improve the immune system and combat comorbidities such as obesity, diabetes, and mental health disorders (Sallis *et al*, 2020; Woods *et al*, 2020). In contrast, sedentary behavior refers to any walking behavior that involves an exergy expenditure of ≤1.5 metabolic equivalents (METs, while in a sitting, reclining, or lying position) (Tremblay *et al*., 2017). This scenario is extremely concerning because physical inactivity is a major cause of cardiovascular disease, diabetes, obesity, and premature death worldwide (Guthold *et al*, 2018, Moker *et al*, 2014, Siodia, 2020).

As a result, if the population's physical activity levels continue to decline during this period of physical distance, public health agencies will face an even greater challenge, as this condition may complicate the pandemic scenario, as diabetes, obesity, hypertension, and other comorbidities associated with ~~physical~~ inactivity can worsen the COVID-19 prognosis (Ammar *et al*, 2021; Osimo *et al*, 2021). This scenario of physical inactivity and physical distancing/isolation measures may

exacerbate pre-existing health issues and social inequities among women (Ammar *et al*, 2020; Lesser *et al*, 2020).

How do adults cope with stress during must stay at home due to social distancing related to exercise? During the COVID-19 pandemic, the Centers for Disease Control and Prevention (CDC) recommends exercising to cope with stress and maintain health (CDC, 2023). People who used exercise as a coping mechanism to maintain their physical health during the COVID-19 pandemic may have preserved their mental health. Coping is a multidimensional process of cognitive and behavioral efforts to reduce or tolerate stressful situations, both internal and external, and divided into two main categories, problem-focused and emotion-focus coping (Lazarus and Folkman, 1984). However, the effects of physical distancing on physical activity levels between the sexes are still unknown. It is reasonable to assume that the impact on physical activity levels would be greater in women, as they accumulate professional tasks with household tasks such as taking care of children now the schools are closed (Tremblay *et al*, 2017).

The study sought to investigate physical activity and its impact on psychological well-being among Indonesian adults during the COVID-19 pandemic. The hypothesis in the study posits that individuals who engaged in physical more activities during the COVID-19 pandemic would have better mental health and overall well-being compared to their less active.

MATERIALS AND METHODS

Study design and participants

The study aimed to investigate physical activity during the

COVID-19 pandemic and its impact on psychological well-being among Indonesian adults. We planned to conduct a self-reported cross-sectional online survey. Based on the application software "Epi Info" version 7.2.2.6 (https://www.cdc.gov/epiinfo/index.html) drawn from an unlimited population size, expected frequency of 15%, confidence level of 95%, resulted in a minimum of 196 respondents to be recruited in the study.

Data collection

The online survey was divided into four parts: socio-demographics characteristics, well-being, physical activity behavior, and coping strategy. Socio-demographic characteristics included age, gender, marital status, education, and employment status. Meanwhile, psychological well-being was assessed using the WHO-5 well-being index (WHO-5) WHO/EURO (1998). The WHO-5 well-being index comprises five statements: (1) I have felt cheerful and good spirits; (2) I have felt calm and relaxed; (3) I have felt active and vigorous; (4) 1 woke up feeling fresh and rested; and (5) My daily life has been filled with things that interest me. The respondent answered five statements to how they have been feeling over the past two weeks. Each of the 5 statements is scored as: 5 (all the time), 4 (most of the time), 3 (more than half of the time), 2 (less than half of the time), 1 (some of the time), and 0 (none of the time) and then the total raw score was multiplied by 4. The final score ranges from 0 (absence of well-being) to 100 (maximal well-being).

In the last section, we evaluated the physical activity levels of adults using a standardized protocol based on the International Physical Activity Questionnaire short form (IPAQ-SF) that was tested for the validity and reliability among 12 countries (Craig *et al*, 2003). For our study, this instrument was translated into Bahasa Indonesia. Preliminary testing of the questionnaire demonstrated its construct validity, as

indicated by a significant Pearson correlation. Furthermore, the test-retest reliability of the International Physical Activity Questionnaire (IPAQ) was established using Cronbach's alpha, yielding a coefficient greater than 0.60, indicating satisfactory internal consistency.

With previously reported internationally validated results, this translated IPAQ has adequate measurement properties for estimating physical activity levels (Bauman *et al*, 2009). In the IPAQ short form version, the participants were asked how many days during the past seven days and average how many minutes per day they did vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling, and also how much time they spent on the moderate physical activity like carrying light loads, bicycling at a regular pace, doubles tennis, and walking for at least 10 minutes at a time.

