A Cross-Cultural Comparison of College Students' Physical Activity in Korea and Malaysia using the Transtheoretical Model

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The present study aimed to compare the levels of physical activity among Korean and Malaysian university students and their associated psychosocial variables. A total of 574 Korean university students from Seoul National University of Science and Technology, South Korea and 562 Malaysian university students from the Universiti Sains Malaysia, Malaysia volunteered for the study. Before analyzing the main purposes of the study, measurement invariance between the Korean and Malaysian TTM measures was identified. The results showed that the levels of physical activity by nationality and gender were significantly different. In addition, all of the transtheoretical model (TTM) constructs were significantly different across the various stages of physical activity, excluding the cognitive processes of change. The findings provide fundamental knowledge that may be useful in the development of generic physical activity interventions that meet the needs of a culturally diverse population.

KEY WORDS: Transtheoretical Model; Cross-Cultural; Korean; Malaysian; Physical Activity.

It is well recognised that increases in physical inactivity and sedentary lifestyles have become a critical international health problem (Hajar, Rizal, & Kuan, 2019; Kueh, Kuan, & Morris, 2019). Although numerous studies have highlighted that physical activity is important for the general population

(Kim & Kang, 2020; Kuan, Sabo, Sawang, & Kueh, 2020), young adults' physical inactivity has been not sufficiently answered. Nevertheless, the available studies show that most youths around the world have failed to engage in regular physical activity (U.S. Center for Disease and Prevention, 2017; World Health Organization, 2017). Korean Ministry of Health and Welfare (2018) found that 34.3% of the university students reported never exercising (male: 25%; female: 43%). In addition, 32.5% of those university students who engaged in regular physical activity did so less than three times per week (once per week: 15.8%; 2 – 3 times per month: 16.7%). According to the national survey on physical activity conducted by Korean Ministry of Culture, Sports, and Tourism (2018), 28% of young adults reported that they never exercised. More importantly, for those who engaged in physical activity, approximately 17% only exercised once per week, and 16% did so two to three times a month. Malaysian data relating to physical inactivity in young populations revealed similar statistical patterns as those reported in Korean. In one study in particular, Lian, Bonn, Han, Choo, and Piau (2016) indicated that 23% of university students never exercised (male: 16%; female: 28%). Moreover, 40% of students participating in the physical activity did so less than three days a week (once a week: 20%; 2 – 3 times a month: 25%). In Malaysia, recently, Yusoff and colleagues (2018) reported that 47% of university students did not engage in vigorous physical activity, and 17% were physically inactive. Moreover, female youths tended to be less active overall compared to their male counterparts, with 31% of females counted as sedentary compared with 23% of males.

In the last ten years, identifying ways to promote physical activity for health and wellness among young adults in Western societies has become increasingly important (Vierling, Standage, & Treasure, 2007; Wengreen & Moncur, 2009). However, in both Korea and Malaysia, there has been relatively little research conducted in this area; instead, the emphasis has been on demographic-based differences and the health effects of physical activity (Hidrus et al., 2020; Yi, 1996). Physical activity itself is a dynamic action that is influenced by multidimensional variables (Rovniak, Anderson, Winett, & Stephens, 2002). Therefore, variables that influence and impact the physical activity of young adults may be derived from a consideration of the psychosocial and socio-cultural contexts that emerge from social cognitive theory (Fleury & Lee, 2006; Kim & Cardinal, 2009). Given of the complexity for the theory in nature, careful attention should be paid to the multiple factors that influence physical activity levels.

According to Glanz, Lewis, and Rimer (1997), sport and exercise psychologists have been motivated to use psychosocial theories to examine peo-

ple's physical activity and gain a better understanding of it. One tool that they employ is the transtheoretical model (TTM), which is a contemporary psychological paradigm that seeks to understand the adoption and maintenance of intentional health behaviour (Prochaska & DiClemente, 1983); it is also frequently used to classify physical activity correlates (Han, Gabriel, & Kohl, 2017). The TTM consists of five major stages of change, known as the temporal and motivational aspects of change (i.e., pre-contemplation, contemplation, preparation, action, and maintenance). Moreover, several psychological and behavioural variables, such as processes of change, self-efficacy, and decisional balance (i.e., pros and cons) have been shown to have stable relationships with the stage of change and are included in the model as other constructs (Kang & Kim, 2017). A number of previous studies have documented both basic and specific descriptions for the TTM constructs (Kirk, MacMillan, & Webster, 2010). The TTM indicates that behavioural change happens in a variety of stages over time and that the causes of change involve the cognitive and behavioural processes that individuals participate in at the different stages of change. Additionally, people will also weigh the pros and cons of physical activity. As they progress through the stages of physical activity, they should typically experience increased self-efficacy (Elezim, Elezi, Gontarev, & Georgiev, 2019).

