Association between the levels of perceived physical literacy and physical activity amongst undergraduates in Mainland China: A cross-sectional study

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Abstract

Background

This study examines the association between perceived physical literacy (PL) and physical activity (PA) levels amongst Chinese undergraduates through a cross-sectional study.

Methods

A total of 622 Chinese undergraduates aged between 18 and 21 years participated in the study. A simplified Chinese version of the Perceived Physical Literacy Instrument (PPLI-SC) and long form of the International Physical Activity Questionnaire (IPAQ-SC) were used to measure the participants' perceived PL and PA levels. Pearson's Product–Moment Correlation and multiple linear regression were then used to examine the relationship between the perceived PL and PA levels.

Results

The correlation between perceived PL and PA levels was low but significant ($r = 0.254$, $p < 0.01$). Except for the sedentary domain, the correlation between the rest of the domains and intensities of PA and dimensions of PL are also the same ($r = 0.089–0.336$, $p < 0.01$). Multiple linear regression equation was significant ($F = 25.228$, $p < 0.01$, $R^2 = 0.125$). Metabolic equivalent (MET) values were used to predict the PA level of the participants, which were $-3818.582 + 272.535(\text{Motivation}) + 249.848 (\text{Confidence and physical competence}) + 149.899 (\text{Interaction with the environment})$. Additionally, the correlation between perceived PL and PA levels showed no significant difference in terms of gender, body mass index (BMI) and socio-economic status (SES), but showed a significant difference in grade point average (GPA).

Conclusions

Perceived PL and PA levels were significantly related and associated with gender, BMI, GPA, and SES. Two factors that were unrelated to PL and PA were sedentary and higher GPA, indicating that the current system of education and examination has led to physical inactivity in Chinese undergraduates. The study highlights the importance of the association between PA and PL, and offers a path by which to explore the concept of PL and how it can affect the PA of Chinese undergraduates. Furthermore, on the basis of this study's findings, more research could develop practical interventions to help Chinese undergraduates enhance their PL and to take responsibility to engage in life-long PA.

Introduction

The concept of physical literacy (PL) has rapidly gained global attention [1]. The International Physical Literacy Association sets the definition of PL as 'the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities (PAs) for life' [2]. Moreover, Whitehead further stated that PL is physiologically related to the concept of human flourishing, which is a term referring to a state in which the individual is thriving or living optimally [3, 4]. In other words, the concept of PL helps people gain health and wellness through a lifetime of PA engagement. PA is defined by The World Health Organisation (WHO) as 'any bodily movement produced by skeletal muscles that requires energy expenditure—including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits' [5]. Having sufficient

level of PA can effectively strengthen bones and muscles and reduce the risk of hypertension, coronary heart disease, stroke, diabetes and various types of cancer (including breast cancer and colon cancer), which all are diseases with high mortality. Additionally, PA can also improve people's mental health and defer the onset of dementia [6–14].

Insufficient PA is one of the leading causes of death in many countries. It causes a 20–30% increased risk of death compared to those who are sufficiently physically active [5]. Recent reports have shown that over a quarter of adults globally suffer from insufficient PA (32% men vs. 23% women) [15]. Although WHO Member States have agreed that the number of insufficient PA must be reduced by 10% by 2025, the trend continues to grow by far [5, 16]. Many Western countries have realised that only emphasising PA is inefficient; thus, they started to promote PL through PA in various environments, including schools, communities and public health institutes [17]. For example, the Australian Government had invested A\$200 million to promote the population's PA through PL-oriented programmes, which would enable the government to save about A\$13.8 billion for future healthcare budget. The US, UK and New Zealand also started large-scale initiatives in education, community and public health policy to enhance public participation and performance in PA through PL [18]. In Mainland China, the status of public PA level is worse than ever in recent decades. Levels of PA for adults in Mainland China fell by nearly half between 1991 and 2011 [19]. Since then, the Chinese Government has successively released several policies aiming to improve PA in population and enhance overall population health [21, 22]. However, simply focusing on mandating the amount of PAs by PE teachers during PE courses is insufficient to fit the high fitness test standard [21]. In 2019, the Chinese Government started to realise that PL maybe the key solution of increasing PA of population and released a policy resetting the goal of PE from enhancing PA to PL [22]. PL then became the core of theoretical guidance for PE in Mainland China, and Chinese scholars began to embrace the concept of PL [23].

