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The correlates of physical activity during COVID-19 pandemic among Indonesian young adults: A longitudinal study

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Abstract:

BACKGROUND: Social distancing policy during the COVID-19 pandemic may affect physical activity levels. This study aimed to compare physical activity levels before and during the pandemic and to explore physical activity correlates among Indonesian young adults.

MATERIALS AND METHODS: This longitudinal study was conducted before the pandemic ($n = 141$) in September 2019 and was followed by an online follow-up survey during the pandemic (79% response rate) in September 2020. Physical activity was measured using the global physical activity questionnaire and was classified into “sufficient” and “insufficient.” The potential correlates of physical activity were constructs from social-cognitive theory and health belief model. Those were measured using a validated questionnaire in the follow-up survey. Physical activity levels before and during pandemics were compared using the Wilcoxon signed-rank test. Simple logistic regressions were used to assess the relationships between each potential correlate and physical activity status during the pandemic.

RESULTS: Physical activity levels decreased significantly during the pandemic, mostly in the work-related domain. Participants with favorable physical activity-related constructs were more likely to be physically active. The odds ratio ranged from 3.41 (95% confidence interval [CI] = 1.15–10.11) in participants with higher self-efficacy to 4.50 (95% CI = 1.44–14.06) in those with higher outcome expectations of physical activity.

CONCLUSION: A significant decline in physical activity during the COVID-19 pandemic among Indonesian young adults was confirmed. The application of behavioral change theories for explaining physical activity status during the pandemic in this population is also supported. It is recommended to incorporate these constructs to develop physical activity interventions in this target population.

Keywords:

Association, COVID-19, exercise, health belief model

Introduction

Coronavirus disease (COVID-19), due to its relatively high transmission and high case fatality rates which are mostly associated with respiratory distress^[1] or coagulopathy,^[2] has caused significant health, social, and economic burden worldwide,^[3,4] including in Indonesia.^[5] While several countries have contained

the transmission rate,^[6,7] COVID-19 cases are continually increasing in Indonesia.^[8] Preventive measures which include social restriction, thus, are still heavily imposed in Indonesia.^[9] Consequently, it affects various sectors of life including the economy,^[10] transportation,^[11] social,^[12] culture,^[10] and education system in Indonesia.^[13]

Although the social restriction policy is intended to minimize the spread of COVID-19, it potentially reduces

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individuals' opportunities to be physically active.^[14] It is unfortunate because the decline of physical activity could result in adverse effects on the immune system.^[15] In contrast, a growing body of evidence has stated that moderate-to-vigorous- physical activity (MVPA) increases the antipathogenic activity of tissue macrophages, immunoglobulins, anti-inflammatory cytokines, neutrophils, natural killer cells, cytotoxic T-cells, and B-cells.^[16,17] Thus, MVPA increases the body's resistance to bacterial and viral infections.^[16] In addition, it also reduces cortisol, a stress hormone that can suppress immune cell function,^[18] improves metabolic parameters,^[19] improves bioenergetics,^[20] and reduces systemic inflammations.^[21,22] All of which play an important role in boosting the immune system^[23] which further plays significant roles in controlling COVID-19 transmission. Moreover, individuals who were consistently meeting physical activity recommendations experience reduced risks for severe COVID-19 complications when they are infected with the coronavirus,^[24] which is associated with an increase in quality of life.^[25] Thus, in addition to the social restriction policy, physical activity promotion needs to be emphasized as a significant public health agenda during the COVID-19 pandemic to curb both the COVID-19 transmission and case fatality rates.

