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(Original article)

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Abstract

This study examined the psychometric properties of the 8-item Physical Activity Enjoyment Scale (PACES) in Hong Kong older adults. Study 1 assessed the scale’s factor validity and test–retest reliability, whereas Study 2 examined its convergent validity in Hong Kong older adults.

A total of 168 (Study 1) older adults completed the PACES twice over a 2-week interval, and 57 (Study 2) older adults completed both the 8-item PACES and a measure of quality of life. The results of both studies showed that the 8-item PACES had a high degree of internal consistency. Both the composite reliability and average variance extracted of Study 1 were high, suggesting that as a set, the 8 items of the PACES reliably measured the construct. The observed test–retest reliability was satisfactory over a 2-week interval. This 8-item PACES is an expedited and reliable instrument for assessing physical activity enjoyment in Chinese older adults.

Keywords: Enjoyment, older adults, measurement

Introduction

As revealed by Hong Kong’s latest population projection (Census and Statistics Department, HKSAR, 2012), the number of people aged 65 years or above will increase to 2.16 million and 2.56 million by 2031 and 2041, respectively, in Hong Kong. Specifically, by 2041, approximately one-third of Hong Kong residents will be 65 years or above. To address the challenges of this aging population (e.g., increased health care costs), the Hong Kong government has created new incentives for social development by promoting active aging (Steering Committee on Population Policy, HKSAR, 2014). However, older adults in Hong Kong were identified as inactive (Community Sports Committee, 2012). In 2012, the Community Sports Committee of the Sports Commission of Hong Kong conducted a territory-wide physical fitness test of Hong Kong people. Less than 30% of adults (aged 40–59 years) and older adults (aged 60–69 years) performed sufficient physical activity (PA) and nearly half of adults were identified as being sedentary (Sports Commission of Hong Kong SAR Government, 2012). Physical inactivity results in premature aging, obesity, cardiovascular vulnerability, musculoskeletal fragility, and depression (Kesaniemi, Danforth, Jensen, Lefebvre, & Reeder, 2001)

Developing PA interventions among this population is essential for promoting active aging. Regardless of the content of the PA intervention, the health benefits of PA can only be sustained by long-term adherence to PA (DiMatteo, Giordani, Lepper, & Croghan, 2002). The average proportion of older adults completing exercise programs or interventions is 65%–85% (Picorelli, Pereira, Pereira, Felício, & Sherrington, 2014), but adherence to these programs can decrease over time (Findorff, Wyman, & Gross, 2009). Of the factors affecting adherence to PA intervention or exercise programs, perceived PA enjoyment (Trost, Owen, Bauman, Sallis, & Brown, 2002) has been the focus of research (Allen & Morey, 2010). An increased level of PA enjoyment was reported to be linked with higher adherence to PA participation in older adults (Jekauc, 2015). Hagberg, Lindahl, Nyberg, and Hellénius (2009) demonstrated that greater PA enjoyment was associated with a high level of PA. Therefore, accurately measuring PA enjoyment is vital for evaluating the long-term effectiveness of health care-based PA interventions. All these factors are crucial in promoting active aging and reducing health care costs to the Hong Kong government.

The Physical Activity Enjoyment Scale (PACES) was first developed by Kendzierski and DeCarlo (1991), who examined the validity and reliability of their original 18-item 7-point bipolar PACES with college students. They determined that the scale exhibited high internal consistency and moderate-to-high test–retest reliability. Its validity was supported by its significant correlation with the Boredom Proneness Scale score ($r = -.30$). The Chinese version has been identified as valid and reliable for use in children (Liang, Lau, Huang, Maddison, & Baranowski, 2014) and university students (Zhou, Keating, Zhou, Shanguan, & Liu, 2015).

Some modifications have been made to the PACES. For example, because the content of one of the items was irrelevant to enjoyment (i.e., I am very absorbed in this activity) and one was redundant when other items were used (i.e., It’s very invigorating), researchers have used a 16-item PACES with younger girls (Motl et al., 2001), children with asthma (Roman, Pinillos, Martiniez, & Rus, 2014), German children and adolescents (Jekauc, Voelkle, Wagner, Mewes, & Woll, 2013), and Italian adolescents (Carraro, Young, & Robazza, 2008).