For more than a decade, many studies across a wide range of populations and settings have shown that there is a significant relationship between physical activity and the TTM constructs (McGlumphy, Gill, & Hasson, 2019; Nigg et al., 2019). However, most previous studies have been conducted mainly in Western countries; such research is limited in other cultures, such as Korea and Malaysia, where only recently has attention been focused on TTM-based physical activity research (Rizal, Hajar, Kueh, Muhamad, & Kuan, 2019). Therefore, before disseminating findings through nations and cultures, it is important to establish their external validity.

Furthermore, it is widely acknowledged that culture refers to a way of life of a group of people, including the behaviours, beliefs, values, and symbols that are learned and shared, and it is normally passed from one generation to the next (Betancourt & Lopez, 1993). Given this definition of culture, it is generally understood that culture has significantly influenced physical activity and its related psychosocial variables (Benitez, Tesevska, Indiana, & Keller, 2017; Cardinal, Tuominen, & Rintala, 2004). Duda and Allison (1990) have indicated that cultural studies can provide important insights into how it may be possible to generalise the antecedents of physical activity, and that culture-related characteristics play an important part in explaining physical activity levels. More specifically, Seo and colleagues (2009) have argued that

university students in different cultures (e.g., United States, India, Costa Rica, and South Korea) have exhibited different physical activity levels and psychological factors relating to physical activity. Additionally, Cardinal and colleagues (2004) found that culture was a significant contributor in the classification of physical activity stages, with a unique variance of 14% in explaining physical activity. In particular, American university students were more likely to be in the maintenance stage, and Finnish university students were more likely to be in the contemplation and pre-contemplation stages. Along similar lines, Chiang, Zhang, Casebolt, and Chiang (2013) have indicated that understanding the cultural differences in youth's psychological attributes can facilitate the organisation of physical activity that offers university students the expected physical activity experiences and movement learning outcomes.

As described above, culture has a significant influence in accounting for physical activity levels, but most studies have focused on the populations within one specific Western culture. Therefore, continued interest in cross-cultural physical activity studies aimed at fostering international understanding and appreciation is needed. Accordingly, the present study examines physical activity and its associated psychosocial variables among both Korean and Malaysian university students based on the TTM.

Methods

PARTICIPANTS

Korean participants were from Seoul National University of Science and Technology, South Korea (n = 574, mean age = 21.71 years, SD = 2.7) and Malaysian participants were from Universiti Sains Malaysia, Malaysia (n = 562, mean age = 20.81 years, SD = 1.2). In the initial phase of the study, recruitment flyers with explanations on the objectives and procedures were made available on the websites and newsletters, and the student bulletin board in both universities. The data collection took place over two months of concurrently in Korea and Malaysia. Then, the potential participants who expressed interest in the study were added to a wait-list database. Through these procedures, 600 Korean university students consented to participate in the study. Of those, 574 students (95.60%) completed the survey form; there were 357 males (62.2%) and 217 females (37.8%). The remaining 26 (4.40%) were excluded because they did not complete the survey form or return it. For the Malaysian participant, 586 university students gave their consent, and 95.90% (n = 562) completed the survey form; there were 118 males (21.0%) and 444 females (79.0%). The remaining 24 (4.10%) were disqualified, which is similar to the Korean population. All participants provided their informed consent in compliance with the approval of the Institutional Review Board; the Human Research Ethics Committee (USM/JEPeM/17070322) and the study was carried out in accordance with the International Declaration of Helsinki guidelines.

Measures

All Korean measures were revised and standardised into the Korean language (Kim, 2007). In the case of Malaysia, university students were competent in English; thus, original English version questionnaires were employed. For the Korean measures, following the translation and validation outlined by Banville, Desrosiers, and Genet-Volet (2000), and the methodological process can be found in previous studies (Cardinal et al., 2004; Kang & Kim, 2017; Liu, Kueh, Arifin, Kim, & Kuan, 2018). The measures applied were both culturally appropriate and psychometrically sound.

Stages of Change Scale. Stage of physical activity change scale, developed by Marcus, Selby, Niaura, and Rossi (2016) was translated into Korean. In this questionnaire, the stage of physical activity was assessed using the 5-item, dichotomous (yes/no) scale related to regular physical activity and intentions. Individuals have been categorised into one of the five stages of physical activity change described above. In a pilot phase of the test, test-retest reliability was carried out as a measure of instrument stability and achieved.85 for the Korean scale (Kim, 2007), and 0.78 for the English version (Liu et al., 2018).

Decision Balance Scale. The decisional balance scale is a 10-items questionnaire that has been developed by Plotnikoff, Blanchard, Hotz, and Rhodes (2001). The scale was revised for the Korean version in the study, and the English version was used in Malaysia based sample. The scale consists of the two sub-scales (pros and cons with five items each). The 5-point Likert scale was used, and participants were required to respond on the basis of their preference from "not at all important" to "extremely important". Two main components of the decisional balance scale are the pros and cons, which represent the positive and negative aspects of the behavioural changes of the individual. The internal reliability of the Korean scale was reported as 0.89 for pros and 0.88 for cons (Kim, 2007), while for the English scale, the internal reliability was 0.82 for pros and 0.72 for cons (Liu et al., 2018).

