Assessing factor structure of the simplified Chinese version of Perceived Physical Literacy Instrument for undergraduates in Mainland China

Rui-Si Ma a, *, Raymond K.W. Sum b, Yu- Na Hu a, Tian-Yu Gao a

a School of Physical Education, Jinan University, Guangzhou, China
b Department of Sports Science and Physical Education, Faculty of Education, The Chinese University of Hong Kong, Hong Kong, China

Article history:
Received 6 August 2019
Received in revised form 6 January 2020
Accepted 7 January 2020
Available online 7 January 2020

Abstract

Background: / Objective: To evaluate the factor structure of the simplified Chinese version of “Perceived Physical Literacy Instrument” (PPLI) among Chinese undergraduates.

Methods: The PPLI scale (simplified Chinese version) is based on the original 18-item Cantonese version of PPLI scale, which was first constructed and validated to measure the perceived physical literacy (PL) of physical education (PE) teachers and adolescents in Hong Kong. In this study, 622 undergraduates were randomly split into two subsets. Exploratory factor analysis (EFA) was conducted on the first subset (n = 311) and then confirmatory factor analysis (CFA) was conducted on the second subset (n = 311) for the adapted version based upon the first EFA result.

Results: EFA led to an 8-item, 3-factor scale and item loadings ranged from 0.68 to 0.93, Cronbach’s alpha ranged from 0.79 to 0.83. CFA showed that the construct factor loading ranged from 0.60 to 0.92, which further confirmed the satisfactory factor validity.

Conclusion: The PPLI (simplified Chinese version) is a reliable and valid instrument to examine the perceived PL for Chinese undergraduates. Unlike the original Cantonese version of PPLI, PPLI (simplified Chinese version) exactly explore the kernel attributes, namely, motivation, confidence and physical competence, and interaction with the environment, of the concept of PL. Build from this instrument, more studies could explore the potential factors that influence the physical activity level, as well as structure appropriate intervention programs to utilize PL as a standard to evaluate the quality of PE courses or foster lifelong physical activity level, among Chinese young generation.

© 2020 The Society of Chinese Scholars on Exercise Physiology and Fitness. Published by Elsevier (Singapore) Pte Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

As an influential concept, physical literacy (PL) has rapidly gained global attention and incorporated into several sports and educational policies. A growing number of countries are beginning to implement PL to improve the physical activity (PA) level of youth. Canada is leading this area with many of its provinces (i.e., British Columbia and Labrador) beginning to use PL as a standard to evaluate the quality and outcome of physical education (PE) courses. The Society of Health and Physical Educators America used PL as a standard for evaluating kindergarten through 12th-grade PE courses in the hopes of using it as a standard for evaluating children of all ages. As a leader of PL research, Whitehead defines PL as “the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in PAs for life.”

Failure to have adequate levels of PA increases individuals’ risk of cancer, heart disease, stroke, and diabetes by 20–30% and shortens lifespan by three to five years. Moreover, physical inactivity burdens society through the hidden and growing costs of medical care and loss of productivity. The latest report showed over one in four adults globally are physically inactive (32% men vs 23% women). The majority of adults who are inactive or irregularly active are those who had no interest in PE at school or had negative experiences of PAs when they were young; therefore, they tended
to have sporadic PL journeys.7,8 Additionally, most adults do not value PA and do not even recognize the importance of taking responsibility for their health.7 To start refreshing adults’ participation and create learning experiences to foster lifelong PA, strategies should be taken to develop movement competence and promote self-confidence and self-esteem, which are the key components of PL.