The development of physical activity interventions requires an understanding of factors that influence physical activity behaviors.^[26] Studies which have conducted before the COVID-19 pandemic have shown that physical activity behaviors could be explained using behavior change theories such as the social-cognitive theory (SCT) and health belief model (HBM).^[27] Those theories also have been used as frameworks for developing effective physical activity interventions pre COVID-19 pandemic,^[28,29] and understanding overall COVID-19 preventive behavior during the pandemic.^[30,31] The SCT is operated within several main constructs such as self-efficacy, outcome expectation, social supports, and self-regulation.^[26] These constructs have been found useful in explaining and predicting physical activity behavior.^[32,33] Meanwhile, the HBM is potentially useful in explaining physical activity behaviors during the pandemic using the HBM's main constructs, which are the perceived susceptibility and severity of health consequences of physical inactivity as well as the perceived benefit and barriers of physical activity.^[26]

While the association between the SCT and HBM constructs and physical activity behavior in the general population has been established before the COVID-19 pandemic,^[14,34] it is unknown to what extent those constructs influence physical activity behavior during the COVID-19 pandemic among young adults that were previously physically active (i.e., sports science

students) in Indonesia. The impact of the COVID-19 pandemic on their physical activity levels also has not been evaluated considering that they were heavily affected by the social restriction policy which has left them with fewer opportunities to be physically active during the class hours caused by the fully online learning education mode and the halts of many sporting events. Therefore, this study aimed to compare the trend of physical activity before and during the pandemic and to evaluate the relationship between constructs from behavioral change theories (i.e., SCT and HBM) and physical activity behaviors in this target population. It is expected that the findings of this study would inform the policymakers for providing them with adequate support for maintaining their physical activity levels by developing physical activity intervention that best suits this target population.

Materials and Methods

Study design and setting

This study was a longitudinal physical activity survey that compared physical activity levels before and during pandemic among students in a Sports Science Faculty in Indonesia. The first survey was conducted on-site in September 2019. The second survey was an online follow-up survey that was conducted in September 2020, during the university closure and fully online learning.

Study participants and sampling

The participants were students in a Sports Science Faculty in Indonesia who participated in a physical activity survey recruited through convenience sampling. They were then invited a year later invited to participate in an online follow-up study. Those responding to the follow-up survey were included in the final analysis.

Data collection tool and technique

The first survey was a paper-based survey assessing participants' physical activity levels, social demography, and anthropometric data. The follow-up survey was an online survey assessing the participants' physical activity levels and potential social-cognitive factors based on the SCT and HBM constructs.

Physical activity

The physical activity level and status were assessed in 2019 and 2020 using the Global Physical Activity Questionnaire (GPAQ). This questionnaire has been developed by the WHO for surveillance of physical activity in various countries.^[35] The GPAQ was used in this study because it has been validated in adult populations in nine countries and has demonstrated adequate reliability with coefficients (kappa) of 0.67–0.73 and Spearman rho 0.67–0.81.^[36] Although the concurrent validity with the pedometer was 0.35,^[36] the

GPAQ is a globally accepted physical activity measure. It consists of 16 items related to work, active travel, recreational-related physical activity, and sedentary behavior.^[35]

The total metabolic equivalent of task (MET) per week in three domains (work, active travel, and recreational) was calculated according to the standard GPAQ scoring. To create the total Mets per week, the time spent in walking, cycling, or moderate physical activity was multiplied by 4 and was added up with the time spent in strenuous activities which were multiplied by 8. Mets per week were also calculated for each physical activity domain. Based on the scoring guideline, we used three criteria to classify participants as ‘insufficiently’ active, which were (i) participants who did not meet the threshold of physical activity recommendations of ≥ 600 METs per week, (ii) participants who engaged in < 5 days of MVPA per week, or (iii) participants who accumulated less than 150 MVPA minutes per week.^[35] Otherwise, participants were classified as ‘sufficiently’ active.

Potential correlates

The social-cognitive correlates were assessed through an online questionnaire which was sent to the participants’ registered students’ e-mail along with the informed consent in the second survey during the pandemic. The potential correlates were adapted from instruments from constructs from the SCT and the HBM. Self-efficacy in this regard was defined as an individual’s perceived ability in engaging insufficient physical activity regardless of barriers they experience during the COVID-19 pandemic, while outcome expectation was construed as individuals’ perception of the likelihood and importance of outcomes resulted in being physically active related to COVID-19.^[32] Meanwhile, social support was interpreted as individuals’ opportunities to receive support from their family and friends to become physically active during the COVID-19 pandemic, and self-regulation was defined as individuals’ ability to regulate their behavior to become physically active during the COVID-19 pandemic.^[32] The perceived severity and susceptibility were related to their health risks associated with COVID-19 infection, while perceived benefits and barriers were concerning on their perception of being physically active during the COVID-19 pandemic.^[37] Table 1 further summarizes and defines potential correlates of physical activity behaviors.

