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Applying the behavior change wheel to identify pandemic-related attitudes and feelings about physical activity as predictors of physical activity level among university students in Indonesia during the COVID-19 pandemic

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A recent systematic review found a significant drop in physical activity (PA) among university students during the coronavirus disease 2019 (COVID-19) pandemic. Identifying students' attitudes and feelings about PA and coronavirus, which could facilitate or hinder PA, is essential to guide intervention planning. Therefore, this study aimed to examine attitudes and feelings about PA and coronavirus as predictors of PA levels. We conducted a cross-sectional study among undergraduate university students in Indonesia to collect their PA levels using the global PA questionnaire version 2 and their attitudes and feelings about PA in pandemic situations. A binomial logistic regression has been conducted to predict whether students will sufficiently engage in PA based on their attitudes and feelings related to PA, coronavirus, and demographic characteristics. Results from 588 undergraduate students (75% female) showed that students perceived the health benefits of PA, perceived feeling guilty about wanting to do PA during the pandemic, body mass index (BMI), and field of study were statistically significant predictors of PA levels. An increase of one unit of perceived health benefits of PA increases the odds of meeting the PA guidelines by 2.313 (95% confidence interval 1.708–3.132, $p < 0.001$). On the other hand, raising one point of feeling guilty about conducting PA was associated with 1.285 times lower odds

(95% confidence interval 1.062–1.558, $p = 0.01$) of meeting the PA guidelines. Thus, intervention should increase students' awareness of the physical health benefits of PA during the pandemic and reduce their feeling of guilty about conducting the PA.

KEYWORDS

attitude, COVID-19, exercise, pandemic, students, universities

Introduction

The college period is a transition to adulthood which is a critical moment that can determine a person's lifestyle (Carney et al., 2000; Naudeau et al., 2008). Although an active lifestyle has an essential role in maintaining fitness, physical and mental health, as well as academic achievement, almost half of the student population is classified as lacking physical activity (PA) (Keating et al., 2005; Anuar et al., 2021). In addition, the novel coronavirus disease 2019 (COVID-19) pandemic exacerbated the physical inactivity among university students. A recent systematic review showed that the level of PA in college students decreased to half of their level of PA before the pandemic (López-Valenciano et al., 2021). In that systematic review, several studies conducted in the United States, Mexico, Australia, and several European countries consistently showed decreased PA levels in university students. Therefore, PA promotion among students is an urgent need.

Effective PA promotion should address factors influencing PA engagement in its target population. Physical activity engagement can be affected by several factors, including the environment, social support, and personal factors, such as knowledge, motivation, and attitude toward PA (Treiber et al., 1991; Sallis et al., 2008; Howlett et al., 2019). The behavior change wheel (BCW) framework, a comprehensive theoretical model to create a change in behavior, suggested that individual, social and environmental factors could equally contribute to influencing behavior through changing capacity, opportunity, and motivation (COM-B) components (Michie et al., 2011; Biddle et al., 2021). Universities can play a role in promoting an active lifestyle among students by providing support through all three factors.

In order for universities to provide effective and efficient support for establishing an active lifestyle among students, identification of PA predictors among students is required (Michie et al., 2011; Atkin et al., 2016). The COVID-19 pandemic changed social and environmental factors, which could influence students' attitudes and feelings toward PA (Yon et al., 2022). A longitudinal study suggests that pandemic-related attitudes and feelings could be a predictor factor influencing PA levels (Sport England, 2020). While recent studies showed that general individual and environmental factors, such as perceived

general benefits of PA and field of study, and pandemic-related individual and social factors, such as self-efficacy in being physically active despite barriers during the COVID-19 pandemic, were strong correlates of PA during the COVID-19 pandemic among university students in Indonesia, there was no study examined the comprehensive pandemic-related attitudes and feelings toward PA which including individual, social and environmental factors (López-Valenciano et al., 2021; Rizal and Wibowo, 2021; Ruhayati et al., 2021; Arovah, 2022; Cruz et al., 2022). Also, the two studies in Indonesia resulted from a majority sample of sport science students, which limit their generalizability to university students (Ruhayati et al., 2021; Arovah, 2022). Thus, our study aimed to examine university students' attitudes and feelings related to PA and coronavirus as predictors of their PA level in a representative sample of university students.