Studies have found that PL is the predecessor of PA, whilst PL is developed through PA [24]. A study also found an internal relationship between PA and PL [25]. To be specific, instead of being forced to participate in PA, individuals will take an active part in PA if they understand PL. At the same time, individuals will enhance their PL by joining in PA, thus forming a virtuous circle. Until now, many researches have focused on how to utilise PL as a tool to promote overall PA, but few of them tested their constructs. This is because, on the one hand, the definition of PL varies depending on the institution and research team. On the other hand, only a few instruments for testing PL have been proposed. At present, the International Physical Literacy Association has set a clear definition that has solved the long-standing confusion [2]. Moreover, the Perceived Physical Literacy Instrument (PPLI) was invented to measure the perceived PL of PE teachers and adolescents in Hong Kong [26, 27]. Then, the Cantonese version of PPLI was translated into simplified Chinese to test the perceived PL of undergraduates in Mainland China [28]. The current study thus used perceived PL to represent how undergraduates perceived their PL and thus value PL. For PA, the PA levels were used to present the behaviours and exercise intensities of the undergraduates [29, 31]. The subject of the research was Chinese undergraduates, the last stage of education process from primary school, high school and college. Young people at this stage should take PA seriously as it has a great deal to do with their healthy lives. Given that undergraduates are essentially on campus most of time for their daily lives, the university plays a vital role in developing and maintaining continued participation in PA. Understanding the relationship between PA and PL can thus help improve the school's PE courses which, in turn, enhances the health of students. Therefore, this study aimed to explore the relationship between PL and PA amongst undergraduates in Mainland China. The respective links between PL and individual factors, such as gender, grade and socioeconomic status, will also be tested for further measuring the relationship between PL and PA [24, 29].

Method

Study design

Cross-sectional study was utilised in this research. Participants' perceived PL and PA levels were calculated by the simplified Chinese version of the PPLI (PPLI-SC) and simplified Chinese version of the long form of the International Physical Activity Questionnaire (IPAQ-SC). The demographic information (gender, grade, GPA, etc.) of participants was also collected. Body mass index (BMI) was obtained by height and weight. Then, a cross-sectional study was conducted to investigate the relationship between the perceived PL and PA levels of undergraduates in Mainland China.

Data collection and sampling

Participants from Jinan University were randomly invited to join this research. A total of 622 undergraduate students aged between 18 and 21 years participated in the study. Each participant was required to finish a questionnaire, which included demographic information, PPLI-SC, and the long form of the IPAQ-SC. The research assistant was responsible for distributing the questionnaire to each participant before the physical education class and for answering the participants' questions during the period. The research assistant was fully trained so that he understood the structure and content of the questionnaire. Whilst answering the questionnaire, each participant was allowed to ask questions. Every participant was free to refuse answering the questionnaire and they can withdraw from the study at any time. To encourage participation, some simple gifts, such as pens and bookmarks, were given to them if they finish the survey. Once the participants finished the questionnaire (average answering time was 10 minutes), all questionnaires were collected by the research assistant.

Measures

Participants' perceived PL was assessed by PPLI-SC, which was translated from PPLI. This is an 8-item instrument that was used to measure the perceived PL of Chinese undergraduates. It includes three dimensions: 1) motivation, 2) confidence and physical competence and 3) interaction with the environment. All of these dimensions were described as kernel attributes of Whitehead's concept of PL. The participants responded on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree; the total score ranges from 8 to 40). The PPLI-SC was proven to be a reliable and valid questionnaire to measure the perceived PL of Chinese undergraduates through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) [28].

Participants' PA level was measured by the long version of IPAQ-SC, which was translated from the long version of IPAQ. It involves five environment domains: work-related (unrelated in this study), transportation, housework, leisure time and sedentary. These domains were used to record participants' moderate and vigorous PA performed for at least 10 uninterrupted minutes in the previous 7 days (5 school days and 2 weekend days). The data were collected in minutes per week for each of the PA intensities. Then, the minutes were calculated to metabolic equivalent (MET) values by using the MET-minutes computation formulation [33, 34]. Qu NN and Li KJ translated the IPAQ into simplified Chinese version and tested its reliability and validity. Reliability was verified using the test-retest method ($p \geq 0.05$) and validity was tested using Spearman's rank correlation established by Caltrac accelerometer ($p \geq 0.05$, $r = 0.50$). Results showed that the long version of the IPAQ-SC had intraclass correlation coefficients above 0.7 for PA [35].