Factor analysis of the PACES identified the scale to be multidimensional (Crocker, Bouffard, & Gessaroli, 1995). In addition to identifying enjoyment with PA, the PACES identifies the antecedents and consequences of this enjoyment. Raedeke (2007) thus shortened the PACES to eight items in accordance with content analyses from experts in exercise psychology and measurement. These eight items reflect a generalized state of enjoying an activity and the experience itself. The shortened version of the PACES has been used with college students (McArthur & Raedeke, 2009; Raedeke, 2007), but its psychometric properties have yet to be investigated.

The PACES was not used with older adults until 2011, when Mullen and colleagues (2011) validated an eight-item PACES for a sample of older adults. A novel eight-item PACES was developed, and the results of confirmatory factor analysis (CFA) supported its unidimensional factor structure. Further evidence of the validity of the PACES was demonstrated by its significant and positive correlation with social support as well as with a specific group (i.e., exercise conditions) and longitudinal measurement invariance analysis. However, this short eight-item PACES (Raedeke, 2007) has not been used with Chinese older adults, and its reliability and validity are yet to be investigated.

Subsequently, even though one study examined the reliability and validity of the PACES among older adults in China (Xiong et al., 2013), the results could have been enhanced through an analysis of their validity by using CFA. Xiong et al. (2013) suggested that the Chinese version of the PACES achieved acceptable reliability (test–retest reliability = .522; Cronbach's alpha = .879) and validity in older adults. However, its construct validity was only examined through exploratory factor analysis (EFA). The difference between EFA and CFA is that CFA involves observed variables (items) in which measurement error is considered, in addition to involving analyses based on a theory or EFA results (Nunnally & Bernstein, 1994). Furthermore, CFA can be used to confirm the factor structure extracted through EFA (Nunnally & Bernstein, 1994). Therefore, this paper discusses the validity and reliability of the eight-item PACES in Hong Kong older adults by reporting the results of two distinct studies. Study 1 assessed (a) the factor validity of the eight-item PACES and (b) its test–retest reliability. Study 2 examined the convergent validity of the eight-item PACES, correlating with the quality of life in a sample of Hong Kong older adults.

Because the Chinese version of the eight-item PACES has not been used in Hong Kong, this study can considerably enhance our knowledge about PA enjoyment among Hong Kong older adults.

Methods

Participants

Study 1. A convenience sample of 168 older adults from two community centers for older adults participated in this study. The older adults were surveyed between October 2015 and December 2015. This sample size satisfied Bentler's recommendations (1993) that a ratio of sample size to estimated parameters of at least 10:1 is adequate for structural equation modeling, and the sample-size-to-item ratio in this study was also adequate for factor analysis (Costello & Osborne, 2005). Most respondents were women (81%) and retired (82.5%). Approximately 60% (56%) of the respondents were aged 74 years or younger and had attained no or only primary education (62.3%); 48.8% owned an apartment.

Study 2. A convenience sample of 57 older adults from a center for older adults in Hong Kong participated in Study 2. Similar to Study 1, most of the respondents were women (81%), retired (75.9%), and had attained no or primary education (64.9%). Their average age was 72.93 years (SD = 7.57), ranging from 60 to 91 years (See Table 1 for the participants' sociodemographic characteristics for Studies 1 and 2).

Data were managed using SPSS (version 24). In Study 1, no outliers (with standard score ± 4.0) were identified. All items' skewness and kurtosis and their variance inflation factors were less than 4 (−.63–1.14) and 10 (1.38–4.89), respectively, indicating that the data distribution was univariate normal and that no multicollinearity was identified. However, in Study 2, three participants were excluded because they did not complete the questionnaire about quality of life. Again, univariate outliers, normality, and multivariate collinearity were verified. After data management, 168 and 57 cases in Studies 1 and 2, respectively, were subjected to further data analysis.

