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[1]Department of Physiology, Faculty of Medicine, Udayana University, Bali – Indonesia
[2]Department of Public Health and Preventive Medicine, Faculty of Medicine, Udayana University, Bali – Indonesia

*Correspondence to: adiarthagriadhi@unud.ac.id

Exercise behaviour and the determinant factors among medical students before and during the COVID-19 pandemic

Adiartha Griadhi[1*], Luh Putu Ratna Sundari[1], I Nyoman Sutarsa[2]

ABSTRACT

Background and purpose: Students' physical activity levels decreased significantly after college enrollment. Disruption during the COVID-19 pandemic also affects the students' exercise level. The psychological aspect and the academic situation of medical students could interact with pandemic disruption differently compared to other students. This study compares exercise behaviour and its determinant factors among medical students before and during the pandemic.

Methods: This study was conducted by collecting data in August 2021 and then comparing it to our data collected in July 2011. Participants were determined by a proportional random sampling based on gender and education year. There were 127 and 205 research participants in 2011 and 2021. The exercise behaviour and determinant factors were based on the Transtheory Model of behavioural change and grouped into five stages of exercise levels and four categories of factors. The data were analyzed descriptively and comparison tested for the two years.

Results: This study showed a significant increase in exercise behaviour among medical students during the pandemic ($p<0.05$). The number of students in the pre-contemplation, contemplation, and preparation stages has decreased, and those in action and maintenance stages doubled compared to the pre-pandemic period. The change in exercise behaviour showed that changes only occurred in female and clinical-year students ($p<0.05$). There was no significant change in male and pre-clinical medical students. Predisposing, enabling, and maintenance factors are determinants of exercise behaviour that increased significantly during the pandemic ($p<0.05$), and personal factors did not increase significantly.

Conclusion: Female and clinical-year medical students' exercise activity increased significantly during the pandemic. Predisposing, enabling, and maintenance factors also increased substantially during the pandemic, while personal factors did not change significantly. Gender-related psychological and behavioural reactions to COVID-19 pandemic disruption explain these results.

Keywords: medical student, exercise behaviour, Transtheory Model, COVID-19

INTRODUCTION

Research shows that even a small quantity of physical activity can improve health, and at least a moderate intensity is needed to obtain significant health advantages.[1] Unfortunately, active behaviour was not easily adopted.[2] University students are the most likely to engage in sedentary behaviour.[3] After enrolling in college, the frequency of physical activity usually decreased significantly. Time constraints and laziness are some principal reasons for abandoning or not taking up physical exercise,[3,4] while some reasons for students participating in physical activity were to maintain fitness and health, and improve body form.[3,4] Only 76% and 68% of normal-weight students met the daily exercise recommendation.[5] Men reported more physical activity and exercise than women, and younger students scored higher on physical activity indicators than older students.[6] Study shows that the prevalence of obese and overweight was 67% and 85% among male and female students.[5] The assumption that knowledge positively correlates with exercise behaviour needs to be evaluated.[7]

Massive disruption during the COVID-19 pandemic could also impact the physical activity behaviour among students. Depending on their situations, students' regular routines and physical activity can be disrupted to varying degrees. During COVID-19 pandemic lockdowns, most of the research reported declines in physical activity and increases in sedentary behaviours across multiple groups, a significant reduction in children's physical activity, and a lowering adoption of physical activity level.[8-10]

Research revealed that academic situations could modify the interactions between determinant factors and university students' physical activity.[11] Psychological factors were also found to correlate significantly with physical activity levels.[12] Participation of relatives, such as parents and friends, and a positive sense of satisfaction with physical education taught in schools are also positive to physical activity.[3] Considering those results, the pandemic affects medical students' activity levels. It can modify the interactions between determinant factors and medical students' physical activity. The medical student might be exposed to a specific disruptive situation compared to other students. They were intuitively more closed to the pandemic events and at least had a better understanding of the disease's nature than other students.

This study compares exercise behaviour and its determinant factors among medical students before and during the COVID-19 pandemic. The results of this study could explain the specific impact of disruption on determinant factors and medical students' physical activity.