The demographic information of the participants, such as gender, grade and BMI, was also collected in the questionnaire. Grade point average (GPA) is a standard way to measure academic achievement. Jinan University also follows the 5-point GPA model in which students having a GPA of less than 3 equals a normal score, a GPA between 3 and 4 means a good score and GPA higher than 4 means a great score [36]. The factor of socioeconomic status (SES) was used to evaluate students' SES status. According to the National Bureau of Statistics of China, SES can be divided into three levels: RMB 0–4000 equals to low income, RMB 4000–20000 equals to medium and higher than RMB 20000 means high SES [37].

Data analysis

IBM SPSS 25 was used for data analysis. The correlation between perceived PL and PA levels was derived from Pearson's Product–Moment Correlation. Multiple regression analysis was then conducted to detect the association between perceived PL and PA levels. Such measures as demographic information, GPA, and SES were also considered in the Pearson's Product–Moment Correlation in computing the correlation between perceived PL and PA levels. The z-scores were calculated in the correlations to test whether the attributes were significantly different [38].

Results

Before testing the relationship between PA and PL, the demographic characteristics of participants were analysed. A total of 622 undergraduates were recruited and 536 of them completed the questionnaire (Female = 403, Male = 133). Participants' ages ranged from 18 to 21 years old. The average age was 19.40 years old and standard deviation was 0.83 (Table 1), which were all consistent with the research subjects. The number of students in Year 1 (n = 305, 56.9%) were slightly greater than that in Year 2 (n = 231, 43.1%).

Table 1
Demographic characteristics
of the participants (n = 536).

Total N	n = 536	%
Gender		
Female	403	75.2
Male	133	24.8
Age		
18	53	9.9
19	254	47.4
20	190	35.4
21	39	7.3
Grade		
Year 1	305	56.9
Year 2	231	43.1

Pearson's Product–Moment Correlation was then used to test the correlation between each dimension of PA level and three attributes of perceived PL (Table 2). The average of total perceived PL of participants was 30.28 (± 4.20) and the average values of the three domains, namely, Motivation, Confidence and physical competence and Interaction with the environment were 11.92 (± 1.77), 11.09 (± 2.03) and 7.27 (± 1.60), respectively. The daily average times spent by participants on moderate PA and vigorous PA were 51 and 35 minutes, respectively. The daily average transportation time spent by students was 74 minutes in total, including 12 minutes in riding, 0.9 minutes in cycling and 60 minutes in walking. According to the recommended time spent of 60 minutes PA per day, the results met the guidelines. The daily time spent in housework, leisure time and sedentary mode were 30, 95 and 217 minutes, respectively.

The correlation (r) between participants' perceived PL and PA levels was 0.245, which was significant at the 0.01 level (2-tailed). Although the correlations were not high, three dimensions of PPLI-SC, intensities of PA (Walking, Moderate PA and Vigorous PA) and three domains of IPAQ-SC (Transportation, Housework and Leisure time) showed high

significance ($r = 0.089-0.336$, $p < 0.01$). There was no significant correlation between the sedentary domain of IPAQ-SC and any other attribute.

Table 2
Pearson's Product-Moment Correlation of three attributes of perceived PL and PA domains (n = 536).

	PA level	Moderate PA	Vigorous PA	Walking	Transportation	Housework	Leisure time	Sedentary
Total PL	0.254 ^a	0.206 ^a	0.284 ^a	0.220 ^a	0.218 ^a	0.129 ^a	0.336 ^a	0.018
Motivation	0.219 ^a	0.192 ^a	0.274 ^a	0.167 ^a	0.164 ^a	0.113 ^a	0.291 ^a	0.072
Confidence and physical competence	0.213 ^a	0.196 ^a	0.234 ^a	0.183 ^a	0.185 ^a	0.097 ^a	0.198 ^a	-0.018
Interaction with the environment	0.153 ^a	0.155 ^a	0.142 ^a	0.158 ^a	0.153 ^a	0.089 ^a	0.283 ^a	-0.010
^a Correlation is significant at the 0.01 level (2-tailed).								

Multiple linear regression was conducted to predict the PA level of Chinese undergraduates based on three dimensions of perceived PL (Table 3). Before doing regression analysis, the research team examined the normality, linearity and multicollinearity of the data to ensure that there were no violations during the analysis. The analysis showed a significant regression equation ($F = 25.228$, $p < 0.01$, $R^2 = 0.125$) and so did the dimensions of perceived PL. The predicted PA level of the participants had $-3818.582 + 272.535(\text{Motivation}) + 249.848 (\text{Confidence and physical competence}) + 149.899 (\text{Interaction with the environment})$ MET value. Meanwhile, the standardised coefficients of Motivation, Confidence and physical competence and Interaction with the environment were 0.176, 0.184 and 0.087, respectively. The probability values of each dimension were all less than 0.05, indicating a positive relationship between perceived PL and PA levels. In other words, the participants' MET values would increase by 272.535, 249.848 and 149.899 for each dimension score of perceived PL. Thus, the results showed that all dimensions were significant predictors of PA level.