Self-Efficacy Scale. Bandura (1997) developed the self-efficacy scale for physical activity and was revised for the Korean and English version for this study. The participants were asked to indicate on a 5-point Likert scale from 1 (cannot do) to 3 (moderately certain can do) though intermediate levels of assurance, then to 5 (certain can do). Individuals rated in one space under a column labelled "confidence" how confident they were that they could perform exercise routines regularly (three or more times a week) under the different circumstances. Internal reliability was 0.91 for the Korean scale (Kim, 2007) and 0.92 for the English scale (Liu et al., 2018).

Processes of Change Scale. The processes of change scale developed by Nigg, Norman, Rossi, and Benisovich (1999), is a 30-items question, were revised into the Korean version. Similarly, the English version was used for the Malaysian sample. By using the 5-point Likert scale, students were asked to answer from "never (1)" to "repeatedly (5)". In this study, cognitive processes and behavioural processes were influenced by the second-order factors. The five components in cognitive processes are dramatic relief, consciousness-raising, environmental re-evaluation, self-re-evaluation, and social liberation, whereas five components in behavioural are counter conditioning, helping the relationship, self-liberation, reinforcement management, and stimulus control. The internal reliabilities of the Korean version were 0.84 for cognitive processes of change and 0.87 for behavioural processes of change (Kim, 2007), meanwhile, for the English scale, the internal reliability was 0.62 and 0.85 for the cognitive processes of change and behavioural processes of change respectively (Liu et al., 2018).

Godin Leisure-Time Exercise Questionnaire. The leisure-time exercise questionnaire (LTEQ), created by Godin and Shephard (1985), was revised into the Korean version, and the English version was used in Malaysian sample. It was used to assess habitual weekly physical activity behaviours. Participants reported how many times they participated, during a typical week, in strenuous (e.g., running, vigorous cycling), moderate (e.g., fast walking, easy swim-

ming), and mild (e.g., golf, yoga) for more than 15 minutes. Scores were determined by multiplying each recorded activity session by its metabolic equivalent (MET) value and adding the result [MET score = (strenuous × 9) + (moderate × 5) + (mild × 3)]. The Cronbach's reliability coefficient, two-week test-retest, for the Korean LTEQ scale was 0.88. (Kim, 2007) and 0.94 for the English scale (Liu et al., 2018).

Data Analyses

Testing the cross-cultural equivalence between the Korean and Malaysian measures of the TTM constructs is a prerequisite for the main investigation of the current study and it is significant to enhance the validity of findings from the current study. Data analysis was conducted using confirmatory factor analysis (CFA) with full-information maximum likelihood (FIML) estimation in Mplus version 8.3 (Muthén & Muthén, 1998-2017). There were no missing data in the dataset. Measurement and structural invariances across the countries was tested based on guidelines by Byrne et al (2009): (1) configural Invariance requires only that the primary loadings be on the same factor, (2) weak Factorial Invariance constrains model loadings to be proportional, (3) pattern Identity Invariance constrains factor loadings to be the same across models, and (4) strong Factorial Invariance constrains factor loadings, error variances, means, and standard deviations. From these analyses the TTM measures used in this study were cross-culturally invariant for Korean and Malaysian participants (x^2 (76) = 31.51, p = .14, CFI = .99, ΔRMSEA = .03 for self-efficacy, x^2 (72) = 107.77, p = .00, CFI = .93, ΔRMSEA = .05 for decisional balance, and x^2 (98) = 326.77, p = .00, CFI = .93, ΔRMSEA = .06)

Then, descriptive statistics (i.e., means, standard deviations, and frequencies) were used to summarize the characteristics of the participants. Crosstab analysis with chi-square (χ^2) was performed to examine gender and nationality distribution of physical activity. Independent t-test was used to classify significant mean differences in TTM constructs and physical activity by nationality. Multivariate analysis of variances (MANOVAs), and post hoc analyses (i.e., Tukey test), were conducted to identify differences in TTM constructs and physical activity across the physical activity stage. Furthermore, a multivariate ordinal logistic regression analysis was carried to predict the stage of physical activity. Finally, likelihood-ratio tests were employed to test the statistical significance of each predictor of the study.

Results

Physical activity distribution

The physical activity distribution stage for all participants was pre-contemplation (*n* = 21, 6.6%), contemplation (*n* = 96, 18.2%), preparation (*n* = 517, 42.8%), action (*n* = 167, 13.5%), and maintenance (*n* = 335, 18.9%). Overall, 67.6% of the participants recorded inactivity (pre-contemplation or contemplation) or exercise irregularly (preparation). Table I shows physical activity distribution stage as a function of nationality and gender. A significant difference in physical activity distribution between Korean and Malaysian university students has emerged (χ^2 = 7.03, *df* = 4, *p* < .05). There are significant differences in the distribution of physical activity between male and female

Table I
Stages Of Physical Activity Distribution By Gender And Nationality.