METHODS

This research was a repeated cross-sectional study of medical students' physical activity between 2011 (before the pandemic) and 2021 (during the pandemic). Therefore, we compared data collected in July 2011 to those collected in August 2021. The research participants were medical students at the Faculty of Medicine, Udayana University, who were selected by a proportional random sampling based on gender and education year. Therefore, we used the list of active medical students as the sampling frame of the research. There were 127 research participants in 2011 and 205 participants in 2021, which was proportional to the 2011 and 2021 student sizes.

The data on exercise were collected using the questionnaire on exercise behaviour and determinant factor by Hoeger & Hoeger (2005). Exercise behaviour was classified into five-stage of behaviour: pre-contemplation, contemplation, preparation, action, and maintenance. The determinant factors consist of personal, predisposing, enabling, and maintenance factors. Personal factors include age, gender, heredity,

social status, and current fitness condition. Predisposing factors are about the ability to perform these behaviours and understanding the benefits of these behaviours for themselves. Enabling factors to include individual skills to make decisions through adopting a new behaviour, consisting of the ability to set goals, conduct assessments, and carry out personal monitoring. Maintenance factors encourage individuals to continue to perform certain behaviours that depend on their success in carrying out these behaviours and the existence of positive social support for autonomy in decision-making.[13,14]

The statistical analysis included descriptive analysis and a Chi-square interdependence test which assesses differences in determinants and exercise behaviour between 2011 and 2021, including specific differences based on gender and education year. In addition, categorical regression analysis was carried out to describe the model of the relationship between the determinants and exercise behaviour among medical students. This study was approved by the Ethics Committee of The Faculty of Medicine, Udayana University/Sanglah Hospital.

RESULT

This study showed a significant increase in the exercise behaviour of medical students during the pandemic compared to the period before the pandemic ($p<0.01$). Students in the pre-contemplation, contemplation, and preparation stages have decreased compared to the pre-pandemic period. Students in action and maintenance stages have almost doubled compared to the pre-pandemic period from 26.0% to 42.4% and 5.5% to 10.2%, respectively (Table 1).

Table 1. The exercise behaviour of medical students in 2011 and 2021

Exercise Behaviour	Year				p
	2011 (n=127)		**2021** (n=205)		
	f	%	f	%	
Pre-Contemplation	12	9.4	5	2.4	0.001
Contemplation	65	51.2	79	38.5	
Preparation	10	7.9	13	6.3	
Action	33	26.0	87	42.4	
Maintenance	7	5.5	21	10.2	

The distribution of exercise behaviour by sex showed that changes in exercise behaviour before and after the pandemic among the female group were statistically significant ($p<0.001$). At the same time, the male students had a similar distribution of exercise behaviour before and during the pandemic. The specific distribution of exercise behaviour based on education year showed that changes in sports behaviour before and after the pandemic were only found in the clinical education year students ($p<0.01$). The pre-clinical students had the same picture of exercise behaviour (Table 2).

Table 2. The exercise behaviour of medical students by sex and study stages in 2011 and 2021

Characteristic	Exercise Behaviour	Year				p
		2011		**2021**		
		f	%	f	%	
Gender						

Male	Pre-Contemplation	3	5.1	3	4.8	0.745
	Contemplation	16	27.1	20	31.7	
	Preparation	7	11.9	4	6.3	
	Action	29	49.2	29	46.0	
	Maintenance	4	6.8	7	11.1	
	Total	59	100.0	63	100.0	
Female	Pre-Contemplation	9	13.2	2	1.4	<0.001
	Contemplation	49	72.1	59	41.5	
	Preparation	3	4.4	9	6.3	
	Action	4	5.9	58	40.8	
	Maintenance	3	4.4	14	9.9	
	Total	68	100.0	142	100.0	
Academic Level						
Pre-clinical student	Pre-Contemplation	2	2.6	3	2.0	0.625
	Contemplation	34	44.7	56	38.1	
	Preparation	8	10.5	11	7.5	
	Action	27	35.5	61	41.5	
	Maintenance	5	6.6	16	10.9	
	Total	76	100.0	147	100.0	
Clinical student	Pre-Contemplation	10	19.6	2	3.4	<0.001
	Contemplation	31	60.8	23	39.7	
	Preparation	2	3.9	2	3.4	
	Action	6	11.8	26	44.8	
	Maintenance	2	3.9	5	8.6	
	Total	51	100.0	58	100.0	

Table 3 shows differences between exercise behaviour's predisposing, enabling, and maintenance factors before and during the pandemic ($p<0.05$). Meanwhile, personal factors did not experience significant changes during the pandemic. Essential notes that the students perceived the enabling factors in 2021 were much better than those in 2011 ($p<0.001$).