Chinese undergraduates are classified as being in early adulthood (older than 18 years old).3 These young adults should value PA because of its contribution to the quality of life and take steps to incorporate it to their daily lives. This generation of young adults spends most of their time in universities. Hence, universities take an important role in establishing and maintaining continued participation in PA. Furthermore, the United Nations Educational, Scientific, and Cultural Organization has also stated that quality PE should be a key point of the school curriculum because it is the foundation for lifelong engagement in PA.3,4,10

The Ministry of Education of the People’s Republic of China stipulated that PE courses must be offered to freshmen and sophomores in universities, completing a total of 144 h within four semesters.2,13,14 However, only simply mandating the amount of PAs by PE teachers during PE courses is insufficient to fit the high fitness trend mentioned by Whitehead.16 The concept of PL can thus, provide another effective way for PE curriculum by comparing to using physical health as a starting point, cultivating students’ confidence, self-assurance and social skills may be more helpful for improving students’ PA level.14

In this context, PL is an emerging strategy to foster the promotion of PA participation across the lifespan. However, the accurate and systematic instruments for measuring PL are limited due to the differing definitions of each institution. SHAPE America defines PL as “the ability to move with competence and confidence in a wide variety of physical activities in multiple environments that benefit the healthy development of the whole person.” SHAPE highlights three aspects, namely, competence, confidence, and environment.15 The Aspen Institute regards PL as “the ability, confidence, and desire to be physically active for life”. According to the Aspen Institute, the meanings of ability and competence are almost identical.5,17 The latter only replaces environment with desire. Ennis argues that PL should locate its center in knowledge, which serves as a basis for knowing how to do, what to do, and when to do.18 These studies show that the attributes of PL are concentrated mainly in motivation, physical competency and knowledge.19–22 Most of these works are based on the definition of Whitehead, who is one of the leading experts in PL, who claimed that six attributes and two stages were built up the concept of PL.20,22 The first stage, namely, the core stage, contained motivation, confidence and physical competence, interaction with the environment. The second stage contained sense of self and self-confidence, self-expression and communication with others and knowledge and understanding. First stage formed the kernel of the concept of PL and every attribute in this stage was mutually reinforcing with each other. The other three attributes characteristically develop as the first layer grow. The second stage will then further the first one.27 Perceived Physical Literacy Instrument (PPLI) was developed based on the first stage of Whitehead’s thesis. The PPLI was first constructed and validated to measure the perceived physical literacy of physical education teachers in Hong Kong and contained 18 items in the original version and was adjusted to a 9-item scale that appeared to be reliable and valid on adolescents in Hong Kong. It tested three dimension that reflected the second stage of PL mentioned by Whitehead.28 However, the original Cantonese version of the PPLI was not relevant for Mandarin-speaking Chinese undergraduates because their written language uses different characters. Hence, various cultural factors must be considered. The cross-cultural adaptation of a self-administered instrument for use in a new language and culture requires a unique methodology to obtain content and semantic equivalence between the original and target language.29 Thus, this study aimed to evaluate the psychometric properties of the PPLI (simplified Chinese version) for use among Chinese undergraduates.

Methods

Designing the PPLI (simplified Chinese version)

The PPLI (simplified Chinese version) used in this study was based on the original Cantonese version, which was used for the physical education teachers in Hong Kong (Table 1).28 Through exploratory factor analysis (EFA), Sum’s team initially screened 18 items to 9 items and using this new Cantonese version to measure PL level of adolescents in Hong Kong.29 These 9 items fitted into 3 dimensions. Items 2, 7 and 8 were the first dimension, representing “Sense of self and self-confidence”. The second dimension, including items 11, 12 and 13, were representing “Self-expression and communication with others”. Items 4, 5 and 17 were the last dimension, which represented “Knowledge and understanding”.

To assess the reliability and validity of PPLI for undergraduate Chinese students, we selected the original 18 items version to conduct the analysis. This version contained 18 items, which were scored using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree; the total score ranges from 18 to 90). Because the questioning tone in the original version of PPLI was generic and not developed for a designated population or profession, no modification was made to the vocabulary in the PPLI in this study, except for turning traditional characters into simplified characters as permitted by the developer.