Variables	PC	CO	PR	AC	MA	Total
Nationality						
Korea	13(2.3)	44(7.7)	252(44.0)	93(16.2)	172(29.8)	574(100.0)
Malaysia	7(1.2)	53(9.4)	295(52.3)	74(13.2)	133(23.8)	562(100.0)
Gender						
Male	5(1.0)	19(4.0)	202(42.5)	87(18.4)	162(34.1)	475(100.0)
Female	16(3.2)	77(11.8)	315(47.5)	80(12.0)	173(26.0)	661(100.0)
Total	21(6.6)	96(18.2)	517(42.8)	167(13.5)	335(18.9)	1136(100.0)

Parentheses are percent. PC: pre-contemplation; CO: contemplation; PR: preparation; AC: action; MA: maintenance.

university students ($\chi^2 = 24.78$, $df = 4$, $p < .001$). Female university students were more likely to be in the contemplation stage, while males more likely to be in the action and maintenance stages.

DIFFERENCES IN THE TTM CONSTRUCTS AND PHYSICAL ACTIVITY BY NATIONALITY

Table II indicates the mean differences in the TTM constructs and physical activity by both countries. Korean university students showed higher exercise self-efficacy ($t = 4.80$, $p < .001$) and had more pros ($t = 10.29$, $p < .001$) and less cons ($t = -5.27$, $p < .001$), than their Malaysian counterparts. Moreover, Korean students much more engaged in physical activity than their Malaysian peers ($t = 6.48$, $p < .001$).

Table II
Mean Differences In The TTM Constructs And Physical Activity Between Korean And Malaysian University Students.

Variables	Korean M (SD)	Malaysian M (SD)	t	p-value
Self-efficacy	2.96 (.72)	2.71 (.58)	4.80	< .001
Pros	4.01 (.75)	3.81 (.71)	10.29	< .001
Cons	2.03 (.61)	2.27 (.82)	-5.27	< .001
Cognitive processes[a]	2.78 (.76)	2.82 (.79)	0.92	.12
Behavioural processes[b]	2.85 (.88)	2.69 (.83)	1.88	.08
Physical activity (METs)	42.06 (42.48)	27.38 (21.66)	6.48	< .001

[a] Mean of sum of consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation subscales; [b] Mean of sum of counter conditioning, helping relationships, reinforcement management, self-liberation, and stimulus control subscales.

Differences in the TTM constructs and physical activity by the
stage of physical activity

Table III shows the results with means, standard deviations, *F*-tests results
and post hoc Tukey comparison across the five stages of physical activity level
for the cognitive and behavioural processes of change, self-efficacy, pros, cons,
and physical activity. Except for cognitive processes, other TTM constructs
and physical activity differed significantly across the stages of physical activity
[$F(4,1132)$ = 37.29 for physical activity, 23.97 for self-efficacy, 21.65 for pros,
11.57 for behavioural processes, and 7.66 for cons (all $p < .001$). However, on
the basis of eta square (η^2) most variables were significantly correlated with
stages of physical activity; physical activity ($\eta^2 = .40$), followed by self-efficacy
($\eta^2 = .31$), pros ($\eta^2 = .27$), behavioral processes ($\eta^2 = .15$), and cons ($\eta^2 = .12$).

Table III
Mean Differences In The TTM And Physical Activity Levels By Stages.

| Variables | Stage of physical activity | | | | | $F(4,1132)$ | η^2 | Post hoc |
	PC	CO	PR	AC	MA			
	Self-efficacy (Lowest = 18, Highest = 90)							
Mean	43.12	47.95	49.01	53.40	53.43	23.97**	.31	PC<CO<PR<AC<MA
SD	12.67	12.32	10.52	9.34	12.20			
	Pros (Lowest = 5, Highest = 25)							
Mean	15.30	18.11	18.82	19.49	20.19	21.65**	.27	PC<CO<PR<AC<MA
SD	4.63	3.55	3.40	3.09	3.46			
	Cons (Lowest = 5, Highest = 25)							
Mean	14.06	12.70	11.31	10.94	10.71	7.66**	.12	PR, AC, MA<CO<PC
SD	4.31	3.81	3.69	3.84	3.88			
	[a]Cognitive processes (Lowest = 15, Highest = 75)							
Mean	55.83	56.14	55.29	54.86	54.71	.57	.03	
SD	11.08	8.98	9.00	8.37	9.39			
	[b]Behavioural processes (Lowest =15, Highest = 75)							
Mean	50.96	51.82	54.14	56.64	57.08	11.57**	.15	PC, CO<PR<AC<MA
SD	12.14	9.38	10.21	10.76	11.34			
	Physical activity (METs)							
Mean	16.39	29.36	40.13	51.22	52.94	37.29**	.40	PC<CO<PR<AC,MA
SD	17.68	30.14	22.92	23.24	25.09			

PC: pre-contemplation; CO: contemplation; PR: preparation; AC: action; MA: maintenance; [a] sum of dramatic relief, consciousness raising, environmental reevaluation, self-reevaluation, and social liberation subscales; [b] sum of counter conditioning, helping relationships.