Table 3
Results of multiple linear regression analysis predicting PA level using perceived PL and its dimensions (n = 536).

Variable	B ^a	SEB ^a	ρ^a	P ^a
Constant	-3818.582	1016.41	-	0.000
Motivation	272.535	72.159	0.176	0.000
Confidence and physical competence	249.848	63.635	0.184	0.000
Interaction with the environment	149.899	77.192	0.087	0.041
R = 0.353				
R ² = 0.125				
$\Delta R^2 = 0.120$				
^a Unstandardised coefficient				
^b Standard error of unstandardised coefficient				
^c Standardised coefficient				
^d Probability value				

The association between perceived PL and PA levels in each factor, such as gender and grade level, was also explored by Pearson's Product–Moment Correlation (Table 4). Except with the group of GPA higher than 4 ($r = 0.025$), all groups showed positive significant correlations between PL and PA ($r = 0.338–0.529$). Then, the z-scores and their differences were calculated to explore whether significant differences existed between each group (Table 4, Table 5). Although most groups' correlation between the perceived PL and PA levels were different, only two groups of GPA showed significant difference. Students with GPA higher than 4 have a lower correlation between perceived PL and PA level ($r = 0.025$). Such good students who were able to obtain excellent grades were significantly different from other students in terms of perceived PL and PA levels.

Table 4
Pearson's Product–Moment Correlation and z-score of perceived PL and PA level in each factor (n = 536).

	Gender		BMI			GPA			SES		
	Male	Female	< 18.5	18.5–23.9	> 23.9	< 3	3–4	> 4	< 4000	4000–20000	> 20000
N	133	403	153	319	64	144	344	48	80	306	150
r	0.467 ^a	0.346 ^a	0.338 ^a	0.370 ^a	0.366 ^a	0.393 ^a	0.338 ^a	0.025	0.342 ^a	0.374 ^a	0.529 ^a
z	0.506	0.361	0.352	0.388	0.384	0.415	0.352	0.025	0.356	0.393	0.589
^a Correlation is significant at the 0.01 level (2-tailed).											

Table 5
z-differences between perceived PL and PA levels in each factor (n = 536)

z differences between perceived T-E and T-A levels in each factor (n = 556)										
	Gender	BMI			GPA		SES			
	Male vs. Female	Low vs. Medium	Low vs. High	Medium vs. High	Norm vs. Good	Norm vs. Great	Good vs. Great	Low vs. Medium	Low vs. High	Medium vs. High
z ^a	1.43	−0.36	−0.23	0.02	0.63	2.27	2.06	−0.28	−1.66	−1.94
p	0.152	0.718	0.818	0.984	0.52	0.02 ^b	0.03 ^b	0.77	0.09	0.05
^a z-difference										
^b Correlation is significant at the 0.05 level (2-tailed).										

Discussion

This study focused on exploring the relationship between perceived PL and PA levels and investigating which factor related to such a relationship. Thus far, few studies have examined the relationship between PA and the six dimensions of PL when discussing such a topic. According to Whitehead, there are six components of PL to understand and enhance lifelong PA: 1) Motivation, 2) Confidence and physical competence and 3) Interaction with the environment. 4) Sense of self and self-confidence, 5) Self-expression and communication with others and 6) Knowledge and understanding [32]. Many studies have not comprehensively studied the association between PA and PL due to the lack of investigation instrument. PPLI, an instrument that can quantify perceived PL, was thus invented to help solve the issue. The team who invented it first used the instrument to test the relationship between perceived PL and PA levels amongst Hong Kong adolescents [39]. Due to various cultural factors, the current study used the PPLI-SC version to test whether there exists any association between PL and PA amongst Chinese undergraduates.

Relationship between PL and PA of undergraduates in Mainland China

Nearly half of the research claimed that PL is the core of PA, and individuals would not engage in PA if they have low PL [24]. According to such general research, PL will show a strong correlation with PA. However, the result of the current study has shown that they have a significant but relatively low correlation. Although such result was inconsistent with most of the previous literature, it showed a high consistency with past explorations into Hong Kong adolescents [39]. Such a low positive correlation indicates that when the concept of PL has not been fully integrated into the PE courses, students may not have much sense of PL even if some of them have a high level of PA.