Data collection and sampling

The ethical approval was obtained from the Medical Ethics Committee of the First Affiliated Hospital of Jinan University. The cross-sectional study was conducted from October to December 2018. A total of 622 undergraduates (aged from 18 to 21-year-old) majoring in different fields, from Jinan University in Guangzhou,

Table 1

| Items of the original 18-item Cantonese version of Perceived Physical Literacy Instrument. | Items of the original 18-item Cantonese version of Perceived Physical Literacy Instrument. |
|---|---|
| PL1 | I possess adequate fundamental movement skills |
| PL2 | I am physically fit, in accordance to my age |
| PL3 | I am able to apply learnt motor skills to other physical activities |
| PL4 | I have a positive attitude and interest in sports |
| PL5 | I appreciate myself or others doing sports |
| PL6 | I am able to apply PE knowledge in the long run |
| PL7 | I possess self-management skills for fitness |
| PL8 | I possess self-evaluation skills for health |
| PL9 | I am willing to do sports for better health |
| PL10 | I have strong communication skills |
| PL11 | I have strong social skills |
| PL12 | I am confident in wild/natural survival |
| PL13 | I am capable in handling problems and difficulties |
| PL14 | I have a mindset for lifelong sports |
| PL15 | I can turn doing sports into an on-going habit of life |
| PL16 | I establish friendship through sports |
| PL17 | I am aware of the benefits of sports related to health |
| PL18 | I aspire to know the current sports trend |

Items 2, 7, 8, were the first dimension in the 9-item Cantonese version of PPLI. Items 11, 12, 13, were the second dimension in the 9-item Cantonese version of PPLI. Items 4, 5, 7, were the third dimension in the 9-item Cantonese version of PPLI. A items in the 9-item Cantonese version of PPLI instrument.
Guangdong, China, participated in the study. The sample size for this study was large enough to examine the psychometric properties of the PPLI (simplified Chinese version) based on the criterion requiring 5–10 participants per item.31 Study details were fully explained to the participants before the study. Informed consent from all participants were obtained before sending the questionnaire. The research assistant (RA) was responsible for distributing the questionnaire and a pen to each participant before the PE class and for answering the participants’ questions. The RA was trained previously and understood fully the structure and content of the questionnaire. Each participant was allowed to ask questions and they were free to refuse to answer any questions, and they could withdraw from the study at any point. To encourage participation, some simple gifts, such as pen and bookmark, were given to them if they complete the survey. All questionnaires were collected before the class and the average response time was 10 min.

Data analysis

IBM SPSS 25 was used for data analysis. Descriptive statistics, such as frequencies and percentages, were used to summarize the properties of the PPLI (simplified Chinese version) based on the criterion requiring 5–10 participants per item.31 Study details were fully explained to the participants before the study. IBM SPSS 25 was used for data analysis. Descriptive statistics, such as frequencies and percentages, were used to summarize the properties of the PPLI (simplified Chinese version) based on the criterion requiring 5–10 participants per item.31 Study details were fully explained to the participants before the study. Informed consent from all participants were obtained before sending the questionnaire. The research assistant (RA) was responsible for distributing the questionnaire and a pen to each participant before the PE class and for answering the participants’ questions. The RA was trained previously and understood fully the structure and content of the questionnaire. Each participant was allowed to ask questions and they were free to refuse to answer any questions, and they could withdraw from the study at any point. To encourage participation, some simple gifts, such as pen and bookmark, were given to them if they complete the survey. All questionnaires were collected before the class and the average response time was 10 min.

IBM SPSS 25 was used for data analysis. Descriptive statistics, such as frequencies and percentages, were used to summarize the properties of the PPLI (simplified Chinese version) based on the criterion requiring 5–10 participants per item.31 Study details were fully explained to the participants before the study. Informed consent from all participants were obtained before sending the questionnaire. The research assistant (RA) was responsible for distributing the questionnaire and a pen to each participant before the PE class and for answering the participants’ questions. The RA was trained previously and understood fully the structure and content of the questionnaire. Each participant was allowed to ask questions and they were free to refuse to answer any questions, and they could withdraw from the study at any point. To encourage participation, some simple gifts, such as pen and bookmark, were given to them if they complete the survey. All questionnaires were collected before the class and the average response time was 10 min.