MULTIVARIATE ORDINAL LOGISTIC REGRESSION ANALYSIS

The multivariate ordinal logistic regression model was statistically significant; likelihood ratio χ^2 [9,901] = 277.66, p < .001; Nagelkerke's R^2 = 0.36. As shown in Table IV, Korean college students have higher odds of being physically active than Malaysian counterparts (OR: 0.27; 95% CI: 0.09-0.41). In addition, males are significantly more likely to be in action and maintenance stages than their female peers (OR: 1.36, 95% CI: 0.87-2.89). In the TTM constructs, except cognitive processes, the rest of the TTM constructs are significant in explaining the physical activity stage; self-efficacy (OR: 0.63, 95% CI: 0.41-0.86), pros (OR: 0.42, CI: 0.23-0.61), behavioral processes (OR: 0.37, CI:0.07-0.58), cons (OR: 0.26, CI: 0.13-0.49).

Discussion

This study was the first cross-cultural study aiming at clarifying the TTM-based psychosocial variables at play among university students in Korea and Malaysia. In fact, physical activity as a key behaviour to preserve and improve individuals' health is not a prime priority for health psychologists, health practitioners, or government bureaucrats in either country. Along with such a socially undervalued background, the existing studies have primarily focused on limited physical activity and its associated psychological attributes.

The findings reported here have indicated that university students' physical inactivity in Korea and Malaysia could seriously affect their future health status. More than two-thirds of the university students in each country

Table IV
Multivariate Ordinal Regression Model For Predicting Stage Of Physical Activity.

Variables	OR	*p-value*	95% CI	Likelihood ratio test(χ^2)
Nationality (Korean = 0, Malaysian = 1)	0.27	<.05	0.09-0.41	9.03
Gender (Female = 0, male = 1)	1.36	<.001	0.87-2.89	23.21
Nationality X gender	0.09	0.12	0.04-0.14	4.75
Age	0.13	0.18	0.04-0.31	5,17
Physical activity (METs)	0.32	<.001	0.14-0.71	18.44
Self-efficacy	0.63	<.001	0.41-0.86	24.74
Pros	0.42	<.001	0.23-0.61	23.84
Cons	0.26	<.05	0.13-0.49	22,31
Cognitive processes	0.03	0.41	0.01-0.09	3.61
Behavioural processes	0.37	<.001	0.07-0.58	8.61

CI indicates confidence interval; OR= odds ratio.

reported that they did not exercise or engage in regular physical activity. It is possible that the university students' low levels of physical activity could be attributed to the lack of time available, as such students must often study excessively to earn high grades, and they may suffer from significant psychological stress owing to individual and family expectations to get a good job after graduation (Seo et al., 2009).

This study found that Korean university students are more regularly engaging in physical activity than their Malaysian counterparts. These results can be interpreted in terms of different educational policies and the physical environments of the universities in the two countries. Compared to Malaysia, many Korean universities provide a wide range of free exercise and health promotion programmes (e.g., workout, yoga, and cross fit) on campus for students. In addition, many universities have a variety of exercise and sports facilities (e.g., gyms, fitness centres, exercise studios, indoor golf ranges, and yoga studios) and provide to students at low cost or free of charge. However, such differences are not documented in the literature, and there is consequently a need for further study to determine whether differences in terms of physical activity may have resulted these differences in the Korean and Malaysian universities' respective physical environments and policies.

It has also been shown that there were significant differences in the physical activity stages between male and female university students. Regardless of nationality, male students were more regularly engaged in physical activity than their female counterparts. This finding is also supported by previous studies conducted on physical activity (Lian et al., 2016). The difference in physical activity by gender in this study can be understood from the social contexts. Although Korean and Malaysian societies have undergone radical change and westernisation, they tend to be considered conservative in certain sectors of society. Such conservative tendencies stem from the traditional Confucian and Muslim ideas that have been rooted in the national life of each country. For example, according to some Muslim views of the role of women, physical activity is seen as non-feminine and may also be associated with lower social status. Future interventions should therefore attend to the cultural attitudes among women regarding the importance and desirability of physical activity. Similarly, consideration should be given to providing culturally acceptable venues for women (especially Muslims) to engage in physical activity.