Materials and methods

Study design and setting

We conducted a cross-sectional survey among Universitas Gadjah Mada (UGM) students for 1 week in the second semester of the academic year 2020/2021 (11–17 April 2021), following the ethical principles of the Declaration of Helsinki. This study is a part of the ASEAN University Network Health Promoting Network (AUN-HPN) Physical Activity in College Students (PACS) Project (Rahman et al., 2022), which collected PA data and its correlates in UGM on three-phase (28 March –3 April 2021; 4–10 April 2021, and 11–17 April 2021). The study protocol was approved by the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health and Nursing UGM (approval number: KE/FK/1066/EC/2020). We wrote the manuscript following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies (Supplementary Table 1; von Elm et al., 2008). Universitas Gadjah Mada, located in Daerah Istimewa Yogyakarta Province, is the largest public university in Indonesia with 59,540 students in the second semester of academic year 2020/2021 (Sekretariat Direktorat

Jenderal Pendidikan Tinggi Kementerian Pendidikan dan Kebudayaan, 2022). While there was a social activity restriction called Pemberlakuan Pembatasan Kegiatan Masyarakat Berbasis Mikro (PPKM Mikro) during April to June 2021 in Java and Bali Island (Negeri, 2021), UGM was still not reopened the university yet. The majority of learning activities were conducted through online platforms, and only a minority of activities, such as practical skills and thesis, were allowed to be conducted on campus (Rektor Universitas Gadjah Mada, 2020).

Participants

All undergraduate students were eligible to participate in the study. Failure to complete the questionnaire and postgraduate students were excluded from the study. Using a convenient sampling method, we distributed an online questionnaire link to students *via* several social media groups in each faculty. A minimum sample size of 500 was suggested to derive statistics involving logistic regression that can represent the parameters in the population (Bujang et al., 2018). Therefore, this study required at least a total sample size of 625 subjects to anticipate a 20% missing value.

Outcome measures

We collected university students' demographic data, including age, academic year, gender, field of study, height and weight which then were calculated as body mass index (BMI).

Physical activity levels

Students were requested to fill out the Global Physical Activity Questionnaire (GPAQ), a reliable instrument for monitoring PA in population surveillance with an acceptable validity, through an online form Bull et al. (2009). Having cleaned the GPAQ data following the GPAQ Analysis Guide, we categorized students' PA levels to whether meeting the PA guidelines or not meeting the PA guidelines (World Health Organization, 2002, 2010). Students were categorized into meeting the guidelines if they were engaged in at least: 150 min of moderate-intensity PA a week or 75 min of vigorous-intensity PA a week, or a combination of moderate and vigorous-intensity PA reaching at least equivalent to 600 MET-min per week.

Attitudes and feelings about physical activity and coronavirus

We adopted a questionnaire from Sport England to capture students' attitudes and feelings related to PA and coronavirus (Sport England, 2020). The original questionnaire asked for agreement with 17 statements based on the COM-B model in the BCW framework (Michie et al., 2011). Having conducted expert consultations with three specialists in exercise physiology,

education, and health promotion, we removed five items because of redundancy. Therefore, the adopted version consists of 12 statements to ask for respondents' agreement with a Likert scale from 1 for disagreeing to 5 for agreeing with the statement (Table 1). We also add a bogus item to minimize inattentive responses by asking them, "please choose option number 2 if you read this statement" (Meade and Craig, 2012; Maniaci and Rogge, 2014; Niessen et al., 2016). Our unpublished data showed that the adopted questionnaire with one bogus item had acceptable reliability ($W = 0.662-0.800, p < 0.05$).