Measurements

PACES. The short version of the PACES (Raedeke, 2007) was used to measure PA enjoyment among older adults. The scale was originally developed by Kendzierski and DeCarlo (1991) and comprised 18 bipolar items rated on a 7-point scale. Kendzierski and DeCarlo demonstrated that this version of the PACES had high internal consistency, moderate-to-high test–retest reliability, and satisfactory convergent validity. Its Chinese version has been determined to be valid and reliable for children (Liang et al., 2014) and university students (Zhou et al., 2015). In this study, only the shorter eight-item PACES version was used, identifying only the generalized state of activity and experience enjoyment. The seven bipolar rating items included "I find it pleasurable" (one extreme) to "I find it unpleasurable" (the other extreme). Negative items (i.e., 1, 4, 5, and 7) were reverse coded. Higher PACES scores indicated greater levels of PA enjoyment.

Quality of life. Quality of life was measured using the Chinese version of the Medical Outcomes Survey 36-Item Short Form Health Survey (SF-36) (Ware & Sherbourne, 1992). The reliability and validity of the SF-36 questionnaire have been evaluated in different populations globally, including China (Zhang, Qu, Lun, Guo, & Liu, 2012). This measurement comprises eight domains: physical functioning, physical role, bodily pain, general health, vitality, social functioning, emotional role, and mental health. In the present study, only physical functioning and social functioning were included, because they are associated with PA enjoyment. Physical functioning refers to the presence of limitations associated with physical capability, whereas social functioning refers to psychological well-being. Examples of the items include asking participants if they encountered any restrictions or limitations while performing moderate PA, such as moving a table, using a vacuum cleaner, bowling, playing golf, and walking (physical capability), and how much of the time their physical health or emotional problems had interfered with social activities over the preceding 4 weeks (social functioning). PA enjoyment has been determined to be positively associated with quality of life in physical and social dimensions (Mullen et al., 2011; Rejeski & Mihalko, 2001). A higher score indicated better physical or social functioning.

Procedures

In Study 1, data were collected at each center through face-to-face interviewing by trained interviewers. Consent was provided by the centers prior to the site visits, and we subsequently scheduled the data collection dates. At each site visit, a study material pack describing the purpose and details of the study was provided or explained to the potential participants. With their consent, they were asked to complete the short version of the PACES with the trained interviewers’ help, who included a research assistant and trained student helpers. The research assistant held a master’s degree in Sport Medicine and Health Science. All student helpers underwent training in the testing and training procedures before implementation. After a 2-week interval, all participants were asked to return to the centers and recompleted the questionnaire set.

The student helpers required 5 min to explain the study’s purpose, and the participants completed the questionnaires in approximately 5 min. Similar procedures were used in Study 2, except that participants were asked to complete both the short version of the PACES and SF-36.

All participants provided written consent and declared that they understood the confidentiality agreement of the study and that they could leave the project before data collection.

Permission was granted by the institutional review board for research with human subjects of the university.

Data analysis. Data were analyzed using LISREL 9.3 (Jöreskog & Sörbom, 1993) and SPSS (Version 24.0) at a significance level of .05. First, the factor validity of the eight-item PACES was measured through CFA with maximum-likelihood estimation; therefore, it assessed if the data fitted this single-factor model of the PACES. Multiple indices were used to assess the model fit, namely relative chi-square (chi-square/df), root-mean-square error of approximation (RMSEA), standardized root mean residual (SRMR), non-normed fit index (NNFI), and comparative fit index (CFI). In general, NNFI and CFI values above 0.90 indicate a good fit to the data. SRMR and RMSEA values less than .80 indicate a reasonable fit (Hu & Bentler, 1999). A relative chi-square value ranging from 2 to 5 is considered acceptable (Tabachnick & Fidell, 1989). After the factorial validity was examined, measurement invariance was assessed between men and women.