The findings reported here also showed that the self-efficacy and pros scores were lower during the pre-contemplation and contemplation stages compared to the action and maintenance stages. In contrast, cons scores were higher during the pre-contemplation and contemplation stages compared to the action and maintenance stages. This finding supports previous studies showing that self-efficacy and pros scores increase as people move

from an inactive to an active lifestyle. The current data on exercise self-efficacy can be explained by the fact that individuals with high levels of confidence who engage in physical activity, despite facing obstacles, can be seen as having high self-efficacy for exercise. They can be expected to be much more motivated for exercise and participate in more physical activity than people with low self-efficacy. This explanation is consistent with Bandura's (1997) hypothesis that an individual's degree of confidence to participate in a particular activity is substantially linked to their actual behaviour.

The present study also indicated that the use of behavioural processes increased with progression through each stage. This finding is supported by previous studies on stages of change for physical activity showing that the behavioural processes of change were found to be a significant variable (Hwang & Kim, 2011; Romain, Horwath, & Bernard, 2018). With regard to the importance of behavioural processes in determining physical activity, it is possible to suggest that the use of individual behavioural strategies increases continuously from the pre-contemplation to maintenance stages, and that those behavioural strategies of 'helping relationships' and 'counter-conditioning' are the key predictors of the physical activity stages (Kim & Cardinal, 2009). These findings demonstrate that behavioural strategies are important in the adoption and maintenance of physical activity, and that as people become more active, they appear to have more meaningful relationships with others who encourage them to consistently maintain their exercise habits, thereby making it easier for them to abondon sedentary behaviours in favour of physical activity.

It might be plausible to introduce the significance of a country's nationality as accounting for physical activity levels, reflecting the influence of group-specific cultural or socioeconomic profiles. For example, regular physical activity cannot be a central goal for a specific society (e.g., Malaysia) because of established cultural norms and prevalent societal acceptability. Therefore, lower levels of physical activity might possibly be due to cultural norms (e.g., the lack of encouragement for physical activity from parents and friends, or traditionally unfavourable perceptions of leisure-time physical activity) or the socioeconomic status of a particular society and the subsequent consequences (e.g., unsafe neighbourhoods, poor maintenance of exercise facilities, and lack of physical activity resources) (Suminski & Petosa, 2002). However, there is a need for further study to determine whether these lower levels actually are a result of these socio-cultural aspects because this is not consistent with the diverse evaluations of engaging in physical activity found in a typical society. Furthermore, the present findings have revealed that female university students have less self-efficacy and social support for engaging in physical activity than their male counterparts. Thus,

concerning the significance influence of gender on physical activity, it might be possible to interpret these levels in terms of the psychosocial viewpoint.

Individual beliefs, values, and confidence are elusive and intangible elements shaped within a particular culture, and culture exerts a strong and lasting impact on one's lifestyle, including physical activity and its related factors. Therefore, the psychosocial correlates of physical activity are best understood within a socio-cultural context in the present study. According to such points of view, it has been concluded that TTM constructs relate significantly to the various stages of physical activity. Given the strong involvement of the TTM constructs in explaining physical activity (Kim, 2007), it is not surprising that TTM constructs play a significant role as antecedents in shifting physical activity. This result can, therefore, reinforce the argument for considering TTM constructs in the design and development of physical activity and health promotion programmes.

There are several limitations that should be addressed in future work. First, this study gathered data from just two universities: one each in Seoul and Kelantan. Therefore, the data obtained from each university's students cannot be considered indicative of the eligible population of all Korean and Malaysian university students. Furthermore, this was a cross-sectional comparison study, and so caution should be exercised when making causal inferences. Longitudinal studies are also needed to determine the impact of multiple variables on physical activity over time. A possible methodological weakness in the survey research could involve the questionable validity of the measures adopted in other countries. However, the validity of the measurements used in this study was demonstrated by the similarity between the behavioural and psychological findings presented here and those obtained with the same measurements in other studies. The measures applied in the present study have gone through a rigorous and systematic process of translation and validation. However, they relied on self-report data, which may result in some bias or prejudice from item interpretation, recall, and social desirability of the items.

In conclusion, this study was the first cross-cultural study aiming at determining the levels of physical activity and the related influential psychosocial variables based on TTM among Korean and Malaysian university students. The current findings provide fundamental knowledge to develop generic physical activity intervention programmes that meet the needs of a culturally diverse population.

REFERENCES

Bandura, A. (1997). *Self-efficacy: the exercise and control*. W.H. Freeman, New York.
Banville, D., Desrosiers, P., & Genet-Volet, Y. (2000). Translating questionnaires and inventories using a cross-cultural translation technique. *Journal of Teaching in Physical Education*, 19, 374-387.

Benitez, T. J., Tasevska, N., Indiana, K. C., & Keller, C. (2017). Cultural relevance of the transtheoretical model in activity promotion: Mexican-American women's use of the process of change. *Journal of Health Disparities Research and Practice*, 10, 20-27.