IBM SPSS 25 was used for data analysis. Descriptive statistics, such as frequencies and percentages, were used to summarize the socio-demographic data. Internal consistency was tested via the Cronbach’s alpha. Content validity of the PPLI (simplified Chinese version) was assessed by computing content validity indexes (CVIs) at the item level(I-CVI) and the scale level(S-CVI). CVI was completed by a panel of five experts that included sports and PA specialists who were invited to evaluate each item of the PPLI (simplified Chinese version) for content relevance, using a four-point Likert scale (1 = not relevant to 4 = highly relevant). The I-CVI of 0.8 or above and S-CVI of 0.9 or above were considered to be acceptable content validity.32 Then, with the ratio 1:1(311 cases in each subset and satisfied with the minimum amount of data),33 the total sample was randomly split via a computer-generated randomization sequence into 2 subsets, subset 1 was used for EFA and subset 2 was used for CFA. To assess structural validity, EFA was first used to determine the factor structure of the PPLI (simplified Chinese version) using the maximum likelihood estimation via Varimax rotation. Kaiser-Meyer-Olkin (KMO) index was used to assess sampling adequacy on subset 1, with a value of KMO higher than 0.8 deemed satisfactory for the items.32 Bartlett’s test of sphericity (p < 0.001) was used to identify if the correlations among the scale items were large enough for conducting principal components analysis.33 The commonalities of each item needed to be > 0.40, with a factor loading ≥ 0.32.32 To confirm the structure obtained from EFA, CFA was used as a key step to refine and identify the factor structure of PPLI by using AMOS 25. Subset 2 was used for CFA.34 CFA can use different estimation methods for model evaluation. In general, the most commonly used method is maximum likelihood estimation. The advantages of maximum likelihood were that when the sample size is not large, or when the variable has an unsatisfactory kurtosis, the ideal parameter estimation can still be obtained.35 Therefore, this study used maximum likelihood as the estimation method. Only one model was constructed a priori for dataset and the indices used were the chi-square goodness of fit statistic, comparative fit index (CFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), parsimonious normed fit index (PNFI), Tucker-Lewis index coefficient (TLI) and the root mean square error of approximation (RMSEA). According to the literature review of the examination of the best practice determination of model fit suggested within multivariate analysis texts, these indices were selected to represent absolute fit, incremental fit, and model parsimony categories could be represented by these selected indices.36–38

Results

Sample characteristics

Before validating the PPLI, students’ demographic characteristics were analyzed, a total of 622 undergraduates were recruited (Female = 448; Male = 174). The age of the participants ranged from 18 to 21 years old, with the mean age was 19.43 and the standard deviation (SD) was 0.86 (Table 2), which was consistent with the research subjects. More than half (n = 341, 54.8%) of the participants were in Grade One, with others (n = 281, 45.2%) came from Grade Two. After checking raw data, EFA was used as a critical step in finding the essential structure of multivariate observational variables and processing dimensionality reduction.

Internal consistency and content validity

Before analyzing the factor structure, the expectation–maximization algorithm was used to estimated missing values in dataset.0.86 alpha coefficient was calculated, which was higher than the acceptable value of 0.7,39 and indicated the satisfied internal consistency. In terms of content validity, the I-CVI ranged from 0.8 to 1 and the S-CVI higher than 0.9 (S-CVI = 0.93), which indicated that PPLI had acceptable content validity.

EFA on subset 1

EFA was conducted on the 18-item PPLI (simplified Chinese version) on subset 1 (n = 311). The KMO index of sampling adequacy was 0.78 and the p-value of the Bartlett’s test of sphericity was 0.000, which indicate the suitability of the data for EFA.32,33