To minimize the response load and thus to increase the participation rate, all potential correlates were asked with a single item with dichotomous responses. The content validity of the questionnaires was previously examined by six specialists in education and health promotion. Based on the recommended procedure,^[38] each expert was asked to rate each item based on two criteria: (1) the relevance of the question to the instrument objective

and local culture and (2) the clarity and equivalence of phrasing. The ratings used were on a 4-point Likert scale (i.e., 1 = not relevant or equivalent, 2 = somewhat relevant or equivalent, 3 = almost relevant or equivalent and 4 = very relevant or equivalent). The proportion of experts who gave each item a rating of 3 or 4 for content validity for each item were calculated to determine the item’s content validity index (I-CVI). An I-CVI of 0.78 or above was the minimum acceptable index for each of the questionnaire items.^[38] The content validity index for all items that assessed potential correlates for physical activity behaviors ranged between 0.83 and 1.

Social demography characteristics and anthropometry measurement

The data on age, sex, height, and weight were collected during the first survey. Height was measured using a stadiometer, while weight was measured using a standardized scale.

Ethical consideration

All participants were provided with informed consent and the study protocol was approved by the Human Ethics Committee of Gadjah Mada University (approval No. KE/0142/02/2019 and No. KE/0523/06/2020).

Data analysis plan

Sociodemographic, anthropometric data and physical activity levels were compared between participants responding to the follow-up survey and participants who were lost to follow-up using Mann–Whitney to account for the nonnormality of the data. Sociodemographic data were also compared between participants with sufficient and insufficient physical activity status based on the second survey. Physical activity levels (i.e., total, work-related, transport-related, and recreational physical activity) were compared between the first survey (before pandemic) and the second survey (during the pandemic) using the Wilcoxon signed-rank test due to the nonnormality of the data. Simple logistic regressions were carried out to calculate the odds ratio (OR) of each potential correlate in engaging with sufficient physical activity, unadjusted for sex and age since these were not found in association with physical activity status. SPSS® v25.0 was used to analyze the data (SPSS Inc., Chicago, IL, US). Statistical significance was defined as $P < 0.05$.

Results

Participants social demographic characteristics

The study participants in the first physical activity survey were 141 students. One hundred eleven (79%) of those responded to the second survey. The characteristics of participants who were recruited in the follow-up study and the characteristics of the participants who did not respond (lost to follow-up) are shown in Table 2. In

Table 1: Social-cognitive correlates of physical activity behavior

Potential correlates	Explanation
Social-cognitive theory-based constructs	
Self-efficacy	Self-assessed ability in being physically active despite barriers during COVID-19 pandemic
Outcome expectations	Expectations of exercise for improving resistance in contracting COVID-19
Self-regulation	Self-assessed ability in regulating physical activity during COVID-19 pandemic
Social support	Perceptions of the amount of support an individual received from family or friends to be physically active during COVID-19 pandemic
Health belief model-based construct	
Perceived susceptibility	Self-assessed susceptibility in contracting COVID-19
Perceived severity	Self-assessed severity in contracting COVID-19
Perceived benefit	Self-assessed benefit that and individuals obtain by being physically active during COVID-19 pandemic
Perceived barrier	Self-assessed barriers that and individuals faced being physically active during COVID-19 pandemic

Table 2: Description of sociodemographic characteristics

Characteristics	Total (n=141)	Lost to follow-up group (n=30)	Follow up group (n=111)	P*
Age (years)	19.5±0.7	20.7±0.9	20.5±0.6	0.530
Height (cm)	167.2±7.0	168.4±6.7	166.8±7.1	0.251
Weight (kg)	58.9±9.9	59.14±9.0	58.9±10.1	0.641
Body mass index (kg/m ²)	21.0±2.6	20.76±2.2	21.1±2.6	0.811
Physical activity level (mets/week)	3924±1731	3834±1693	3948±1816	0.707
Gender, n (%)				
Male	109 (77.3)	26 (87.7)	83 (74.8)	0.221
Female	32 (27.3)	4 (13.3)	28 (25.2)	

general, the majority of participants in both the baseline and follow-up studies were male (77.3% and 74.8%). There was no difference in social demography, anthropometry, and physical activity levels between participants participating in the follow-up study and those who were lost to follow-up.