Data analysis

We descriptively presented the demographic of our respondents, including their age, gender, BMI, academic year, and field of study. Students' BMI was categorized into underweight (<18.5), normoweight (18.5–22.9), overweight (23–24.9), and obese (≥ 25 kg) (World Health Organization, 2000). Students' field of study was categorized into health science, non-health natural science, and social science. Then, we presented the prevalence of students who did not meet the PA guidelines among our samples, proportion of gender, BMI, academic year, and field of study. Students' engagements in each PA domain were described using the median and interquartile range (IQR) (Lang and Altman, 2015). We also visually presented the proportion of the scale of the agreement to each attitude and feeling related to PA and coronavirus. We calculated the Pearson chi-square to examine the association of potential confounding, including gender, BMI, and field of study (Rejali and Mostajeran, 2013; Naim et al., 2016; Chung et al., 2018; Haynes et al., 2018; Rizal and Wibowo, 2021), using the SPSS v26 (SPSS Inc., Chicago, IL, US). Finally, a logistic regression using an alpha of $p < 0.05$ was conducted to examine the odds ratio of each theme of the attitudes and feelings related to PA and coronavirus as predictors of meeting the PA guidelines with and without controlling gender, BMI, and field of study as confounders. We treated each theme of attitudes and feelings about PA as a continuous variable, whereas confounders as categorical variables. We observed The Nagelkerke R^2 and receiver operating characteristic (ROC) curve to check the best model for predicting PA level (Steyerberg et al., 2010).

Results

Sixty hundred and thirty-nine students filled out the online questionnaire, but two of them did not fill the questionnaire completely, 32 (5%) of them filled in the wrong answer to the bogus question, and 17 (3%) of them had an implausible value of the GPAQ. Therefore, 588 subjects with a median age of 19 (IQR 1) years were included in the analysis. The sample consisted of first-year (43.9%), second-year (34.9%),

TABLE 1 Themes and statements asked in the attitudes and feelings questionnaire.

Theme	Statements
Physical health benefits	I exercise to help manage my physical health during the outbreak
Mental health benefits	I exercise to help manage my mental health during the outbreak
Knowledge of the physical activity recommendations	I have been encouraged to exercise by the University's recommendation
Time opportunities	I have more time now to be physically active
Lost of physical activity opportunities	I miss the types of physical activity I was able to do before the outbreak
New physical activity opportunities	Since the outbreak, I have found new ways to be active
Feeling worried about doing outdoor physical activities	I worry about leaving my home to exercise or be active
Feeling guilty about not exercising	I feel guilty about not exercising more during the outbreak
Feeling guilty about wanting to exercise	I feel guilty about wanting to exercise during the outbreak
Lost of enjoyable physical activities	I do not find exercising on my own enjoyable
Feeling that the pandemic did not impact physical activities	The current situation has not impacted my current exercise regime
Feeling that being active is more important at the moment	I felt that being active is more important at the moment

TABLE 2 Participants' demographic.

	<i>n</i> (%)
Physical activity level	
Met the PA guidelines	275 (47%)
Did not meet the PA guidelines	313 (53%)
Gender	
Female	441 (75%)
Male	147 (25%)
Field of study	
Health science	87 (15%)
Non-health natural science	331 (56%)
Social science	170 (29%)
Body mass index	
Underweight	140 (24%)
Normoweight	280 (48%)
Overweight	82 (14%)
Obese	86 (14%)

third-year (18.5%), fourth-year (1.9%), and fifth-year (0.9%) undergraduate students. Third-quarter of our samples were female. Most of our sample were studying non-health natural science (56%) and had a normoweight (48%). Our samples' prevalence of physical inactivity was 53% (Table 2).

Students' gender, field of study, and BMI were associated with their PA level with X^2 of 10.841, 10.329, and 8.681, respectively (Table 3). Male, non-health natural science, and obese students were more likely to meet the PA guidelines. Among students who met the guidelines, they had median academic-related PA, transport-related PA, and recreational PA of 0 (IQR 1800) MET.minutes/week, 0 (IQR 480) MET.minutes/week, and 900 (IQR 1560) MET.minutes/week respectively. In contrast, students who did not meet the guidelines had median academic-related PA, transport-related

PA, and recreational PA of 0 (IQR 0), 0 (IQR 0), and 0 (IQR 20), respectively.

Our respondents tended to agree that they engaged in exercise to help manage their physical health and mental health, they had more time to be physically active, and they lost opportunities to do several types of PA. They also tend to agree that the importance of an active lifestyle is even greater during a pandemic. On the other hand, they tend to disagree with the statement that the pandemic did not impact their physical activities; they lost their enjoyable exercise, they felt guilty about wanting exercise, and they felt worried about doing outdoor physical activities (Figure 1).