Betancourt, H., & Lopez, S. R. (1993). The study of culture, ethnicity, and race in American Psychology. *American Psychologist*, 48, 629-637.

Byrne, B.M., Oakland T., Leong, F.T.L., de Vijver, F.J.R., Hambleton, R.K., & Cheung, F.M. (2009). A Critical Analysis of Cross-Cultural Research and Testing Practices: Implications for Improved Education and Training in Psychology. *Training and Education in Professional Psychology, 3*, 94-105.

Cardinal, B. J., Tuominen, K. J., & Rintala, P. (2004). Cross-cultural comparison of American and Finnish college students' exercise behavior using transtheoretical model constructs. *Research Quarterly for Exercise and Sport*, 75, 92-101. doi:10.1080/02701367.2004.10609137

Chiang, L. M., Zhang, P., Casebolt, K., & Chiang, J. (2013). A comparison of college students' physical activity levels between Taiwan and the United States. *Asian Journal of Exercise & Sports Science*, 10, 49-59.

Duda, J. L., & Allison, M. T. (1990). Cross-cultural analysis in exercise and sport psychology: A void in the field. *Journal of Sport and Exercise Psychology*, 12, 114-131. doi:10.1123/jsep.12.2.114

Elezim, A., Elezi, G., Gontarev, S., & Georgiev, G. (2019). Application of the transtheoretical model (TTM) to exercise behavior among Macedonian college students. *Journal of Human Sport and Exercise*, 15, 1-12. doi:10.14198/jhse.2020.153.19

Fleury, J., & Lee, S. M. (2006). The social ecological model and physical activity in African American women. *American Journal of Community Psychology*, 37, 129–140. doi:10.1007/s10464-005-9002-7

Glanz, K., Lewis, F. M., & Rimer, B. K. (1997). *Health behavior and health education: theory, research, and practice*. Jossey-Bass: San Francisco.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Sciences*, 10, 141–146.

Hajar, M. S., Rizal, H., & Kuan, G. (2019). Effects of physical activity on sustained attention: a systematic review. *Scientia Medica*, 19, e32864. doi:10.15448/1980-6108.2019.2.32864

Han, H., Gabriel, P. K., & Kohl, H. W. (2017). Application of the transtheoretical model to sedentary behaviors and its association with physical activity status. *PLoS ONE,* 12, e0176330. doi:10.1371/journal.pone.0176330

Hidrus, A., Kueh, Y. C., Norsaadah, B., Chang, Y. K., Hung, T. M., Naing, N. N., & Kuan, G. (2020). Effects of brain-breaks videos on the motives for the physical activity of Malaysian with type-2 diabetes mellitus. *International Journal of Environmental Research and Public Health*, 17, 2507. doi:10.3390/ijerph17072507

Hwang, J., & Kim, Y. H. (2011). Adolescents' physical activity and its related cognitive and behavioral processes. *Biology of Sport*, 28, 19-22.

Kang, S. J., & Kim, Y. H. (2017). Application of the transtheoretical model to identify predictors of physical activity transition in university students. *Journal of Sport Psychology*, 26, 6-11.

Kim, Y. H. (2007). Application of the transtheoretical model to identify psychological constructs influencing exercise behavior: a questionnaire survey. *International Journal of Nursing Studies*, 44, 934-944. doi:10.1016/j.ijnurstu.2006.03.008

Kim, Y. H., & Cardinal, B. J. (2009). Effects of a transtheoretical model-based stage-matched intervention to promote physical activity among Korean adults. *International Journal of Clinical and Health Psychology*, 9, 259-273.

Kim, Y. H., & Kang, S. J. (2020). Effects of a weight control intervention based on the transtheoretical model on physical activity and psychological variables in middle-aged obese women, *Journal of Women & Aging*, doi:10.1080/08952841.2020.1728183

Kirk, A., MacMillan, F., & Webster, N. (2010). Application of the transtheoretical model to physical activity in older adults with Type 2 diabetes and/or cardiovascular disease. *Psychology of Sport and Exercise*, 11, 320-324. doi:10.1016/j.psuchsport.2010.03.001

Kuan, G., Sabo, A., Sawang, S., & Kueh, Y. C. (2020). Factorial validity, measurement and structure invariance of the Malay language decisional balance scale in exercise across gender. *PLoS ONE*, 15, e0230644, doi:10.1371/journal.pone.0230644

Kueh, Y. C., Kuan, G., & Morris, T. (2019). The physical activity and leisure motivation scale: a confirmatory study of the Malay language version. *International Journal of Sport and Exercise Psychology*, 17, 250-265. doi:10.1080/1612197X.2017.1321029

Lian, T. C., Bonn, G., Han, Y. S., Choo, Y. C., & Piau, W. C. (2016). Physical activity and its correlates among adults in Malaysia: A cross-sectional descriptive study. *PLoS ONE*, 11, e0157730. doi:10.1371/journal.pone.0157730

