BMC Psychology

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Structural relationship of the social-ecological factors and psychological factors on physical activity

Abdulwali Sabo[1,2], Garry Kuan[3] and Yee Cheng Kueh[1*]

Abstract

The present study examines the mediating effect of psychological factors in the structural relationships between social and physical environmental factors and the amount of physical activity among undergraduate students at Universiti Sains Malaysia. The sample consisted of 422 students with a mean age of 20.2 years (SD = 1.27). The majority of the students were female (69.7%) and Malay (81.3%). Standardized scales were used to measure the total amount of physical activity and all the study variables. The final SEM had a good fit to the data: CFI = 0.968, TLI = 0.948, SRMR = 0.036, RMSEA (90%CI) = 0.046 (0.025, 0.065), RMSEA p-value = 0.609 with 11 paths relationships. Family support had a significant effect on perceived benefits and perceived barriers. The effect of friend support on physical activity was significantly mediated by perceived benefits, self-efficacy, and psychological needs satisfaction. The effect of the availability of exercise facilities on physical activity was significantly mediated by perceived benefits and psychological needs satisfaction. Furthermore, psychological needs satisfaction mediated the effect of perceived benefits, perceived barriers, and self-efficacy on physical activity. The study findings illustrated that the application of the social-ecological model and psychological factors is important in order to understand and promote positive physical activity behaviour.

Keywords Exercise, Benefits, Barriers, Self-efficacy, Satisfaction, Family, Friends

Introduction

A substantial body of research evidence reported that physical activity participation promotes physical, mental and spiritual health [1–4]. Regular physical activity lowers the risk of various noncommunicable diseases such as cardiovascular diseases, diabetes mellitus, stroke, obesity, and some cancers [5–8]. The health benefits of physical activity are widely reported and associated with improved quality of life and well-being [2, 9]. A previous study reported that lack of physical activity contributed to 9% of total death globally [1]. However, habits of physical inactivity remain prevalent in the global population, and the global age-standardized prevalence was 27·5%, with a higher proportion (80%) of adolescents not meeting the current physical activity guidelines [10].

Physical activity is a complex behaviour that is affected by the interaction of various factors, including social (family and friends support), psychological (perceived benefits and perceived barriers), and physical environmental (availability and quality) factors [11–14]. Furthermore, physical activity is affected by demographic

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factors (e.g., gender, age, and socio-economic status) and interpersonal factors (e.g., social networks, social participation, social support, and self-determined motivation) [15–18]. Hence, a more comprehensive model is needed to capture the track of relationships and interactions between the various possible predictors of physical activity [19].

The social-ecological model, developed by Bronfenbrenner [20], was applied by various researchers as a framework to examine and illustrate the dynamic interrelationships between the social, individual, psychological, and physical environmental factors in promoting physical activity behaviours [11, 21, 22]. According to the social-ecological model, these factors interrelate to promote physical activity behaviour [21]. Precisely, the model proposed that positive physical activity behaviour initiates from individual factors such as age, gender, knowledge, and skills through psycho-social factors to the level of environmental factors [21, 23].

Over the past decade, various empirical studies have shown that social, psychological, and physical environmental factors are significant predictors of physical activity [11, 13, 14, 24]. For example, social and physical environmental factors have a direct relationship with physical activity, and this relationship was significantly mediated by the psychological factors [11, 13, 14]. While previous studies have demonstrated the mediating effect of psychological variables (i.e., self-efficacy, perceived benefits, and perceived barriers) [11, 14], in the present study, psychological needs satisfaction was added as one of the mediating factors.

In general, research studies that examined the interrelationships between the social, psychological, and physical environmental factors were predominantly performed in western cultures and few studies in other cultures, such as Malaysia [11, 14]. Furthermore, regular physical activity promotes school students' academic performance, quality of life, and lifetime activity levels [25, 26]. Therefore, among a sample of university students in Malaysia, the current study examined the effect of social and physical environmental factors on physical activity through psychological factors.