Physical activity levels

Figure 1 shows a comparison of physical activity levels before and during the COVID-19 pandemic among participants in the follow-up survey (*n* = 111). In the first survey, all participants met physical activity recommendations, while in the follow-up survey, 16 participants (11.3%) did not meet physical activity recommendations.

There was an overall decrease in total physical activity, with a median of 3960 and 1720 Mets/week before and during the pandemic (*P* < 0.001). The main decline occurred in the work-related domain (1920 ± 360 Mets/week, *P* < 0.001), while only slightly decreased in the transport domain (200 ± 180 Mets/week, *P* = 0.002) and the recreational domain (1320 ± 1120 Mets/week, *P* = 0.295).

Correlates of physical activity

Table 3 summarizes the ORs of the potential correlates in predicting the likelihood of engaging insufficient physical activity level during the COVID-19 pandemic. As seen in the table, age and sex did not correlate with physical activity status. Those with favorable

social-cognitive factors related to physical activity were approximately 3–4 times more likely to engage be physically active. Meanwhile, those with higher perceived barriers of being physically active were 0.3 less likely (95% confidence interval; 0.10–0.89) to engage in sufficient physical activity.

Discussion

While few studies have assessed physical activity levels in Indonesia during the COVID-19 pandemic,^[39,40] to our knowledge, this study is the first longitudinal study comparing the physical activity levels before and during the COVID-19 pandemic among previously active young adults in Indonesia. We found that physical activity levels decreased significantly during the pandemic. Our findings were in corroboration with studies that reported a decline in physical activity level in the general population in the UK,^[41] in Australian college students,^[42] in adolescences in Bosnia and Herzegovina,^[43] and among previously physically active young adults in Canada.^[44]

The decline in physical activity levels in our study participants was also in line with a recent study reporting an overall global physical activity level decrease which was based on the data from smartphone step counter applications from users around the world.^[34] That study also found that even countries which had relatively low COVID-19 infection rates and have therefore do not imposed lockdowns, such as South Korea, Taiwan, and Japan, also exhibited decreases in overall step counts.^[34]