Second, an intra-class correlation coefficient was used to assess the PACES test–retest reliability. Internal consistency was measured using Cronbach alpha coefficients, composite reliability (CR), and average variance extracted (AVE). Third, the convergent validity of the PACES was measured by examining the correlations between the PACES and the physical and social functioning of older adults measured using SF-36. Correlation coefficients in the range of .5–.75 are considered to indicate a moderate to good relationship (Field, 2009).

Results

Factorial Validity

Before CFA was performed, common factor analysis with a varimax (orthogonal rotation) was conducted to identify the underlying structure of each measurement. The EFA results confirmed the one-factor structure of the PACES, explaining 67.72% of variance. All items’ factor loadings ranged from .53 to .89, which are over .40 recommended by Costello and Osborne (2005).

Table 2 presents the fit indices for the models (PACES), and Table 3 presents the standardized factor loadings (SFLs), standardized error, squared multiple correlation (R^2), and composite reliability (CR) for the eight-item PACES. The CFA results showed that the initial model (Model 1) of the eight-item PACES indicated room for modification (χ^2 (20) = 100.11, $p <$ .001; CFI = .918; NNFI = .885; RMSEA = .153 [90% CI = .124 to .183]). The large standardized residual between items 4 and 7 meant that these two items were correlated. After correlating the standardized residual of these two items, the modified model (Model 2) was improved with a better model fit (χ^2 (19) = 81.352, $p <$ .001; CFI = .936; NNFI = .906; RMSEA = .138 [90% CI = .108 to .170]). The RMSEA value remained above .9. Again, with reference to the large standardized residual between items 3 and 6 (Model 3), items 4 and 5 (Model 4), and items 5 and 7 (final Model), these items were associated sequentially in terms of their error terms. The final model satisfactorily fitted the data (χ^2 (16) = 24.276, $p >$ .001; CFI = .981; NNFI = .967; RMSEA = .082 [90% CI = .043 to .119]). All SFLs were high (i.e., over .50; ranging from .69 to.88), except that of item 8 (i.e., .41), considered an indicator of a reliable item measuring PA enjoyment. The SFL of item 8 was lower, but the inclusion of this item did not negatively affect the fit indices of the model. The CFA results supported the one-factor structure of the eight-item PACES.

We subsequently measured the measurement invariance of this eight-item PACES among women and men. Table 4 presents the result of measurement invariance for the PACES. Before invariance analysis, a one-factor baseline model was acceptable in both men (χ^2 (20) = 23.40, $p <$ .001; CFI = .985) and women (χ^2 (20) = 97.47, $p >$ .05; CFI = .904). First, the *configural model* (i.e., the unconstrained model) imposing no constraint to the model was found to satisfactorily fit the data in both men and women (χ^2 (40) = 120.173, $p < .001$; CFI = .953). Second, the *matric invariance* observed when imposing the same factor loadings across men and women also provided good fit indices to the data (χ^2 (47) = 130.741, $p < .001$; CFI = .951). Because this level of invariance was nested within Model 1, a chi-square difference test was conducted to compare models to determine which more satisfactorily fitted the data (χ^2 difference = 10.568, $df = 7$). The result was not significant. No change in the CFI between Models 1 and 2 was observed, which confirmed that the factor loadings were invariant across men and women. Third, the model was tested by constraining the intercepts of the items to be the same across men and women *(Scalar invariance)*. The result revealed that this constrained model was satisfactory (χ^2 (53) = 137.450, $p < .001$; CFI = .951). Again, combining the nonsignificant chi-square difference test and the no change in the CFI suggested that, other than the factor loadings, the intercepts of each item were invariant among groups. Finally, error variances were constrained to be equal in the model among groups *(Error variance invariance)*. Although the model fitted the data satisfactorily, the chi-square difference test comparing Models 3 and 4 was significant. The CFI decreased by .036, indicating that the level of measurement error was not invariant for the items between men and women. Jan-Benedict and Baumgartner (1988) suggested that the invariance of factor patterns (configural invariance) and factor loadings (metric invariance) is sufficient to determine whether the measurement should be valid for making inferences among groups. Therefore, a satisfactory level of factorial invariance was observed for the CFA model of the PACES across men and women.