Nine (items 4, 6, 7, 8, 9, 12, 14, 15, and 16) out of 18 items of PPLI with loading value under 0.40 were deleted after the initial factor analysis.34 And then the principal component analysis (PCA) were computed again with all items’ factor loaded higher than 0.60 in the final structure. Items that loaded at 0.32 or higher on two or more factors were defined as cross loading items.35 After removed cross loading items, PCA was reconstucted until the model was cross loading free, which led to the final 8-item scale with three factors, as shown in the pattern matrix in Table 3. The remaining 8 items, namely, item 1, 2, 3, 5, 10, 11, 17 and 18 loaded on a three-factor model explained 73.45% of the variance. The factor loadings of these 8 items were all greater than 0.60. Their factor loadings ranged from 0.68 to 0.93, thereby indicating adequate relevance to the respective latent factors. The total correlation of the corrected item ranged from 0.44 to 0.69. The Cronbach’s alpha of the items deleted were 0.79–0.83. The scale alpha of three factors were 0.80, 0.68, and 0.90.

| Table 2 Demographic characteristics of the undergraduates (n = 622). |
|------------------|---------|--------|
|                  | Total N | N = 622 | %     |
| Gender           |         |         |       |
| Female           | 448     | 72.0    |       |
| Male             | 174     | 28.0    |       |
| Age              |         |         |       |
| 18               | 62      | 10.0    |       |
| 19               | 286     | 46.0    |       |
| 20               | 227     | 36.5    |       |
| 21               | 47      | 7.5     |       |
| Grade            |         |         |       |
| Grade 1          | 341     | 55      |       |
| Grade 2          | 281     | 45      |       |
CFA on subset 2

CFA was then adopted among the second group (n = 311) of participants to cross-validate and confirm an acceptable model with the three-dimension structure of the remaining 8-item PPLI (simplified Chinese version) through IBM SPSS - Amos 25 (Fig. 1). The factor loading of all items, ranged from 0.60 to 0.92, were higher than the standard of 0.45, which means the factor validity of this 8-item instrument was satisfactory.40 The absolute fit indexes of RMSEA (0.03) was below the accepted maximum fit value (0.05), and AGFI (0.96) was above the expected minimum of 0.90.41 Normed chi-square index (1.32) was under the marginal maximum of 3.00.42 NFI (0.97), CFI (0.99) and TLI (0.99) were all well above the 0.95, which indicated a strong incremental fit.43 For parsimonious fit of the structure, PNFI (0.59) was smaller than incremental fit values but was within the acceptable range values.44

Discussion

This study adapted original Cantonese version of PPLI into simplified Chinese version. Results showed that the PPLI (simplified Chinese version) had a good validity to measure the perceived physical literacy, in terms of three dimensions of motivation, confidence and physical competence, and interaction with the environment, among undergraduates in Mainland China.

The first dimension or factor of the PPLI (simplified Chinese version) included item 1, 2 and 3, which were stated as “I possess adequate fundamental movement skills”, “I am physically fit, in accordance to my age”, and “I am able to apply learnt motor skills to other physical activities.” respectively. These items reflected that physical literate people should have strong confidence and physical competence. The participants perceived themselves as physically fit and having full confidence in their physical abilities and have the confidence to apply what they have learned to other areas.
Undergraduates in the current study noticed that their body improved while performing physical activities.

The second dimension or factor of the PPLI (simplified Chinese version) included item 5, 17, and 18, which read: “I appreciate myself or others doing sports,” “I am aware of the benefits of sports related to health,” and “I aspire to know the current sports trend.” respectively. These items reflected that physical literate individuals have a positive attitude in doing sports. They enjoyed participation in sports and feel the same way seeing others. Physical literate people treated physical activity as a lifestyle, which they would like to live their whole lives. They are also aware that doing sports is good for their health and eager to find out what is the current sports trend.

The third dimension or factor of the PPLI (simplified Chinese version) included item 10 and 11, which read: “I have strong communication skills,” and “I have strong social skills.” respectively. These items revealed participants perceived PL included knowing how to interact with environment. They can empathize and express their feelings freely, which improves their self-expression and communication with others.23 With a strong social communication skill, physical literate people can integrate more effectively into society.