Table 3. Distribution of the determinants of exercise among medical students in 2011 and 2021

Determinant factors	**Category**	**Year**				**p**
		2011 (n=127)		**2021** (n=205)		
		f	%	f	%	
Personal	Poor	45	35.4	66	32.2	0.711
	Fair	32	25.2	49	23.9	
	Good	50	39.4	90	43.9	
Predisposing	Poor	29	22.8	33	16.1	0.024
	Fair	24	18.9	70	34.1	
	Good	35	27.6	47	22.9	
	Excellenc	39	30.7	55	26.8	
Enabling	Poor	80	63.0	76	37.1	<0.001
	Fair	42	33.1	93	45.4	
	Good	5	3.9	36	17.6	
Maintenance	Poor	71	55.9	91	44.4	0.041
	Fair	56	44.1	114	55.6	

Changes in predisposing factors were found among male and female students during the clinical-academic year. On the other hand, improvement in enabling factors was found among male and female students in the pre-clinical and clinical-academic years. Meanwhile, changes in maintenance factors were found among female students in the clinical education year (Tables 4 and 5). These results should be related to the exercise behaviour level among medical students since the determinant will affect the psychological decision process to exercise.

Table 4. Determinants of exercise among medical students by gender in 2011 and 2021

Determinant factors	Gender	Category	Year				p
			2011		2021		
			f	%	f	%	
Personal	Male	Poor	1	32.2	24	38.1	0.790
		Fair	14	23.7	14	22.2	
		Good	2	44.1	25	39.7	
	Female	Poor	2	38.2	42	29.6	0.314
		Fair	1	26.5	35	24.6	
		Good	2	35.3	65	45.8	
Predisposing	Male	Poor	1	18.6	11	17.5	0.524
		Fair	9	15.3	16	25.4	
		Good	1	27.1	17	27.0	
		Excellenc	2	39.0	19	30.2	
	Female	Poor	1	26.5	22	15.5	0.059
		Fair	1	22.1	54	38.0	
		Good	1	27.9	30	21.1	
		Excellenc	1	23.5	36	25.4	
Enabling	Male	Poor	2	49.2	23	36.5	0.047
		Fair	2	44.1	26	41.3	
		Good	4	6.8	14	22.2	
	Female	Poor	51	75.0	53	37.3	<0.001
		Fair	1	23.5	67	47.2	
		Good	1	1.5	22	15.5	
Maintenance	Male	Poor	23	39.0	27	42.9	0.664
		Fair	3	61.0	36	57.1	
	Female	Poor	4	70.6	64	45.1	0.001
		Fair	2	29.4	78	54.9	

Table 5. Determinants of exercise among medical students by academic year in 2011 and 2021

Determinant Factors	Academic stage	Category	Year				p
			2011		2021		
			f	%	f	%	
Personal	Pre-clinical	Poor	2	26.3	48	32.7	0.618
		Fair	2	28.9	38	25.9	
		Good	3	44.7	61	41.5	
	Clinical students	Poor	2	49.0	18	31.0	0.105
		Fair	1	19.6	11	19.0	
		Good	1	31.4	29	50.0	
Predisposing	Pre-clinical	Poor	1	22.4	28	19.0	0.537

		Fair	1	21.1	44	29.9	
		Good	2	27.6	34	23.1	
		Excellence	2	28.9	41	27.9	
	Clinical students	Poor	1	23.5	5	8.6	0.006
		Fair	8	15.7	26	44.8	
		Good	1	27.5	13	22.4	
		Excellence	1	33.3	14	24.1	
Enabling	Pre-clinical	Poor	4	53.9	52	35.4	0.013
		Fair	3	40.8	74	50.3	
		Good	4	5.3	21	14.3	
	Clinical students	Poor	3	76.5	24	41.4	<0.001
		Fair	1	21.6	19	32.8	
		Good	1	2.0	15	25.9	
Maintenance	Pre-clinical	Poor	3	44.7	63	42.9	0.788
		Fair	4	55.3	84	57.1	
	Clinical students	Poor	3	72.5	28	48.3	0.010
		Fair	1	27.5	30	51.7	