Results from binomial logistic regression without adjusting confounding variables showed that the model was statistically significant, $\chi^2(12) = 130.710$, $p < 0.0001$. The unadjusted model explained 26.6% (Nagelkerke R^2) of the variance of students' PA level and had an area under the ROC curve of 0.759 [95% confidence interval (CI) 0.720–0.797]. Binomial logistic regression was performed to ascertain the effects of attitudes and feelings related to coronavirus on the likelihood that university students engage in recommended amounts of PA by controlling their gender, BMI, and field of study. The logistic regression model was statistically significant, $\chi^2(18) = 151.974$, $p < 0.0001$. The model explained 30.4% (Nagelkerke R^2) of the variance in PA levels, correctly classified 69.0% of cases, and had an acceptable level of discrimination by having an area under the ROC curve of 0.777 (95% CI 0.740–0.814), which was better than the unadjusted model. There were four of fifteen predictors that were statistically significant: physical health benefits, feeling guilty about wanting to exercise, the field of study, and BMI (Table 4). Each increase in one point of agreement that students engaged in PA to get physical health benefits was associated with 2.313 times higher odds (95% CI 1.708–3.132) of meeting the PA guideline. Having obesity and studying non-health natural science was also associated with an increased likelihood of engaging in a recommended amount of PA. On the other hand,

TABLE 3 Association between students' characteristics and their physical activity (PA) levels.

	Did not meet the guidelines <i>n</i> (%)	Met the guidelines <i>n</i> (%)	<i>P</i> -value	χ^2
Gender			0.001	10.841
Female	252 (42.9%)	189 (32.1%)		
Male	61 (10.4%)	313 (14.6%)		
Field of study			0.006	10.329
Health science	54 (9.2%)	33 (5.6%)		
Non-health natural science	157 (26.7%)	174 (29.6%)		
Social science	102 (17.3%)	68 (11.6%)		
Body mass index			0.034	8.681
Underweight	85 (14.4%)	55 (9.4%)		
Normoweight	148 (25.2%)	132 (22.4%)		
Overweight	45 (7.7%)	37 (6.3%)		
Obese	35 (5.9%)	51 (8.7%)		

TABLE 4 Predictors of meeting the physical activity (PA) guidelines.

	B	SE	Wald	dF	<i>p</i>	Odds ratio (95% confidence interval)
Perceived physical health benefits	0.839	0.155	29.408	1	0.000	2.313 (1.708–3.132)
Feeling guilty about wanting to do physical activities	−0.251	0.098	6.638	1	0.010	0.778 (0.642–0.942)
Non-health natural science student	0.754	0.283	7.087	1	0.008	2.126 (1.220–3.705)
Obese student	0.684	0.301	5.177	1	0.025	1.982 (1.099–3.574)
Perceived mental health benefits	0.188	0.144	1.710	1	0.191	1.207 (0.910–1.600)
Time opportunities	−0.033	0.099	0.109	1	0.742	0.968 (0.797–1.175)
Lost of physical activity opportunities	0.108	0.094	1.313	1	0.252	1.114 (0.926–1.340)
New physical activity opportunities	0.210	0.119	3.140	1	0.076	1.234 (0.978–1.556)
Feeling worried about doing outdoor physical activities	−0.022	0.098	0.050	1	0.823	0.978 (0.807–1.186)
Feeling guilty about not exercising	0.031	0.096	0.100	1	0.752	1.031 (0.853–1.246)
Lost of enjoyable physical activities	0.009	0.100	0.007	1	0.932	1.009 (0.829–1.227)
Feeling that the pandemic did not impact physical activities	0.029	0.095	0.096	1	0.757	1.030 (0.855–1.240)
Feeling that being active is more important at the moment	−0.197	0.135	2.133	1	0.144	0.821 (0.631–1.070)