Method

Participants

The sample consisted of 422 undergraduate students (male: $n=128$, 30.3%; female: $n=294$, 69.7%, Mage=20.2, SD=1.27, range=18–25) from Universiti Sains Malaysia. The participants were from the schools of medical sciences (12.8%), health sciences (83.2%), and dental sciences (4.0%). The study participants reported their ethnicity as Malays (81.3%), Chinese (8.3%), Indians (6.4%), and others (4.0%). However, they were all Malaysians with a strong understanding and speaking abilities in the Malay language. The mean frequency of reported exercise/week was 2.9 (SD=1.57) with a mean duration of 63.8 min/session (SD=37.37). The participant's reported sports were football, basketball, badminton, tennis, netball, jogging and cycling. Furthermore, almost all the participants (99.0%) reported having no illness.

Measures

The Malay version social support for exercise scale was used to assess the social support for physical activity [27]. The scale consisted of two factors (i.e., family support and friend support) with a total of 24 items. The participants rated their perceived family and friend support, such as "my family or friend tries to exercise with me" using a 5-point rating option ranging from 1 (never) to 5 (very often). The internal consistency of the scale was 0.940 and 0.936 for family support and friend support, respectively. Also, the test-rest reliability was 0.920 and 0.984 for family support and friend support, respectively [27]. In the present study, the internal consistency was 0.945 and 0.933 for family support and friend support, respectively.

To assess the level of perceived physical environment, the Malay version physical environment scale for physical activity was used to assess the physical environment support for physical activity [27]. The scale consisted of two factors (i.e., availability and quality of exercise facilities) with a total of 5 items. The participants rated their perceived environmental support such as "in my community exercise facilities or places are nearby" using a 5-point rating option ranging from 1 (not true at all) to 5 (definitely true). The internal consistency of the scale was 0.743 and 0.771 for perceived availability and perceived quality, respectively. Also, the test-rest reliability was 0.895 and 0.774 for perceived availability and perceived quality, respectively [27]. In the present study, the internal consistency was 0.686 and 0.676 for perceived availability and perceived quality, respectively.

For the decisional balance (i.e., perceived benefits and perceived barriers), the Malay version decisional balance scale in exercise was used to assess a prevailing exercise behaviour [28]. The scale consisted of two factors (i.e., perceived benefits and perceived barriers) with a total of 10 items. The participants rated their decision to exercise or not such as "physical activity would help me reduce tension or manage stress" using a 5-point rating option ranging from 1 (strongly disagree) to 5 (strongly agree). The internal consistency of the scale was 0.857 and 0.859 for perceived benefits and perceived barriers, respectively. Also, the test-rest reliability was 0.979 and 0.960 for perceived benefits and perceived barriers, respectively [28]. In the present study, the internal consistency was 0.868 and 0.837 for perceived benefits and perceived barriers, respectively.

For self-efficacy, the Malay version of the self-efficacy for exercise scale was used to assess the participant's level of confidence for exercise activities [29]. However, the Malay version was tested based on a 1-factor and 3-factor model. In this study, the 1-factor model was used. The scale consisted of 18 items and the participants rated their ability to exercise such as "I am feeling depressed, or it is raining" using a 5-point rating option ranging from 1 (not at all confident) to 5 (extremely confident). The internal consistency of the scale was 0.931. Also, the test-rest reliability was 0.990 [29]. In the present study, the internal consistency was 0.931.

The Malay version psychological needs satisfaction was used to assess participants' psychological need satisfaction during exercise [30]. The scale consisted of 3 factors (i.e., competence, autonomy, and relatedness) with a total of 18 items. The participants rated their level of satisfaction such as "I feel that I am able to complete exercises that are personally challenging" using a 6-point rating option from 1 (false) to 6 (true). The internal consistency was 0.891, 0.898, and 0.908 for competence, autonomy, and relatedness, respectively. Also, the test-retest reliability were 0.982, 0.985, and 0.980 for competence, autonomy, and relatedness, respectively [30]. In the present study, the internal consistency were 0.890, 0.900, and 0.905 for competence, autonomy, and relatedness, respectively.

Finally, the International Physical Activity Questionnaire (IPAQ) was used to assess the participant's intensity of physical activity participation and sitting time during their daily activities. The total amount of physical activity participation was estimated in MET-min/week. The students stated the time they spent physically active in the last seven days. The test re-test reliability was established (Cronbach alpha = 0.80) [31]. In this study, the translated Malay version was used [32].