Classification of declared physical activity was based on an estimate of energy expenditure, which was obtained by multiplying the frequency of performing vigorous or moderate physical activity and walking over the week by the duration of each activity. The result was stated in units of metabolic equivalents of work (MET min per week), which was the amount of energy a person expended at rest and was equivalent to burning 1 kcal/kg/h. The total physical activity was determined by adding the MET values for three weekly activities, classified as high (intense PA), moderate (increasing and moderate PA), and low (insufficient PA) (Bienat *et al*, 2015). A high level of physical activity was defined as an indicator greater than 1,500 MET-min/week in conjunction with three or more days of intense physical activity per week or an indicator greater than 3,000 MET/week. They were considered high PA when values were above the indicator of 1,500 MET-min/week but lasted less than three days per week. 600-1500 MET-min/week was moderate as physical activity. A low-level PA is indicated by less than 600 MET-min per week or a mismatch between

moderate, high, and intense PA settings. Physical activity behavior was defined indoors (gymnastics, bicycle static, treadmill, etc.) and outdoors (jogging, cycling, *etc*).

During the COVID-19 pandemic, adults coped with stress related to reducing sedentary or physical activity. A coping strategy in the study was divided into two main categories, problem-focused and emotion-focused coping, based on respondent answers 'Yes' and 'No (Lazarus and Folkman, 1984; Stanisławski, 2009). The problem-focus strategy was divided into making plans, strategies, and ways to overcome problems related to efforts to increase physical activity actively and exercise (PCS 1), trying to overcome the feeling of being lazy to do physical activity and exercise, or willing to make changes gradually (PCS 2), and delaying or refraining from engaging in active physical activity or exercising in a hurry until conditions allow (PCS 3). Meanwhile, the emotion-focus strategy was divided into staying focused, prioritizing active physical activity and exercise, or overcoming any distractions that may arise (ECS 1), and discussing and seeking emotional support from family and friends to overcome problems caused by a lack of active physical activity and exercise (ECS 2).

Statistical analysis

The analysis is to investigate changes in physical activity level, well-being index, coping strategy category, and participant's characteristics during COVID-19, independent t-test and chi-square analyses have been performed. Analyses were conducted using the Statistical Package for the Social Scientists (SPSS) software version 22.0 for Windows (IBM Corp, Armonk, NY). Statistical significance was defined as a two-tailed $p<0.05$ with the confidence interval set at 95%.

Ethical approval

The ethics committee of the Faculty of Medicine, Universitas Brawijaya (Certificate No. 348/EC/KEPK/11/2021) granted ethical approval.

RESULTS

Socio-demographic characteristics and physical activity

The total subjects recruited were 216 adults aged 26-50 years with 10% being added for refusals or dropouts from the original 196 minimum sample size calculation. Of the 216 study participants, 131 (60.6%) were women with an average age of 37.01± 8.69 years, and employed (81.5%). The results showed that the majority of respondents had low physical activity (41.2%); 33.3% had moderate physical activity and 25.5% had high physical activity. The study revealed a significantly higher proportion of female adults engaging in low levels of physical activity compared to male adults (p<0.001). The majority of participants (59.7%) possess a postgraduate educational background, and 68.5% exhibit a markedly distinct low level of physical activity, as confirmed by statistical significance testing (p<0.001). Adults with a graduate-level education exhibited a higher propensity for remote work engagement (Table 1).

Psychological well-being during COVID-19 pandemic

WHO 5 well-being indexes were a short self-reported measure of current mental well-being. According to Table 2, there was no difference in the WHO-5 means scores (SD) of females (71.29 ± 18.17) and males (71.71 ± 25.62) (p=0.062). The WHO-5 score was marginally elevated