The dependency test between the determinant factors and sports behaviour showed that the predisposing, enabling, and maintenance factors were directly related to sports behaviour ($p<0.05$), while personal factors did not directly relate to sports behaviour. The categorical regression test (Regression for Categorical Data – CatReg) used in the path analysis of the relationship between determinants and sports behaviour shows that the determinant factors that have a direct relationship with sports behaviour are enabling, predisposing, and maintenance factors. Meanwhile, personal factors directly correlate with predisposing, enabling, and maintenance factors. This model of the relationship between the determinants and exercise behaviour has a statistical value of $R2=0.298$, $df=8$, $F=17,170$ ($p<0.01$) (Figure 1).

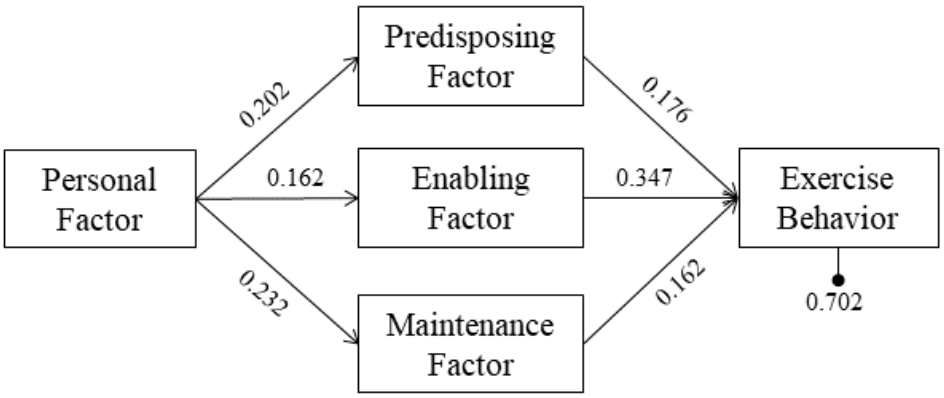

Figure 1. Path analysis of the relationship between determinants and exercise behavior

DISCUSSION

This study shows that the students in action and maintenance exercise levels have almost doubled during the pandemic. On the contrary, other researches show a decrease in activity level or the adoption of exercising behaviour among students during the pandemic.[8-10] This result indicates that the disruption during the COVID-19 pandemic has a different impact on medical student exercise behaviour compared to other student groups. Research supports this finding by stating that university characteristics and lifestyle, exams, and academic pressure appeared to modify the interactions between determinant factors and university students' physical

activity and sedentary behaviour.[11]

The specific distribution of this research shows that significant change in exercise behaviour only occurs among female medical students and students in the clinical education year. Male and pre-clinical medical students show no significant difference in exercising during the pandemic compared to the pre-pandemic period. This result shows that the pandemic disruptions affect the students specifically based on gender and academic year. The Transtheory Model states that during the contemplation stage, the individual encountered a severe consideration to improve his behaviour and awareness that his recent behaviour can lead to bad things. It takes an opinion that supports the new behaviour and a stronger motivation to change the behaviour.[15] This shows that female and clinical students have a better consideration and awareness to exercise compared to male and pre-clinical students. Meanwhile, the female and clinical students at the maintenance stage seem to receive positive feedback from the environment by exercising. For example, during the pandemic, there was a flood of information on the benefit of exercise to immunity. This information could positively maintain female and clinical students' exercising behaviour and help them face the temptation to relapse and be more confident to continue the new change.

Among the determinant factors, significant changes were found in predisposing, enabling, and maintenance factors. Personal factors such as age, gender, heredity, social status, and current fitness condition do not change significantly during the pandemic. Beliefs influence predisposing factors related to the individual's intrinsic motivation about the ability to perform exercise and understanding of the benefits of these behaviours.[2] The pandemic period seems to provide a good balance of opinion toward exercise and its benefit to improving immunity. These pieces of information are also widely available during the pandemic. Medical students also have a better belief about exercise benefits during the pandemic than in the pre-pandemic period. Clinical and pre-clinical students can better set goals, conduct assessments, and carry out personal monitoring, known as enabling factor.