Data analysis

Descriptive analysis was used to describe the socio-demographic characteristic of the participants, such as age, gender, ethnicity, school, exercise frequency, and duration of exercise sessions per week. The results were presented as mean, standard deviation, frequencies, and percentages (%). The structural equation modelling was performed to determine the effect of the social-ecological factors (social support and physical environment) on physical activity through psychological factors (self-efficacy, decisional balance, and psychological needs satisfaction) (Fig. 1). The path analysis was performed to test the initial hypothesized model using the maximum likelihood robust (MLR) estimator. In this study, the

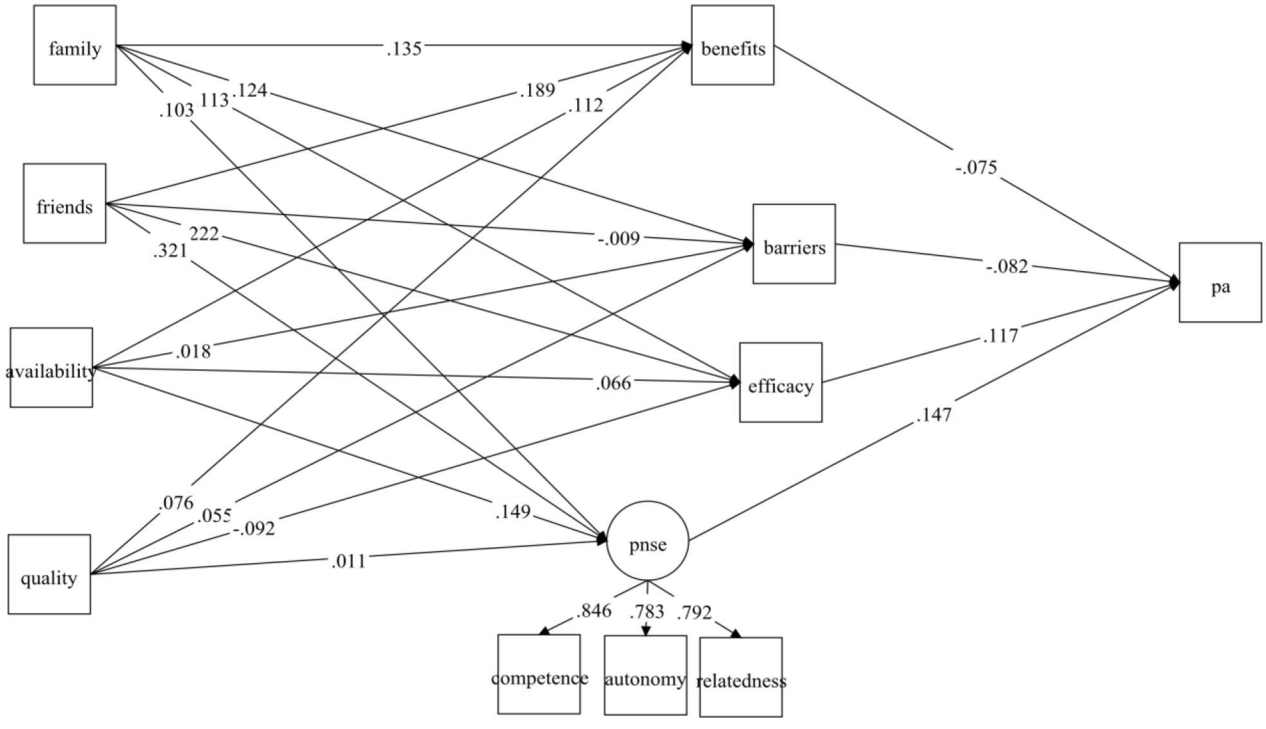

Fig. 1 Hypothesized initial structural model of the relationships between social-ecological with psychological constructs and amount of PA with a standardized regression coefficient. Notes: family = family support, friend = friends support, availability = availability of exercise facilities, quality = quality of exercise facilities, efficacy = Self-Efficacy for Exercise, pnse = Psychological Needs Satisfaction in Exercise, benefits = perceived benefits, barriers = perceived barriers, p.a. = Physical Activity