Table 1
Characteristic of participants by physical activity level

Characteristic	All (N = 216)	Low PA (N = 89)	Moderate PA (N = 72)	High PA (N = 55)	*p*-value*
Age in years (mean ± SD)	37.01 ± 8.69	38.137 ± 8.53	35.81 ± 8.51	36.76 ± 9.11	0.233
Sex, *n* (%)					
Female	131 (60.6)	63 (70.8)	48 (66.7)	20 (36.4)	<0.001
Male	85 (39.4)	26 (29.2)	24 (33.3)	35 (63.6)	
Employment status, *n* (%)					
Unemployed	40 (18.5)	19 (21.3)	13 (18.1)	8 (14.5)	0.589
Employee	176 (81.5)	70 (78.7)	59 (81.9)	47 (21.8)	
Education level, *n* (%)					
Primary school	15 (6.9)	2 (2.2)	5 (6.9)	8 (14.5)	<0.001
Secondary/high school	72 (33.3)	26 (29.2)	18 (25.0)	28 (50.9)	
Graduate degree	129 (59.7)	61 (68.5)	49 (68.1)	19 (34.6)	

*Significant at $p \leq 0.05$

PA: physical activity; SD: standard deviation

Table 2
WHO-5 well-being index mean score

Variable	WHO-5 well-being index mean score		
	Mean ± SD	95% CI	*p*-value*
Sex			
Female	71.29 ± 18.17	74.15-80.43	0.062
Male	71.71 ± 25.62	66.18-77.23	
Employment status			
Unemployed	70.63 ± 22.65	63.38-77.87	0.146
Employee	76.11 ± 21.20	72.95-79.26	
Physical activity level			
Low	70.06 ± 20.55	65.73-74.39	0.015
Moderate	78.68 ± 21.93	75.53-83.83	
High	78.55 ± 21.29	72.79-84.30	

Low level physical activity: less than 600 MET min per week; moderate level physical activity: 600-1,500 MET-min/week; high level physical activity: greater than 1,500 MET min/week in conjunction with three or more days of intense physical activity per week or an indicator greater than 3,000 MET/week

*Significant at $p \leq 0.05$ using independent t-test

CI: confidence interval; MET: metabolic equivalents; SD: standard deviation

among employed individuals (76.11 ± 21.20); however, statistical analysis did not reveal a significant difference (p=0.146). Notably, the study's findings demonstrated that adults with moderate (78.68 ± 21.93) and high levels of physical activity (78.55 ± 21.29) exhibited significantly greater WHO-5 well-being mean scores compared to those with low physical activity levels, with a p-value of 0.015.

Physical activity behavior during COVID-19 pandemic

In the study, distinct categories of physical activity behaviors were delineated with indoor activities encompassing options such as gymnastics, stationary cycling, and treadmill use, while outdoor activities included jogging and cycling, among others.

The study's findings (Fig 1) revealed that there was a statistically significant difference between the level and behavior of indoor physical activity engagement (p<0.001). Amid the COVID-19 pandemic, adults with moderate (44.5%) and high (45.5%) levels of physical activity exhibited a notably higher frequency of indoor physical activity engagement compared to those with low physical activity levels (15.7%).

Conversely, there were no statistically significant differences in the frequency of outdoor physical activity participation among participants with moderate and high levels of physical activity, with both groups displaying reduced engagement in outdoor activities (p=0.06).

Coping strategy of physical activity during the COVID-19 pandemic

Participants with moderate and high PA levels had significantly higher problem-focused coping strategies than those with low PA levels (p<0.001) as shown in Fig 2. There were three coping strategies: (PCS 1) making plans and strategies to overcome problems related to the efforts to increase PA and exercise actively; (PCS 2) trying to overcome the feeling of being lazy to do PA and exercise and willing to make gradual changes; and (PCS 3) delay or refrain from engaging in active PA and exercising in a hurry until conditions allow. Emotion-focus strategies both stay focused, prioritize active physical activity and exercise, and overcome any distractions that may arise (ECS1) or discuss and seek emotional