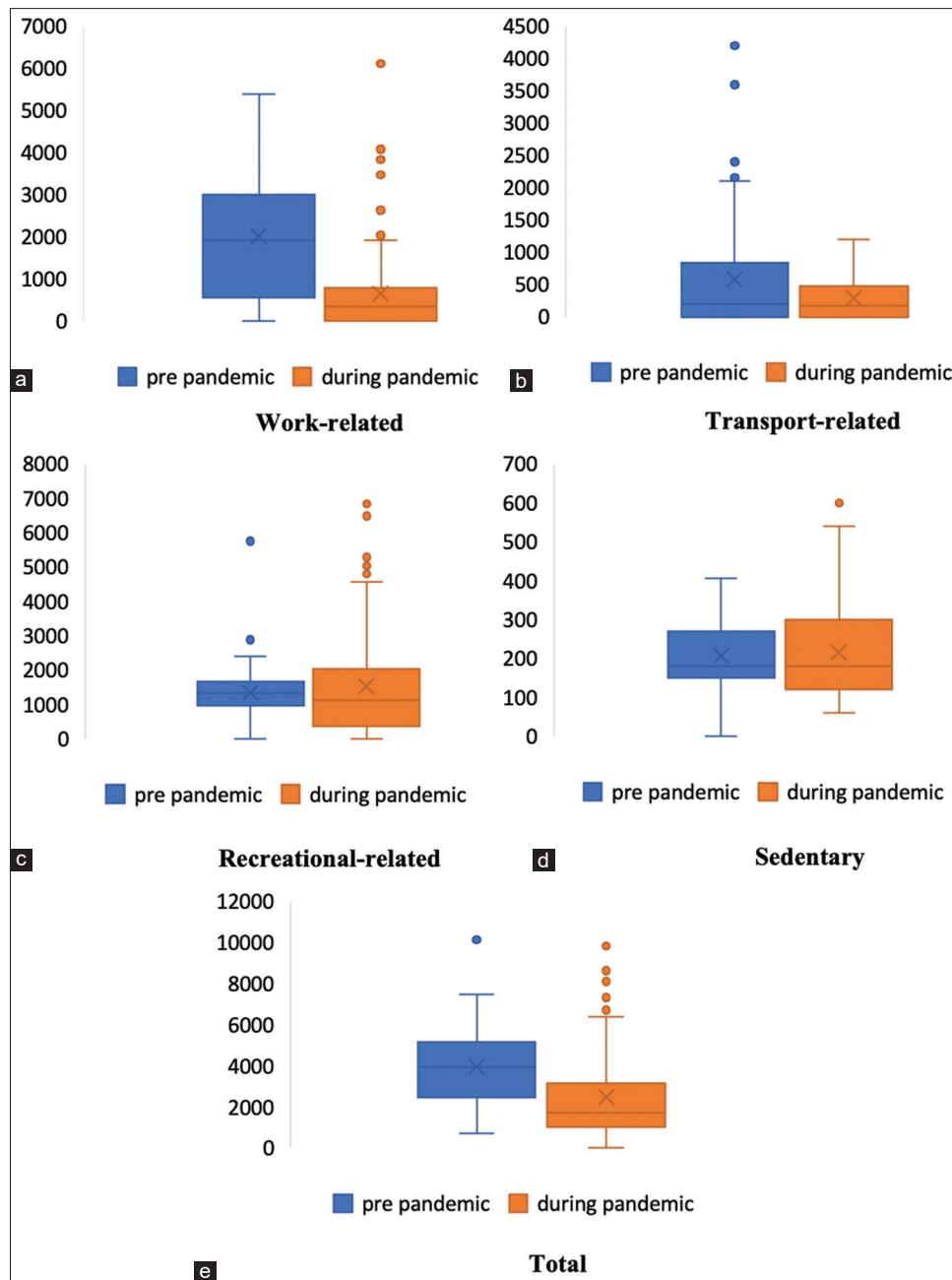


Figure 1: Comparisons of physical activity levels before and during pandemic in Mets per week ($n = 111$)

That study, though, did not include data from Indonesia and other southeast Asian regions; thus our study as well as other studies in Indonesia^[39,40] in part contributed to confirm the decrease of physical activity levels in this region during the COVID-19 pandemic.

We found that the decrease of physical activity levels in our study participants was mostly found within the work-related domain. It should be noted that the sporting activities conducted during school hours in our target population were classified into the work-related domain, thus this finding was expected. We also found that the recreational-related domain was relatively

unchanged, while the transport-related domain slightly decreased. The findings could not be readily compared with findings from previous studies since those studies measured total physical activity and did not report which physical activity domains that were affected by the decline.^[34,41,42,44] The finding of this study thus could inform policymakers to tailor the physical activity intervention in the appropriate physical activity domain.

To be noted, in the light of the global physical activity level decrease, the physical activity reduction trends among countries were varied.^[34] It may reflect variation in COVID-19 cases and regional policies in particularly

Table 3: Correlates of physical activity status (n=111)

	OR	95% CI	P
Age	1.38	0.59-3.20	0.454
Sex			
Women	1		
Male	1.42	0.45-4.52	0.550
Self-efficacy			
Low	1		
High	3.41	1.15-10.11	0.027
Self-regulation			
Low	1		
High	4.28	1.42-12.93	0.010
Social support			
Low	1		
High	3.60	1.21-10.69	0.021
Outcome expectations			
Low	1		
High	4.50	1.44-14.06	0.010
Perceived susceptibility			
Low	1		
High	4.03	1.35-12.01	0.013
Perceived severity			
Low	1		
High	4.53	1.51-13.61	0.007
Perceived benefit			
Low	1		
High	3.80	1.27-11.32	0.016
Perceived barrier			
Low	1		
High	0.31	0.10-0.89	0.031