Table 1 model fit indices of the structural model

Model	CFI	TLI	SRMR	RMSEA (90% CI)	RMSEA *P*-value
Model-1	0.830	0.621	0.077	0.116 (0.099, 0.134)	< 0.001
Model-2	0.968	0.948	0.036	0.046 (0.025, 0.065)	0.609

Notes: CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, SRMR = Standardised Root Mean Square Residual, RMSEA = Root Mean Square Error of Approximation, CI = Confidence Interval

MLR is preferred because its produces parameter estimates that are robust to normality distribution of data [33]. The recommended fit indices and cut-off point values used were root mean square error of approximation (RMSEA) < 0.07, standardized root mean square residual (SRMR) < 0.08, and comparative fit index (CFI) or Tucker and Lewis index ≥ 0.95. Model re-specification was carried out for a misfit model by investigating all non-significant path, standardized residuals (SR), and Modification Indices (MI). A high Modification Index (MI) indicates that the corresponding fixed parameter needs to be freed to adjust the fit of the model [34]. Furthermore, all the scales were measured by a single-construct measure using the mean score of each subscale.

Results

The results of the initial hypothesized structural model of social-ecological factors with psychological factors and physical activity are displayed in Fig. 1. There was a total of 24 hypothesized path relationships in the initial model. The initial model examined (Model 1) did not show adequate fit indices (Table 1).

Model re-specification was made by removing non-significant paths from the structural model. The path with the highest non-significance value was removed one at a time and the model was re-tested after each removal. However, the theoretical importance of each path was considered during the process of removal. The final (model-2) achieved the recommended fit indices with eight paths relationships and three additional paths relationships (psychological needs satisfaction associated with perceived benefits, perceived barriers, and self-efficacy). Table 1; Fig. 2.

Figure 2 shows that family support had a significant and positive effect on perceived benefits (β = 0.139, $p = 0.010$) and perceived barriers (β = 0.136, $p = 0.011$). Friend support had a significant and positive effect on Perceived benefits (β = 0.187, $p < 0.001$), self-efficacy (β = 0.273, $p < 0.001$), and psychological needs satisfaction (β = 0.235, $p < 0.001$). Perceived availability of exercise facilities had