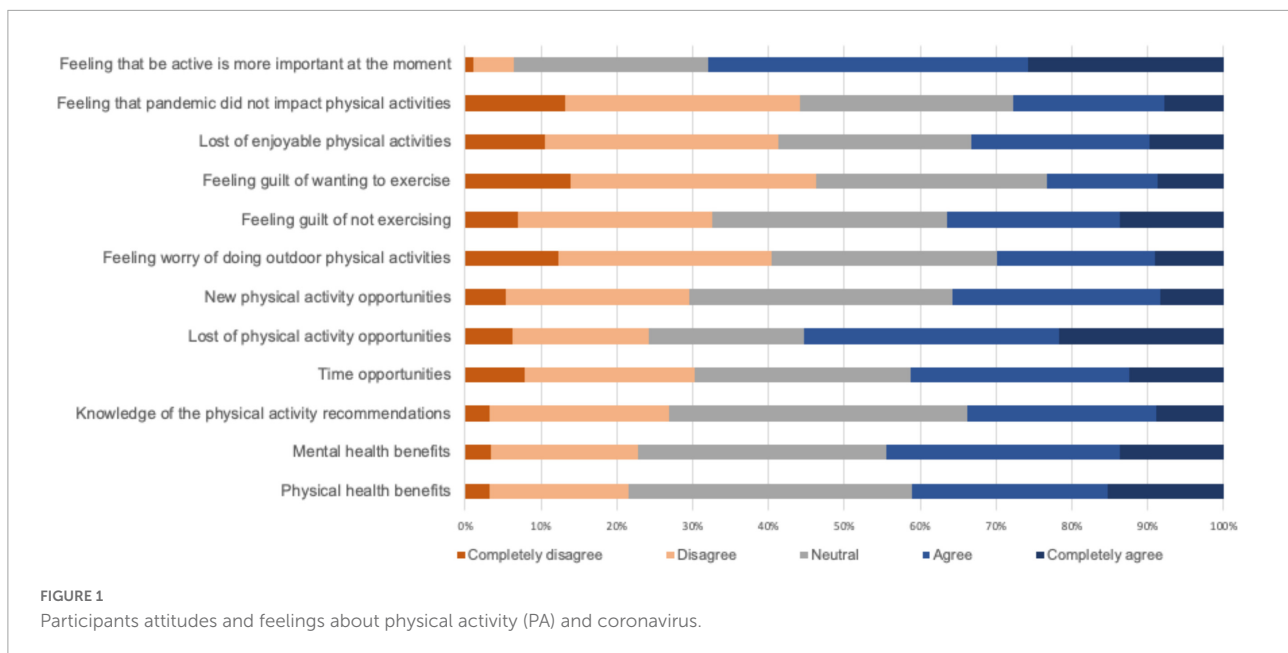
each one-point increase in feeling guilty about wanting to do PA was associated with 1.285 times lower odds (95% CI 1.062–1.558) of meeting the PA guideline.

Discussion

We found that university students' perceived physical health benefits as a motivation to do PA and their feeling guilty about wanting to do PA during the pandemic were the most consistent predictors of PA behavior among them. Our study results could help tailor PA promotion messages to fit the pandemic context and also choose the appropriate messaging framing for university students (Williamson et al., 2021). To increase university students' perceived physical health benefits of PA, it could be suggested that PA promotion targeting university students should use gain-framed persuasive strategies focused on the physical health benefits of PA, such as boosting immunity to protect them from severe infection (McCall et al.,

2020; Chastin et al., 2021; Rahmati et al., 2022). Excessive fear, which was caused by the pandemic itself, several contingency measures to control the pandemic, or opinions on the negative effect of certain kinds of PA on immunity, could lead people to prefer to avoid losses of the PA benefits rather than gain the PA benefits (da Silveira et al., 2021). This loss aversion phenomenon could make students feel guilty about wanting to do PA (Wagner et al., 2012; Collier et al., 2020). Intervention using non-loss-framed strategies should also be implemented to countermeasure the loss aversion phenomenon during the pandemic, for example, by providing examples of PA, which could help students avoid their fear of contracting the infection or avoid their fear of immunity deprivation (Carfora and Catellani, 2021).

Our study is in line with several previous studies showing changes in PA motives during the pandemic. In general, intrinsic motivation is the most consistent motive for PA among university students (Teixeira et al., 2012; Ribeiro Nunes Lages et al., 2015; Valenzuela et al., 2021). However,