This study conducted multiple regression analysis and used three dimensions of PL as predictive factors to test the PA level among Chinese undergraduates. Through enhancing the dimension of motivation, students could find more interest in participating in PA and will more likely maintain this positive attitude towards PA throughout their whole lives. From developing the dimensions of confidence and physical competence, students will move their bodies with elegance and balance which, in turn, will enhance their confidence to engage in more PA. Then, by increasing the opportunities to interact with the environment, students could build more self-confidence, which will further encourage them to engage in PA again. As PE courses are the main way for Chinese undergraduates to get involved in PA, the concept of PL should

be integrated into PE courses to improve their PL. With a greater understanding of the concept of PL, students will place more value on PA and will more likely engage in it.

Relationship between perceived PL and various factors of PA level

Exploring the relationship between perceived PL and PA levels can help find effective ways to improve the PA level of Chinese undergraduates. Based on the PPLI-SC and IPAQ-SC, this study conducted an analysis of the association between perceived PL and various relevant factors of PA level. According to the health recommendations of the WHO, individuals should participate in PA, including moderate and vigorous PA, for at least 60 minutes a day [9].

Undergraduates who met the conditions were selected to conduct an analysis of their perceived PL and PA levels. The results showed that almost all factors of PA (transportation, walking, housework, etc.) have an impact on PL and its three dimensions. However, being sedentary had no effect on PL.

As previously stated, a certain amount of PA is required to achieve the health standard, but the length of PE courses in the universities of Mainland China is often insufficient to meet this requirement. Moreover, most of the students tend to engage in slightly moderate or vigorous PA. Therefore, this situation results in a relatively low correlation between perceived PL and PA levels ($r = 0.254$). Indeed, PE courses are the main way for most students to participate in daily PA. However, the PE course is not the only factor related to PL; other forms of PA like walking, transportation and housework can also increase the core attributes of PL. Such forms of PA in daily life are also vital for understanding the intrinsic value of PL.

Among these various activities, PA in the leisure time has the highest correlation with PL. Thus, in recreational activities, the attribute of free choice of PA can awaken individuals' interest, and this attribute also has the highest performance ($r = 0.291$). While freely choosing PA, individuals can actively integrate into the natural environment and interact with it. Through cooperation with people and responding to different obstacles, another core attribute in PL, interaction with the environment, can be effectively improved. This dimension also shows a relatively high correlation in the relationship between PL and PA in leisure time ($r = 0.283$). In terms of the intensity of PA, vigorous activity is more significantly relevant than moderate activity as the former can better awaken the physical ability and enhance individual confidence ($r = 0.234$). Additionally, vigorous activity can better stimulate interest of participants in PA ($r = 0.274$). There is no correlation between sedentary activities and PL. Nowadays, sedentary activities, such as reading, homework and playing video games, occupy most of the students' daily lives, which is the main reason why Chinese undergraduates have a low PA level. Thus, solely depending on PE courses to improve students' PL is not enough. Rather, students' activity behaviours in their daily lives must be changed to enhance their PA level, ultimately improving their health.

Individual factors on the relationship between PL and PA

Previous studies have reported that gender, physical status, academic achievement and SES of students are factors that need to be considered in the relationship between PL and PA [24, 29, 40]. Worldwide, males are generally more active than females; thus, more women suffer from physical inactivity than men in nearly every country [41]. Compared to males, females are more likely give up PA in their early lifetime. Without compulsory participation in PE courses, females are more inclined to choose not to exercise, thereby hindering the progress of PL. Thus, PE courses must be redesigned by focusing on students' preference in which PA to do, confidence in themselves and interactions with others [32]. The PA habit they develop while in campus will heighten their sense of responsibility to engage in lifelong PA. In addition, a study showed no significant difference between perceived PL and PA levels in males and females, although they prefer different intensities of PA [42]. In other words, all genders improved their PL during PA.