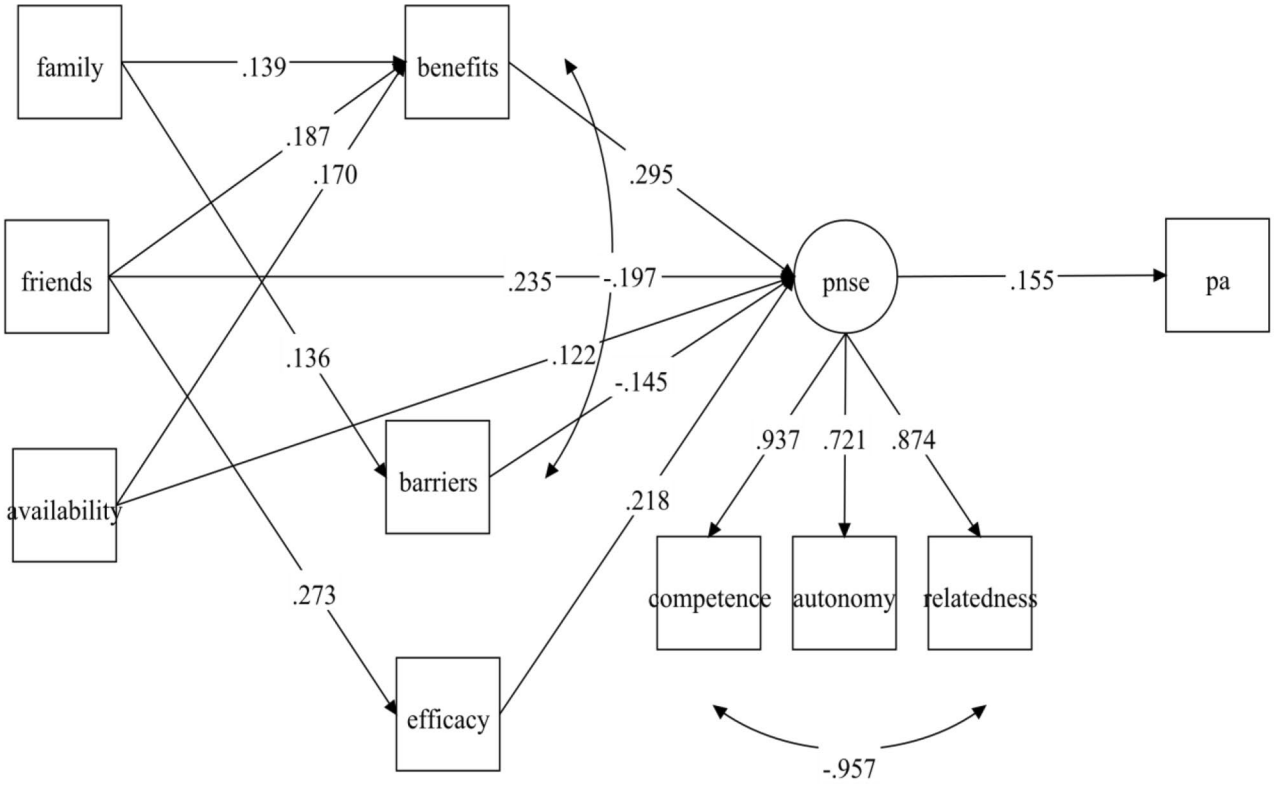

Fig. 2 Final structural equation model of the relationships between socio-ecological variables with psychological variables and amount of PA and standardized regression coefficients. Notes: family = family support, friend = friends support, availability = availability of exercise facilities, efficacy = Self-Efficacy for Exercise, pnse = Psychological Needs Satisfaction in Exercise, benefits = perceived benefits, barriers = perceived barriers, p.a. = Physical Activity

a significant and positive effect on perceived benefits (β=0.170, $p<0.001$) and psychological needs satisfaction (β=0.122, $p=0.014$). Perceived benefits had a significant and positive effects on psychological needs satisfaction (β=0.295, $p<0.001$). Perceived barriers had significant and negative effects on psychological needs satisfaction (β = -0.145, $p=0.002$). Self-efficacy had a significant and positive effects on psychological needs satisfaction (β=0.218, $p<0.001$). Finally, psychological needs satisfaction had a significant and positive effect on physical activity (β=0.155, $p=0.001$).

For the mediating effect, the total indirect effect of family support on physical activity was not significant (β=0.003, $p=0.352$). Friend support had a significant and positive total indirect effect on physical activity (β=0.054, $p=0.002$) through psychological needs satisfaction (β=0.036, $p=0.006$); perceived benefits and psychological needs satisfaction (β=0.009, $p=0.014$); and self-efficacy and psychological needs satisfaction (β=0.009, $p=0.016$). Perceived availability of exercise facilities had a significant and positive total indirect effect on physical activity (β=0.027, $p=0.017$) through psychological needs satisfaction (β=0.019, $p=0.049$); and perceived benefits and psychological needs satisfaction (β=0.008, $p=0.034$). Perceived barriers had a significant and negative total indirect effect on physical activity through psychological needs (β = -0.022, $p=0.034$). Perceived benefits had a significant and positive total indirect effect on physical activity through psychological needs satisfaction (β=0.046, $p=0.003$). Finally, self-efficacy had a significant and positive total indirect effect on physical activity through psychological needs satisfaction (β=0.034, $p=0.006$).

Discussion

The present study explores the mediating role of the psychological variables on the relationship between the social-ecological variables and physical activity participation among undergraduate students in Malaysia. Previous studies have examined the mediating effects of these psychological factors in the relationship between social-ecological factors and physical activity [11, 13, 14]. However, in the present study, psychological needs satisfaction was added, which has not been frequently included in previous studies. The findings of this study have shown that family support, friend support, and availability of exercise facilities have an indirect effect on physical activity through self-efficacy, perceived benefits, perceived barriers, and psychological needs satisfaction.