Maintenance factors only improved significantly among female and clinical medical students during the pandemic. These groups seemed to receive more positive support from their environment and relatives.[2] Research revealed that psychological factors such as self-efficacy, behavioural attitudes, intents, and automaticity have a significant relationship with physical activity levels.[12] An association was also found between physical activity and participation of relatives (parents, mothers, partners, older siblings, and friends), as well as a positive sense of satisfaction with physical education taught in schools.[3] The specific response among female and clinical students on exercise behaviour confirms the rule of the psychological aspect of behaviour adoption, and it was not only correlated with knowledge.[7] The Transtheory Model of behaviour change could be an appropriate behaviour model to explain the results.[16] This gender-related psychological and behavioural reaction may interact with COVID-19-related outcomes, even though the mechanisms behind gender-based effects are still unknown.[17]

As an essential aspect of the Transtheory Model, the behaviour change process could explain that the female and clinical students respond better to the pandemic on exercising. The first five processes are awareness-raising, self-awareness, re-evaluation of oneself and the environment, and self-liberation.[2] Researcher shows that female has better attention to the pandemic than males, and they take it seriously.[18,19] This could lead female students to have a better self-awareness to exercise. Female students are more prone than males to use good emotions to reappraise unpleasant situations.[20,21] Females are more likely to rely on improvisation and intuition. They were more democratic and supported information sharing.[22] Those could lead females to better decisions making based on better self-re-evaluation.[15] Females are less prone to make errors and fail personally, so they can maintain their confidence and commitment better than males during a

crisis.[22] Confidence and belief improve self-liberation needed to take concrete action on exercise.[15]

The next five change processes are social liberation, reverse conditioning, stimulus control, contingency management, and improving the quality of relationships.[15] Females have a desire to help others, the ability to weigh risks, and the resilience to bounce back from failure more pragmatically than males.[23] This ability is needed when we manage contingency by making cognitive reinforcement. Males generally utilize problem-focused coping in stressful times.[24] Females are more likely to seek social support through emotion-focused coping.[25,26] This character will lead females to a more social than males during times of crisis. Social support is an essential factor for most behaviour processes of change. It helps female students to achieve social liberation, reverse conditioning, stimulus control, contingency management, and improving the quality of relationships.

Based on those characteristics, female students will also have self-efficacy and decision balance better than male students. They have better self-confidence to overcome the temptation to return to the initial bad behaviour than males. Self-efficacy is important in changing to advanced stages, such as the preparation and action stages. Decision balance is the individual's ability to judge the opinions of the pros and cons of the new behaviour, the benefits of behaviour change, and the value of the behaviour change itself. This concept was adopted into the Transtheory Model as a balanced decision considering the pros and cons.[15] Public health efforts that stimulate physical activity and enhance health should be encouraged and improvement of information strategies regarding on-campus sports activities, cheaper or more flexible sports subscriptions, and formulas were some recommendations for future physical activity programs.[11,27] Evaluation of exercise could be done more accurately using a specific questionnaire such as International Physical Activity Questionnaire (IPAQ). We could get a broader spectrum of the exercise and a more specific relationship with the determinant factor. It also would be better if this type of research could be done in a cohort study design. The future researcher should consider the limitation found in this study.

CONCLUSION

Our study showed that medical students' exercise activity increased significantly during the pandemic, especially among female and clinical academic year students. However, personal factors did not have a direct association with sports behaviour. Instead, predisposing, enabling, and maintenance factors are drivers of exercise behaviour that significantly change during the pandemic. These results could suggest the importance of determinant factors in making an intended behavioural change.

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AUTHOR CONTRIBUTION

IPAG: design the study, collected and analysed the data, wrote the draft of manuscript; LPRS: aided in interpreting the results and worked on the manuscript; INS: contributed to the final version of the manuscript. All authors discussed the results and commented on the manuscript.

CONFLICT OF INTEREST

We have no conflicts of interest to disclose.

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