Body management is considered to be one of key factors that can affect individuals' PL [32, 43, 44]. Whole body movement, such as balancing and jumping, requires good physical status. Individuals who are healthy and fit will complete such activity easier than obese or emaciated people. From the study, we can see that students with a normal

body size will more likely engage in vigorous PA and, surprisingly, so do the obese students. In 2019, China Youth Daily reported that China University Media United launched a survey to investigate the willingness of Chinese undergraduates to lose weight. The results showed that 72.73% of the respondents were not satisfied with their body mass and 77.78% of them planned to lose weight. However, nearly 90% of them failed to achieve this goal halfway [45]. Compared with thin students, obese students are more motivated to participate in PA, even if they face difficulties. Therefore, the concept of PL should be integrated into students' daily lives to awaken their motivation to participate in PA, to value it as a life-long habit and thereby keep engaging in it. Along with gender, the difference in body mass does not show significant difference between perceived PL and PA levels. Although some of them may lack motivation to start the PA journey, they will still improve their PL once they do.

Meanwhile, academic achievement has been found to have a positive relationship with PA level [40, 46, 47]. However, in this study, we found a different answer. As the GPAs of Chinese undergraduates increase, their willingness to participate in PA declines. For those who achieved GPA higher than 4, the PA level was too low to be associated with perceived PL. This may be due to the situation wherein most teachers in Mainland China emphasize the importance of sedentary learning and examination. Thus, from 1991 to 2006, the PA level of Chinese adults fell by 32% [48]. Although the national government implemented various policies and set a high requirement for PE courses [20, 21], participation in PA outside of school was almost non-existent as Chinese adolescents were under pressure to obtain academic achievement [49]. In such a situation, it is not enough to simply use PE courses to enhance students' PA and PL levels. Rather, students must be encouraged to engage in PA outside of class, especially during leisure time, which is the best way to improve their PL and PA.

Previous studies have found that the students' SES is positively related to their PA level [50, 51]. Students from families with higher SES are more likely to join each PA and to keep them as a lifetime pattern as their families can support them better in their material and educational needs [39]. The results of the current study showed that, in Mainland China, as the families' SES increases, the PA level of students also improves. Moreover, the PA level of children from high-income families far exceeds that of children from low- and mid-income families; this is because the latter are less likely to participate in PA during their leisure time [52].

Limitations

This study has some limitations. First, because participants of this research were randomly sampled, female undergraduates accounted for a larger proportion than males, which may cause deviations in outcomes. Second, the subjects of this research are all Chinese undergraduates (from 18–21 years old). Further studies could continue to explore the association in other age groups. Third, the PL and PA in this study were all collected from subject data (questionnaires of the PPLI and IPAQ). Hence, further research could use objective measures to arrive at more precise results.

Conclusion

This study aims to examine the relationship between perceived PL and PA levels among Chinese undergraduates through a cross-sectional study due to the lack of research focused on the topic. Additionally, the research investigated other factors, such as gender, BMI, GPA and SES differences, which are related to PA and PL levels. The results showed that the attributes of perceived PL and PA levels were associated with most of the domains of PA and factors of individual demographic. The only two factors unrelated to PL and PA were sedentary mode and higher GPA, indicating that the current system of education and examination may be responsible for the lower levels of PA amongst the students. This research focuses on university students who are at the last stage of the education process (beginning with primary school, high school and college). Thus, we highlight the importance of the association between PA and PL,

explored the concept of PL and examined how it can affect the PA of Chinese undergraduates. Furthermore, based on this study, more research could develop practical interventions to help Chinese undergraduates enhance their PL, which can motivate their motivation to engage in a lifetime of PA and have a healthy lifestyle.

Abbreviations

PL: Physical literacy; PA:Physical activity; WHO:World Health Organization; PPLI:Perceived Physical Literacy Instrument; PPLI-SC:the Simplified Chinese version of PPLI; IPAQ-SC:Simplified Chinese version of long for, of International Physical Activity Questionnaire; BMI:Body Mass Index; MET:Metabolic equivalent; GPA:Grade point average; SES:socio-economic status

Declarations

Ethics approval and consent to participate

The ethical approval was obtained from the Medical Ethics Committee of the First Affiliated Hospital of Jinan University. Study details was fully explained to the participants before the study. Before sending the questionnaire, all participants were asked to write informed consent that he or she volunteers to participate in the research.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated during the current study are not publicly available due the limitation of ethics approval and the datasets will continue to be used in further research. But are available from the corresponding author on reasonable request.

Competing interests

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

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Authors' contributions

Conceptualized the study: RSM & RKWS. Statistical analysis: RSM & ZCQ. Result interpretation: RSM. Prepared the first draft: RSM. Contributed during the conceptualization and interpretation of results and substantial revision: RSM, RKWS, YH, XLN. Edited and revised the final draft manuscript: RSM. All authors read and approved the final version of the manuscript.

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