Liu, K. T., Kueh, Y. C., Arifin, W. N., Kim, Y. H., & Kuan, G. (2018). Application of transtheoretical model on behavioral changes, and amount of physical activity among university's students. *Frontiers in Psychology*, 9, 1-8. doi:10.3389/fpsyg.2018.02402

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stage of exercise behavior change. *Research Quarterly foe Exercise and Sport*, 63, 60–66. doi:10.1080/02701367.1992.10607557

McGlumphy, K. C., Gill, A. K., & Hasson, R. E. (2019). Application of the transtheoretical model to physical activity and exercise behaviors in African-American adolescents. *American Journal of Health Behavior*, 43, 119-132. doi:10.5993/AJHB.43.1.10

Ministry of Culture, Sports, and Tourism. (2018). *National survey on physical activity participation*. Ministry of Health and Welfare, Seoul, Korea.

Ministry of Health and Welfare. (2018). *National survey on health and nutrition*. Ministry of Health and Welfare in Korea, Seoul, Korea.

Muthén, L. K, & Muthén, B. O. (1998-2017). *Mplus user's guide.* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Nigg, C., Harmon, B., Jiang, Y., Ginis, K. A. M., Motl, R. W., & Dishman, R. (2019). Temporal sequencing of physical activity change constructs within the transtheoretical model. *Psychology of Sport and Exerc*, 45, 1-7. doi:10.1016/j.psychsport.2019.101557

Nigg, C. R., Norman, G. J., Rossi, J. S., & Benisovich, S. V. (1999). *Processes of exercise behavior change: Redeveloping the scale*. Poster presented at SBM. San Diego, CA.

Plotnikoff, R. C., Blanchard, C., Hotz, S. B., & Rhodes, R. (2001). Validation of the decisional balance scales in the exercise domain from the transtheoretical model: a longitudinal test. *Measurement in Physical Education and Exercise Science*, 5, 191–206. doi:10.1207/S15327841MPEE0504_01

Prochaska, J. O., & DiClemente, C. C. (1983). Stage and processes of self-change of smoking: Toward and integrative model. *Journal of Consulting and Clinical Psychology*, 51, 390-395.

Rizal, H., Hajar, M. S., Kueh, Y. C., Muhamad, A. S., & Kuan, G. (2019). Confirmatory factor analysis of the Malay-language transtheoretical model of physical activity among Malaysian primary school children. *Malaysian Journal of Medical Sciences*, 26, 99-112. doi: 10.21315/mjms2019.26.2.11

Romain, A. J., Horwath, C., & Bernard, P. (2018). Prediction of physical activity level using processes of change from the transtheoretical model: experiential, behavioral, or an interaction effect? *American Journal of Health Promotion*, 32, 16-23. doi:10.1177/0890117116686900

Rovniak, L. S., Anderson, E. S., Winett, R. A., & Stephens, R. S. (2002). Social cognitive determinants of physical activity in young adults: a prospective structural equation analysis. *Annals of Behavioral Medicine*, 24, 149-156. doi:10.1207/S15324796ABM2402_12

Seo, D. C., Torabi, M. R., Jiang, N., Fernandez-Rojas, X., & Park, B. H. (2009). Correlates of college students' physical activity: cross-cultural differences. *Asia Pacific Journal of Public Health*, 21, 421-432. doi:10.1177/1010539509344112

Suminski, R. R., & Petosa, R. (2002). Stages of change among ethnically diverse college students. *Journal of American College Health*, 51, 26-31. doi:10.1080/07448480209596324

U.S. Center for Disease Control and Prevention. (2017). Youth risk behavior surveillance, United States, 2015. *Mortality and Morbidity Weekly Report*, 58, 1-95.

Vierling, K. K., Standage, M., & Treasure, D. C. (2007). Predicting attitudes and physical activity in an at-risk minority youth sample: a test of self-determination theory. *Psychology of Sport and Exercise*, 8, 795–817. doi:10.1016/j.psychsport.2006.12.006

Wengreen, H. J., & Moncur, C. (2009). Change in diet, physical activity, and body weight among young-adults during the transition from high school to college. *Nutrition Journal*, 8, 32-38. doi:10.1186/1475-2891-8-32

World Health Organization. (2017). *Prevalence of insufficient physical activity*. Retrieved from http://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/

Yi, K. O. (1996). The analysis of energy consumption based on survey of female college students on their physical activities and leisure. *Korean Journal of Physical Education*, 35, 89-99.

Yusoff, N. A. M., Ganeson, S., Ismail, K. F., Juahir, H., Shahril, M. R., Lin, L. P., Ahmad, A., Wafa, S. W., Harith, S., & Rajikan, R. (2018). Physical activity level among undergraduate students in Terengganu, Malaysia using pedometer. *Journal of Applied and Fundamental Sciences*, 10, 512-522. doi:10.4314/jfas.v10i1s.36