As defined by Whitehead, PL can be divided into six attributes: 1) motivation, 2) confidence and physical competence, 3) interaction with the environment, 4) knowledge and understanding of PA, 5) sense of physical self and self-confidence, and 6) self-expression and communication with others. The relationships of these attributes in PL can be described in two stages. 1) motivation, 2) confidence and physical competence and 3) interaction with the environment are the kernel stage and are mutually reinforcing. Motivation could build participants’ confidence and more confidence could in turn maintain or enhance motivation. As self-confidence increases, participants will be more skilled in interacting with the environment. As more new challenges appear, this relationship with the environment can in turn enhance the physical confidence. The success of developing relationships with a range of environments can further motivate, which can in turn encourage promote effective interaction with the environment. All the second stage (4, 5, 6) could in turn enhance the first stage (1, 2, 3).27

The original PPLI were used to test PE teachers and adolescents PL in Hong Kong. Three dimensions were found from prior studies, which were 4) knowledge and understanding of PA, 5) sense of physical self and self-confidence, and 6) self-expression and communication with others.28,29 Different from prior studies, the current study found the kernel stage of PL with the PPLI. Since the different culture and environment, some attributes did not attributed to the reason that item 13 was expressed in a vague language, such item (handling difficulties) could show significant in each aspect.

This article has several limitations. First, because the subjects are completely random collected, the proportion of females is larger than males, which may result in some outcome deviations. Second, the participants of study were college students rather than children and adolescents, which leads to the fact that the instrument could be only used for college students in the future. Further research could continue to explore a wide range of age group.

Conclusion

The concept of PL has multiple benefits for health, such like enhancing the PA of undergraduate students and solving the deterioration of national PA. Given that the university plays a vital role in developing exercise habits, this is the first study to develop the original Cantonese version of PPLI, which was an instrument to measure perceived PL, into simplified Chinese version and aim to evaluate the psychometric characteristics of PPLI (simplified Chinese version) for undergraduates in Mainland China. Through testing EFA, internal consistency and CFA, the research team showed that PPLI is a reliable and valid instrument to measure perceived PL among undergraduates in Mainland China. Additionally, different from prior studies, the current result of EFA showed three dimensions in PPLI (simplified Chinese version), namely, motivation, confidence and physical competence, and interaction with the environment, which are exactly the first three attributes, namely, the kernel stage, of the Whitehead’s PL concept.

Further study could use this reliable and valid PL instrument to explore the potential factors that contribute to the current deteriorated PA level, such as lack of motivation, self-confidence, or related competence for PA, among Chinese undergraduates. Moreover, this simplified Chinese version of PPLI could help health or PE professionals to structure appropriate intervention programs to utilize the PL as a standard to evaluate the quality and outcome of PE courses or foster lifelong PA level among Chinese young generation.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Spengler JD, Cohen J. Physical Literacy: A Global Environmental Scan. Washington, DC: The Aspen Institute; 2015.
2. Mandigo J, Francis N, Lodewyk K, et al. Physical literacy for educators. PHE J. 2009;75(3):27–30.
3. Society of Health and Physical Educators America. Physical literacy. SHAPE America web site. https://www.shapeamerica.org/events/physicalliteracy.aspx?key=61893ed9-8a9e-430c-b4f5-8267480cb421. Accessed January 3, 2020.
4. Whitehead M. Definition of physical literacy and clarification of related issues. ICSSPE Bulletin. 2013;65(1):2.
5. World Health Organization. Physical activity. WHO Web site. https://www.who.int/ncds/prevention/physical-activity/introduction/en/. Accessed January 3, 2020.
6. World Health Organization. Launch of new global estimates on levels of physical activity in adults. WHO Web site http://www.who.int/ncds/prevention/physical-activity/lancet-global-health-insufficient-physical-activity-2001-2016/en/. Accessed January 3, 2020.

7. Almond L. What is the relevance of physical literacy for adults. ICSSPE Bulletin J Sport Sci Phys Educ. 2013:65:214–222.

8. Edwards LC, Bryant AS, Keegan RJ, et al. Definitions, foundations and associations of physical literacy: a systematic review. Sport Med. 2017;47(1):113–126.