Reliability

The intraclass correlation coefficient of the eight-item PACES was 0.614, indicating that the scale was moderately stable in the 2-week interval. The Cronbach alpha values were .921 and

.908 before and after the 2-week interval, respectively, showing high internal consistency for the items in the PACES. Additionally, the composite reliability (i.e., .91) indicated that the PACES had satisfactory construct reliability over the recommended value of .7 (Fornell & Larcker, 1981). The eight items in the PACES represented a construct, PA enjoyment in older adults. The SFLs of the items ranged from .41 to .88, denoting acceptable reliability for the indicators concerned.

Convergent Validity

The bivariate association between PA enjoyment and quality of life (i.e., physical functioning and social functioning) was examined, and the correlation coefficients revealed that the PACES was significantly and positively associated with physical functioning (r = .43, p < .01) and social functioning (r = .43, p < .01). Participants who reported having more enjoyment, as measured using the PACES, were associated with a higher quality of life (i.e., physical functioning and social functioning). In this convergent validity analysis, the results of the correlation demonstrated that the PACES was moderately correlated with quality of life in older adults.

Discussion

The aim of this study was to assess (a) the factorial validity of the eight-item PACES; (b) the test–retest reliability of the eight-item PACES (Study 1); and (c) the convergent validity of the eight-item PACES, correlating with the quality of life (Study 2) in a sample of Hong Kong older adults. The results of both Study 1 and Study 2 reveal a high degree of internal consistency in the eight-item PACES in older adults. Both the composite reliability and AVE of Study 1 were high, suggesting that—as a set—the eight items of the PA enjoyment scale provided reliable measurements of the construct. Therefore, the substantial variance in the indicators was captured by the studied construct instead of the measurement error. Additionally, the observed test–retest reliability was satisfactory over a 2-week interval.

Regarding factorial validity, the one-factor eight-item PACES was supported as a valid measurement of PA enjoyment in older adults. The measurement invariance analysis result provides additional support that this eight-item PACES was factor invariant across the sexes in older adults. This result supports Raedeke's (2007) suggestion that the original 18-item PACES was not unidimensional. Rather than identifying both enjoyment of PA and the potential consequences and antecedents of enjoyment as executed in the original 18-item PACES, this eight-item PACES identified only a generalized state of PA enjoyment. Although our shortened eight-item PACES version is different from the shortened eight-item PACES version developed by Mullen and colleagues (2011), both shortened PACES versions were observed to yield a stronger one-factor model of PA enjoyment in older adults, compared with the original 18-item PACES.

Concerning reliability, similar to other studies (Jekua et al., 2013; Kendzierski & Carlo, 1991; Roman et al., 2014), the internal consistency of this eight-item PACES was determined to be very high (above .9). However, compared with the test–retest reliability of the PACES in other studies (approximately .7–.8) (Jekua et al., 2013; Liang et al., 2014; Roman et al., 2014), the test–retest reliability of the eight-item PACES in the current study was determined to be lower (less than .7). The difference in population is a possible explanation. No other studies have been conducted on older adults. Mullen and colleagues (2011) examined the psychometric properties of the shortened version of the PACES in older adults, but this was limited to validity and measurement invariance. Another possible explanation is the variation in environments when completing the questionnaires. In Study 1, one of the participating centers for older adults underwent minor construction work. The noise and distraction may have affected measurement stability.

In terms of convergent validity, as expected, this eight-item PACES was positively correlated with quality of life in the aspects of physical and social functioning. Another study reported similar findings (Mullen et al., 2011). An increase in the score of the shortened version of the PACES was associated with an increase in positive physical and functional changes.