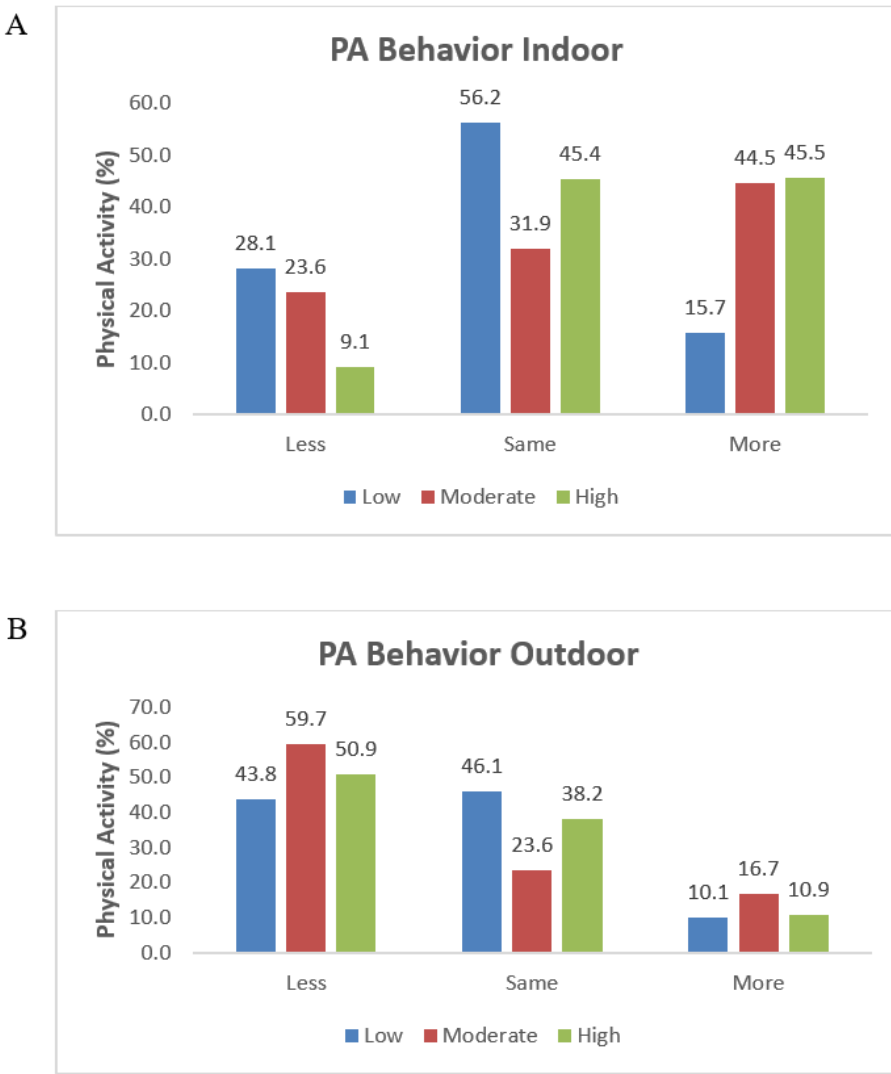

Fig 1 - Physical activity behaviors indoor (A) and outdoor (B) during COVID-19 pandemic

Low level physical activity: less than 600 MET min per week; moderate level physical activity: 600-1,500 MET-min/week; high level physical activity: greater than 1,500 MET min/week in conjunction with three or more days of intense physical activity per week or an indicator greater than 3,000 MET/week

Statistical analysis using Chi-square resulted in $p<0.001$ (A) and $p=0.060$ (B).

COVID-19: Coronavirus Disease 2019; MET: metabolic equivalents; PA: physical activity