OR=Odds ratio, CI=Confidence interval

social distancing measures over time. Even so, it was shown that fluctuation in physical activity levels during the study period in all observed countries occurred when there were no regulatory changes that affect engaging in physical activity within a region.^[34]

We also found higher physical activity variability during COVID-19 pandemic compared to before pandemic in our study participants. There were participants who were able to maintain or even increase their physical activity levels during pandemic, while the others experienced decreases in their physical activity levels during the pandemic. The variability may reflect differences in social-cognitive processes among our participants, particularly on how they perceived COVID-19, the social restriction policy, and the roles of physical activity in protecting their health and well-being during the COVID-19 pandemic. Therefore, it is essential to assess the relationship between these social-cognitive process and physical activity behavior in this target population for characterizing participants who were more likely to engage in “sufficient” and “insufficient” physical activity.

Our study confirmed a significant association between constructs from SCT and HBM with physical activity

status. The findings show that those with favorable attitudes and beliefs toward physical activity and COVID-19 were more likely to engage in sufficient physical activity levels. Previous studies have established the use of these constructs in explaining physical activity status among the general population.^[33,45] Meta-analyses have revealed that 33% and 48% of the variance, respectively, for physical activity and intention were explained by social-cognitive models which include social-cognitive theories and HBM.^[45] The finding in our study is consistent with studies which were conducted before the COVID-19 pandemic, in older adults,^[46] mid-aged adults,^[46,47] and adolescence,^[47,48] which found both direct and indirect association between self-efficacy, outcome expectancies, perceived barriers, and self-regulation with physical activity behaviors.

While few studies have explored the use of the self-determinant theory^[49] and the theory of planned behavior^[50] as frameworks for modeling physical activity behavior during the COVID-19 pandemic, an exploration of constructs from the SCT and HBM as physical activity correlates during COVID-19 pandemic have been limited. A study in Netherland which was conducted among the general population showed a positive and significant association between physical activity and self-efficacy, while the change in vigorous physical activity was negatively and significantly associated with perceived vulnerability during the COVID-19 pandemic.^[51] Our study also found that higher self-efficacy, outcome expectation, social support, self-regulation, perceived susceptibility, perceived severity, and perceived benefits were positively associated with physical activity status in young adults during the COVID-19 pandemic. Our findings, thus, extend the applicability of these constructs for explaining physical activity behaviors among young adults who were previously physically active during the COVID-19 pandemic in Indonesia.

The main strength of our study is the use the longitudinal data which provided us with an opportunity to compare the physical activity levels before and during the pandemic. We also explored physical activity correlates based on established used behavioral change theories (i.e., SCT and HBM), which are commonly used as frameworks in explaining physical activity behavior as well as developing physical activity program. Our findings, thus, are comparable with other physical activity studies in the literature. However, several limitations were acknowledged. First, we did not measure potential physical activity correlates in the first survey, thus we could not compare the association of the behavioral change constructs with physical activity status across times. Second, due to the resource limitation, we used subjective physical activity measures as opposed to the objective physical activity measure such as

accelerometer or pedometer. Thus, although the validity of the instrument has been established, the findings of our study are inherently limited by the nature of the subjective physical activity measure. Third, our study participants were young adults who were previously physically active. Thus, the findings from our study may not be able to be generalized in other demographics (i.e., children or older adults). This study, however, has provided much-needed data on this demographic since studies on young adults' physical activity correlates are scarce and that they usually receive fewer public health supports for improving physical activity levels.

Conclusion

The decline of physical activity levels among young adults who were previously physically active in Indonesia was confirmed. Those with favorable attitudes and beliefs toward physical activity and COVID-19 were more likely to engage in insufficient physical activity levels. It is recommended, thus, to develop physical activity intervention based on these constructs for improving physical activity levels in this target population. Future research involving time-series observations is recommended to capture changes in physical activity levels and assess their correlates. It is essential as COVID-19 policies may change across time due to changes in the COVID-19 epidemic. The findings of this study are expected to inform policymakers to develop physical activity interventions best suited to the target population.

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Conflicts of interest

There are no conflicts of interest.

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