certain situations, such as a pandemic, could shift people's motivation by increasing the role of identified regulations of PA, which drive them to do PA because they consciously value the PA, for example, the health benefits of PA (Angosto et al., 2020; Al-Yaaribi, 2021; Gang et al., 2021; Spence et al., 2021; Wilczyńska et al., 2021). While two previous studies highlight the perceived mental health benefits as a strong motive for PA among the adult population during the pandemic (Angosto et al., 2020; Wilczyńska et al., 2021), our study indicated that perceived physical health benefits were stronger than perceived mental health benefits to influence university students' PA during the pandemic. This is surprising because university students are more prone to psychological distress during the pandemic than the other adult population (Xiong et al., 2020). Timely dissemination of accurate health information and social support from the university, which could reduce students' susceptibility to psychological distress, and also the sensitivity of university students to the PA promotion messages targeting physical health rather than psychological health could be the explanation for this discrepancy (Al-Eisa et al., 2016; Wang et al., 2020; Caso et al., 2021). In addition, a recent study in Indonesia also showed that students value physical performance as the highest perceived exercise benefits than the other subscales (Ruhayati et al., 2021). Another surprising result was that lost opportunities to do several kinds of PA did not associate with PA levels. However, it could be caused that the opportunity lost was compensated by the more available time to engage in PA since the majority of our samples felt that they had more time to be physically active (Yon et al., 2022). In addition, most of our samples also felt they did not lose their enjoyable PA types, which indicate they

could engage in their favorite PA or find new PA routines even if they lost opportunities to engage in certain kind of PA, such as sports (Rizal and Wibowo, 2021; Yon et al., 2022).

Our study also strengthens that BMI and field of study are important predictors of PA among university students. This study strengthens our previous research on the early pandemic, which found an increase in PA among non-health natural sciences students compared to the other fields of study (Rizal and Wibowo, 2021). However, our current study contradicts the majority of previous studies showing that overweight and obese adults were associated with lower PA levels (Haynes et al., 2018). Pandemic situations could increase their awareness of the importance of PA during the pandemic since being overweight or obese is one of the important risk factors for COVID-19 severity (Pu et al., 2020; Robertson et al., 2022; Yang et al., 2022). In addition, their perception of having more spare time during the pandemic could also facilitate them to do more PA (Robertson et al., 2022).

The results of our study should be cautiously interpreted because of several limitations. First, the cross-sectional design of our study limits the causal inference of observed PA predictors. Second, we only captured our participants' PA levels using a subjective measurement tool prone to several biases. However, we used a validated tool and added a bogus item to minimize inattentive responses (Bull et al., 2009). The questionnaire used to examine participants' attitudes and feelings have also not been specifically validated in our study population. We anticipated this limitation by conducting a prior reliability study and adding a bogus item to our questionnaire to minimize inattentive responses (Meade and Craig, 2012; Maniaci and

Rogge, 2014; Niessen et al., 2016). Lastly, we only used a web-based survey as our data collection method, which was prone to sampling bias and resulted in a very high proportion of female students. Because the students were not on campus, remote data collection was the only way to collect data from research participants. This online-based data collection could also cause disproportionate gender representation since women are more likely to participate than men (Smith, 2008). The present study, which represented a high proportion of women, however, makes several noteworthy contributions to PA research since the proportion of female students in Indonesia is indeed more than male students (52 vs. 48%) (Sekretariat Direktorat Jenderal Pendidikan Tinggi Kementerian Pendidikan dan Kebudayaan, 2022). In addition, Mielke et al. (2018) also found that inactivity prevalence was higher in women (27%) than in men (20%), which advocated women as priority targets for PA research and intervention. Future research may need to consider the more heterogeneous remote data collection to avoid sampling bias. Future longitudinal studies using validated tools were also needed to examine solid causal inference of students' PA levels predictors.

Conclusion

During the COVID-19 pandemic, university students' motivation to do PA because of its physical health benefits and their barriers to PA because of feeling guilty about wanting to do it are consistent predictors which could be addressed with appropriate strategies. Appropriate messaging framing that fits the pandemic context could be suggested to increase students' perceived physical health benefits of PA and decrease their feeling guilty about wanting to do PA. Future longitudinal studies using validated tools and heterogeneous data collection methods could be suggested to establish strong evidence on predictors of university students' PA levels.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada. The patients/participants provided their written informed consent to participate in this study.

Author contributions

RW: conceptualization, methodology, investigation, project administration, formal analysis, visualization, funding acquisition, and writing – original draft, review, and editing. MS: conceptualization, methodology, and writing–review and editing. DA: conceptualization, methodology, and supervision. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.958348/full#supplementary-material>

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