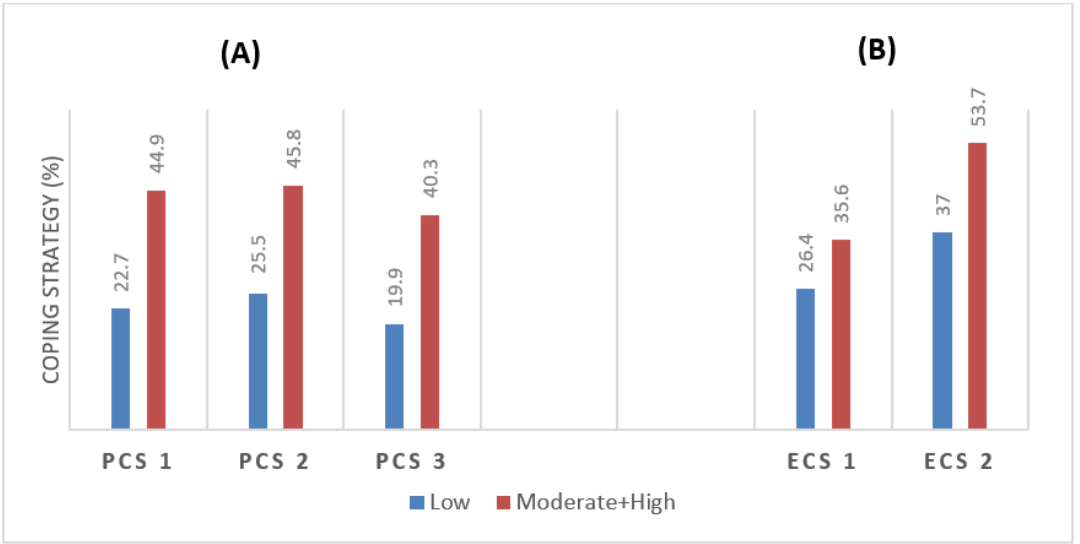

Fig 2 - Coping strategy by physical activity level during the COVID-19 pandemic (A): PCS; (B): ECS

Statistical analysis using Chi-square resulted in $p<0.001$ (A) and $p=0.358$ (B)

COVID-19: Coronavirus Disease 2019; ECS: Emotion-focused Coping Strategy; ECS 1: Emotion-focused Coping Strategy 1; ECS 2: Emotion-focused Coping Strategy 2; PCS: Problem-focused Coping Strategy; PCS 1: Problem-focused Coping Strategy 1; PCS 2: Problem-focused Coping Strategy 2; PCS 3: Problem-focused Coping Strategy 3

support from family and friends to overcome problems caused by a lack of active physical activity and exercise (ECS 2) was more with moderate and high PA level. Still, there was no significant difference ($p=0.358$).

DISCUSSION

The study investigates physical activity and its impact on psychological well-being among Indonesian adults during the COVID-19 pandemic. This study's primary outcomes suggest that individuals

maintaining physical activity during the COVID-19 restrictions likely experienced enhanced psychological well-being. These findings underscore the potential benefits of physical activity in mitigating the psychological impacts of pandemic-related restrictions.

There is a significant difference in the levels of physical activity between female and male adults, with a notably higher proportion of females engaging in less physical activity compared to their male counterparts. This in accordance with the study of Kuzmik *et al* (2022), that women were significantly less physically active than men.

Among participants with moderate and high levels of physical activity, there was a reduced frequency of engaging in outdoor physical activities, and this pattern did not significantly change during the COVID-19 pandemic. The result from Lesser and Nienhuis (2020) also showed that inactive participants who spent more time engaged in outdoor physical activity had lower anxiety than those who spent less time in outdoor physical activity.

During the COVID-19 pandemic, a notable correlation was observed between physical activity levels and mental well-being. Specifically, adults engaging in moderate to high levels of physical activity exhibited significantly higher WHO-5 well-being mean scores compared to those with low physical activity levels. Complementing this finding, a study by Fox *et al* (1999) highlighted the effectiveness of physical activity in treating depression and anxiety, thereby improving mental well-being in the public. Further, research conducted by Ejiri *et al* (2021) reinforced the role of exercise as a coping strategy during the stay-at-home period. This study also emphasized that the impact on psychological well-being varied depending on the type of physical activity undertaken, suggesting a nuanced relationship between the nature of exercise and mental health outcomes.

In the context of mental health and psychosocial well-being, there is compelling evidence suggesting a relationship between physical activity and anxiety and depressive symptoms, as established by previous research (Sharma *et al*, 2006; Chekroud *et al*, 2018; Schuch *et al*, 2018; Schuch and Stubbs, 2019). Engaging in physical activity has been shown to enhance mental health by mitigating symptoms of anxiety and depression, reducing negative mood, and improving self-esteem and cognitive function, as documented by Callaghan (2004). It is important to note that negative psychological responses, such as stress and anxiety, have been identified in prior studies as contributors to adverse health outcomes and diminished well-being, particularly among individuals facing health crises (Wu *et al*, 2005; Pappas *et al*, 2009).

However, this study had several limitations. Firstly, due to the inherent nature of cross-sectional study designs, the causal relationship between psychological well-being and physical activity could not be conclusively established. This limitation arises because cross-sectional studies only capture a snapshot in time, preventing the determination of cause and effect. Additionally, the findings from this study may have limited generalizability to a broader and more diverse population, as the study's sample might not accurately represent the wider demographic variations.

Secondly, conducting surveys online presents a challenge in accurately identifying the characteristics of the respondents to whom they are distributed, as these details often remain unspecified. Additionally, there is a risk of self-selection bias, where respondents may choose to participate in the survey primarily if they hold certain biases, potentially skewing the results.