Family support had a significant relationship with perceived benefits, and this finding is supported by previous studies [11, 12, 14]. These may illustrate that family members with positive perceptions towards physical participation can influence their children during their daily life interaction and therefore, improve their perceived benefits of exercise activities. This coincides with the findings of previous study [11]. Additionally, family support was found to be significant and positively associated with perceived barriers. All the relevant studies have found a non-significant association between family support and perceived barriers [11, 12, 14], however, Kim and Cardinal [35] reported a significant and positive correlation between family support and perceived barriers. One possible explanation may be that the students with negative behaviours towards exercise may be getting extra support from family members to inspire them to engage in physical activity.

The effect of friend support on physical activity was significantly mediated by perceived benefits, self-efficacy, and psychological needs satisfaction. These findings are consistent with previous studies [11, 12, 14], indicating that students with higher support from their colleagues will have more confidence to engage in physical activity despite obstacles and may enjoy better benefits of participation. Regarding the mediating effect of psychological needs satisfaction through self-efficacy, this indicates that students with higher confidence will have more psychological satisfaction, such as a sense of accomplishment and in turn, have more influence on their friend's positive behaviour. Moreover, previous studies reported that social support from friends and families is positively related to psychological needs satisfaction [21, 36].

The effect of perceived availability of exercise facilities on physical activity was mediated by perceived benefits. This finding is supported by previous studies [11, 12, 14], that environmental factors such as the weather, safety, quality, availability, and accessibility of exercise facilities were significant and positively associated with perceived benefits for physical activity. However, in the study, quality of exercise facilities had no significant effect on all the psychological factors. Furthermore, psychological needs satisfaction mediated the effect of perceived benefits on physical activity, and this finding is consistent with the study by Rutten, Boen [37] that the physical school environment is a significant predictor of autonomous motivation for physical activity.

Finally, in the present study, psychological needs satisfaction is the only psychological factor that had a significant direct effect on physical activity. Indicating that psychological needs satisfaction is significantly associated with self-efficacy, perceived benefits, and perceived barriers, as well as mediated their effects on physical activity. This may indicate that the psychological needs for autonomy, competence, and relatedness, are universal in their influence and can promote psychological health across all cultural differences [38, 39]. Moreover, psychological needs satisfaction had a significant influence on

the social-emotional and behavioral functioning of early adolescents [40].

Among the limitations of this study, data was collected from a single university, and this will limit the generalizability of the results to other university students. The study also utilised self-administered questionnaires and a convenience sampling method to assess all the study variables, which could introduce some biases due to insincere responses from the participants. However, all the participants were assured of their confidentiality and encouraged to give their true responses to all the questions. Lastly, the study was a cross-sectional design which can be difficult to establish cause and effect factors. Future studies can replicate the research findings with a more scientific sampling method and study design, such as the random sampling method and longitudinal study design.

Conclusion

In the present study, we examined the inter-relationship of the social-ecological factors (family support, friend support, availability, and quality of exercise facilities) and psychological factors (self-efficacy, perceived benefits, perceived barriers, and psychological needs satisfaction) in promoting physical activity behaviour. The final structural model supported eleven hypotheses with good fit indices, revealing that the psychological factors mediated the effect of the social-ecological factors on physical activity. Students with higher support from social and physical environments will have higher confidence, positive behaviour, and motivation, which could promote their physical activity participation.

Acknowledgements
We express our appreciation to every student who took part in this study.

Author contributions
Conceptualization: Y.C.K, G.K. Data curation: A.S, Y.C.K. Formal analysis: A.S, Y.C.K. Investigation: Y.C.K, G.K. Methodology: Y.C.K, G.K. Data collection: A.S. Software: Y.C.K. Supervision: Y.C.K, G.K. Validation: Y.C.K, G.K. Writing – A.S. Writing review and editing: Y.C.K, G.K, A.S.

Funding
Not applicable.

Data availability
The dataset supporting the findings of this article is available from the corresponding author on request.

Declarations

Ethics approval and consent to participate
The ethical approval for the study was granted by the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/18070305). The participants were informed about the research aim and methods before signing the informed consent form. The investigation conforms to the principles outlined in the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 20 October 2023 / Accepted: 27 May 2024
Published online: 31 July 2024

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