Although the eight-item PACES was found to have acceptable psychometric properties in this study, some limitations were observed. First, most of the participants in Studies 1 and 2 were women (more than 80%). Older adults with different demographic variables (e.g., men or those with a higher education degree) may have different interpretations of PA enjoyment. The unequal sex distribution was probably the reason why scalar invariance and error variance invariance were not satisfied. Second, this was a cross-sectional study; therefore, it remains uncertain whether the changes in PACES scores were caused by the unstable properties of the measure.

In summary, the assessment of the psychometric properties of the PACES revealed acceptable evidence of validity and reliability for PA enjoyment in older adults. Although one item's SFL was comparatively low (item 8), overall, the assessment of the measurement model of the eight-item PACES revealed no critical deficiencies. Such a measurement model may be used for future longitudinal studies and intervention evaluations, as well as to determine how PA enjoyment can alter exercise adherence among older adults. A shorter version of the PACES is required to lower the burden for older adults during data collection. This study filled this research gap by examining the shorter eight-item PACES version for this age group (Motl et al., 2001).

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Table 1: Participant's Socio-demographic Characteristics.

	Study 1 (N = 168)	Study 2 (N = 57)
	%	%
Age (in years)		
65-59	39.9	26.5
70-74	16.1	24.5
75-79	22.0	20.4
80-84	11.9	22.4
≥ 85	10.1	6.1
Gender		
Male	19	19
Female	81	81
Education level		
No education	16.8	19.3
Primary school education	45.5	45.6
Secondary school education	28.7	29.8
Tertiary education or above	9..0	5.3
Housing types		
Bought	48.8	41.8
rented	51.2	58.2
Occupation		
Housewife	16.9	22.4
Retired	82.5	75.9
Part-time job	.6	1.7

Table 2: Fit Indices for the Models (PACES).

Model	χ^2	*df*	*p*	χ^2/df	RMSEA (90%CI)	CFI	NNFI	SRMR
Model 1	100.107	20	.0005	5.005	.153 (.124 - .183)	.9418	.885	.043
Model 2	81.352	19	.0005	4.282	.138 (.108 - .170)	.938	.606	.040
Model 3	57.032	18	.0005	3.168	.112 (.080 - .146)	.960	.938	.034
Model 4	41.498	17	.0005	2.441	.092 (.057 - .127)	.975	.959	.028
Final Model	34.276	16	.0005	2.142	.082 (.043 - .119)	.981	.967	.023

Note: RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; CFI = Comparative Fit Index; NNFI = Non-Normed Fit Index; SRMR =Standardized Root Mean Residual

Table 3: Completely Standardized Factor Loadings (SFL), Standardized Error, Squared Multiple Correlation (R^2), Composite Reliability (CR), and Average Variance Extracted (AVE).

	Items	SFL	Theta	R^2	CR/AVE
					.91/.76
1	I enjoy it.	.88	.23	.78	
2	I feel bored.	.85	.27	.73	
3	I dislike it.	.87	.25	.75	
4	I find it pleasurable.	.79	.37	.63	
5	I am very absorbed in this activity.	.70	.51	.49	
6	It's no fun at all.	.79	.37	.63	
7	It's very pleasant.	.69	.53	.47	
8	I feel as though I would rather be doing something else.	.41	.83	.17	

Table 4: Testing for Measurement Invariance across Males and Females.

Model	χ^2	*df*	*p*	Model comparison	$\Delta\chi^2$	Δdf	CFI	ΔCFI
Males	23.396	20	.270				.985	
Females	97.469	20	.001				.904	
1.	120.173	40	.001				.953	
2.	130.741	47	.001	Model 1 – Model 2	10.568	7	.951	< .01
3.	137.450	53	.001	Model 2 – Model 3	.291	6	.951	0
4.	205.166	61	.001	Model 3 – Model 4	67.716*	8	.915	>.01

Note: χ^2 = Maximum Likelihood Ratio Chi-Square; CFI = Comparative Fit Index. Model 1: Configural Invariance (unconstraint); Model 2: Metric Invariance (Constrained factor loadings); Model 3: Scalar Invariance (constrained factor loadings and intercept); Model 4: Error Variance Invariance (constrained factor loadings, intercepts and measurement error)