In conclusion, exercise was used as a coping strategy during the COVID-19 pandemic and have associated with psychological well-being. During the COVID-19 pandemic, most respondents had low physical

activity levels. The mean scores for physical activity, as measured by the WHO-5 scale, were higher among individuals with high and moderate levels of physical activity compared to those with low levels. The prevalence of indoor physical activity behavior was observed to be significantly higher among adults exhibiting moderate to high levels of physical activity, a trend consistent with expectations. Throughout the COVID-19 pandemic, this pattern of increased indoor physical activity was consistently observed across all groups engaged in physical activity (PA). Furthermore, it was noted that adults predominantly employed problem-focused coping strategies, as opposed to emotion-focused coping strategies. Therefore, it is imperative to implement an effective intervention that focuses on physical activity behaviors as a coping during the pandemic, which can also have a significant impact on psychological well-being.

ACKNOWLEDGMENTS

The authors are grateful to the Faculty of Health Sciences, Universitas Brawijaya for the financial support (Grant No. 4/UN10.F17/PT.01.03.2/2022).

CONFLICT OF INTEREST DISCLOSURE

The authors declare no conflict of interest.

REFERENCES

Ammar A, Brach M, Trabelsi K, *et al*. Effects of COVID-19 home confinement on eating behaviour and physical activity: results of the ECLB-

COVID19 international online survey. *Nutrients* 2020; 12(6): 1583.

Ammar A, Trabelsi K, Brach M, *et al*. Effects of home confinement on mental health and lifestyle behaviours during the COVID-19 outbreak: insight from the ECLB-COVID19 multicenter study. *Biol Sport* 2021; 38(1): 9-21.

Banerjee D, Rai M. Social isolation in COVID-19: the impact of loneliness. *Int J Soc Psychiatry* 2020; 66(6): 525-7.

Bauman A, Bull F, Chey T, *et al*. The international prevalence study on physical activity: results from 20 countries. *Int J Behav Nutr Phys Act* 2009; 6: 21.

Biernat E, Tomaszewski P. Association of socio-economic and demographic factors with physical activity of males and females aged 20–69 years. *Ann Agric Environ Med* 2015; 22(1): 118-23.

Brooks SK, Webster RK, Smith LE, *et al*. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020; 395(10227): 912-20.

Callaghan P. Exercise: a neglected intervention in mental health care? *J Psychiatr Ment Health Nurs* 2004; 11(4): 476-83.

Cecchetto C, Aiello M, Gentili C, Ionta S, Osimo SA. Increased emotional eating during COVID-19 associated with lockdown, psychological and social distress. *Appetite* 2021; 160: 105122.

Centers for Disease Control and Prevention (CDC). Coping with stress, 2023 [cited 2023 May 10]. Available from: URL: https://www.cdc.gov/mentalhealth/cope-with-stress/index.html

Chekroud SR, Gueorguieva R, Zheutlin AB, *et al*. Association between physical exercise and mental health in 1.2 million individuals in the USA between 2011 and 2015: a cross-sectional study. *Lancet Psychiatry* 2018; 5(9): 739-46.

Craig CL, Marshall AL, Sjostrom M, *et al*. International physical activity questionnaire: 12 country reliability and validity. *Med Sci Sport Exerc* 2003; 35(8): 1381-95.

Ejiri M, Kawai H, Kera T, *et al*. Exercise as a coping strategy and its impact on the psychological well-being of Japanese community-dwelling older adults during the COVID-19 pandemic: a longitudinal study. *Psychol Sort Exerc* 2021; 57: 102054.

Fox KR. The influence of physical activity on mental well-being. *Public Health Nutr* 1999; 2(3A): 411-8.

Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Health* 2018; 6(10): e1077-86.

Hootman KC, Guertin KA, Cassano PA. Stress and psychological constructs related to eating behavior are associated with anthropometry and body composition in young adults. *Appetite* 2018; 125: 287-94.

Khalid S, Williams CM, Reynolds SA. Is there an association between diet and depression in children and adolescents? A systematic review. *Br J Nutr* 2016; 116(12): 2097-108.

Kuzmik A, Liu Y, Cuffee Y, Kong L, Sciamanna CN, Rovniak LS. The association between gender and physical activity was partially mediated by social network size during COVID-19. *Int J Environ Res Public Health* 2022; 19(5): 2495.