9. Central People’s government of the People’s Republic of China. People’s Republic of China compulsory education law. GOV web site. http://www.gov.cn/flfg/2006-06/30/content_323302.htm. Accessed January 3, 2020.

10. McLennan N, Thompson J. Penney D, Chandler T. Physical education: what future (s)? Canadian Sport for Life. 2013:239.

11. Chen A. Operationalizing physical literacy for learners: embodying the motivation to move. J Sport Health Sci. 2015;4(2):125–131.

12. Whitehead M. Physical literacy and its Importance to Every Individual. Dublin, Ireland: Paper Presented at the National Disability Association; 2007.

13. Canadian Sport for Life. Developing Physical Literacy: A Guide for Parents of Children Ages 0 to 12. Ottawa, Canada: Canadian Sport Centres; 2015.

14. Penney D, Chandler T. Physical education: what future (s)? Sport. Educ Soc. 2000;5(1):71–87.

15. Lloyd M, Tremblay MS. Introducing the Canadian Assessment of Physical Literacy. London: Routledge Taylor and Francis Group; 2011:239–243.

16. Lloyd M, Colley RC, Tremblay MS. Advancing the debate on fitness testing for children: perhaps we’re riding the wrong animal. Pediatr Exerc Sci. 2010;22(2):176–182.

17. Whitehead M. What is physical literacy and how does it impact on physical education. Debates Phys Educ. 2013:37–52.

18. Whitehead M. Physical Literacy: Throughout the Lifecourse. Routledge; 2010:10–16.

19. Sum RK, Cheng C, Wallhead T, et al. Perceived physical literacy instrument for adolescents: a further validation of PPLI. J Exerc Sci Fit. 2018;16(1):26–31.

20. Beaton DE, Bombardier C, Guillemin F, et al. Guidelines for the process of cultural adaptation of self-report measures. Spine. 2000;25(24):3186–3191.

21. Nunnally JC, Bernstein IH. McGraw-Hill Series in Psychology. Psychometric Theory. New York, NY, US: McGraw-Hill; 1967.

22. Sousa VD, Rojjanasirat W. Translation, adaptation and validation of instruments or scales for use in cross-cultural health care research: a clear and user-friendly guideline. J Eval Clin Pract. 2011;17(2):268–274.

23. Tabachnick BG, Fidell LS, Ullman JB. Using Multivariate Statistics. 5th ed. MA: Pearson Boston; 2007.

24. Velicer WF, Fava JL. Effects of variable and subject sampling on factor pattern recovery. Psychol Methods. 1998:231–251.

25. Costello AB, Osborne JW. Exploratory Factor Analysis: four recommendations for getting the most from your analysis. Pract Assess Res Eval. 2005;10:1–9.

26. Arbuckle JL. Amos 20 User’s Guide. Chicago, IL: SPSS Inc; 2011.

27. Qiu HZ. Quantitative Research and Statistical Analysis: SPSS and R Data Analysis [in Chinese]. Wunan Book Publishing Co, Ltd; 2019.

28. Hair J, Black WC, Babin BJ, et al. Multivariate data analysis 6th edition. Pearson Prentice Hall. New Jersey. humans: critique and reformulation. J Abnorm Psychol. 2006:87:49–74.

29. Holmes-Smith P, Coote L, Cunningham E. Structural Equation Modeling: From the Fundamentals to Advanced Topics. melbourne, australia: School of research, Evaluation, and Measurement Services; 2002.

30. Joreskog KG, Sorbom D. LISREL 7: A Guide to the Program and Applications. 1989. Spss.

31. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Model. 1999(6):1–55.

32. Joreskog KG, Sorbom D. LISREL V. Analysis of Linear Structural Relationship by Maximum Likelihood and Least Squares Methods. University of Uppsala, Department of Statistics; 1981.

33. Bentler PM, Bonett DG. Significance tests and goodness of fit in the analysis of covariance structures. Psychol Bull. 1980;88(3):588.

34. Schreiber JB, Nora A, Stage FK, et al. Reporting structural equation modeling and confirmatory factor analysis results: a review. J Educ Res. 2006;99(6):323–338.