Lazarus RS, Folkman S. Stress, appraisal, and coping. New York, NY: Springer Publishing Company; 1984.

Lesser IA, Nienhuis CP. The impact of COVID-19 on physical activity behavior and well-being of Canadians. *Int J Environ Res Public Health* 2020; 17(11): 3899.

Meyer J, McDowell C, Lansing J, *et al*. Changes in physical activity and

sedentary behavior in response to COVID-19 and their associations with mental health in 3052 US adults. *Int J Environ Res Public Health* 2020; 17(18): 6469.

Moker EA, Bateman LA, Kraus WE, Pescatello LS. The relationship between the blood pressure responses to exercise following training and detraining periods. *PLoS One* 2014; 9(9): e105755.

Moynihan AB, van Tilburg WA, Igou ER, Wisman A, Donnelly AE, Mulcaire JB. Eaten up by boredom: consuming food to escape awareness of the bored self. *Front Psychol* 2015; 6: 369.

Osimo SA, Aiello M, Gentili C, Ionta S, Cecchetto C. The influence of personality, resilience, and alexithymia on mental health during COVID-19 pandemic. *Front Psychol* 2021; 12: 630751.

Pappas G, Kiriaze IJ, Giannakis P, Falagas ME. Psychosocial consequences of infectious diseases. *Clin Microbiol Infect* 2009; 15(8): 743-7.

Pecanha T, Goessler KF, Roschel H, Gualano B. Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease. *Am J Physiol Heart Circ Physiol* 2020; 318(6): H1441-6.

Penaforte FRO, Minelli MCS, Anastacio LR, Japur CC. Anxiety symptoms and emotional eating are independently associated with sweet craving in young adults. *Psychiatry Res* 2019; 271: 715-20.

Sallis JF, Adlakha D, Oyeyemi A, Salvo D. An international physical activity and public health research agenda to inform coronavirus disease-2019 policies and practices. *J Sport Health Sci* 2020; 9(4): 328-34.

Schuch FB, Stubbs B. The role of exercise in preventing and treating depression. *Curr Sports Med Rep* 2019; 18(8): 299-304.

Schuch FB, Vancampfort D, Firth J, *et al*. Physical activity and incident depression: a meta-analysis of prospective cohort studies. *Am J*

Psychiatry 2018; 175(7): 631-48.

Sharma A, Madaan V, Petty FD. Exercise for mental health. *Prim Care Companion J Clin Psychiatry* 2006; 8(2): 106.

Siordia JA Jr. Epidemiology and clinical features of COVID-19: a review of current literature. *J Clin Virol* 2020; 127: 104357.

Song M. Psychological stress responses to COVID-19 and adaptive strategies in China. *World Dev* 2020; 136: 105107.

Stanisławski K. The coping circumplex model: an integrative model of the structure of coping with stress. *Front Psychol* 2019; 10: 694.

Stanton R, To QG, Khalesi S, *et al*. Depression, anxiety, and stress during COVID-19: associations with change in physical activity, sleep, tobacco, and alcohol use in Australian adults. *Int J Environ Res Public Health* 2020; 17(11): 4065.

Tremblay MS, Aubert S, Barnes JD, *et al*. Sedentary Behavior Research Network (SBRN) -Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act* 2017; 14(1): 75.

Van Dyk TR, Becker SP, Byars KC. Rates of mental health symptoms and associations with self-reported sleep quality and sleep hygiene in adolescents presenting for insomnia treatment. *J Clin Sleep Med* 2019; 15(10): 1433-42.

Woods JA, Hutchinson NT, Powers SK, *et al*. The COVID-19 pandemic and physical activity. *Sport Med Health Sci* 2020; 2(2): 55-64.

World Health Organization (WHO). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020, 2020 [cited 2022 Oct 14]. Available from: URL: htpps:// www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

World Health Organization Regional Office for Europe (WHO/EURO).

Wellbeing measures in primary health care/the DepCare Project, 1998 [cited 2022 Oct 13]. Available from: URL: https://iris.who.int/bitstream/handle/10665/349766/WHO-EURO-1998-4234-43993-62027-eng.pdf?sequence=1&isAllowed=y

Wu M, Xin Y, Wang H, Yu W. Private and public cross-subsidization: financing Beijing's health-insurance reform. *Health Policy* 2005; 72(1): 41-52.