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Physical Literacy in Female Youth: A Pilot Study Examining Its Association with Physical Activity, Sports Participation, and Physical Fitness

Koulla Parpa [1,*], Ana Carolina Paludo [2], Efstathios Christodoulides [1], Magdalena Kobus [3] and Marcos Michaelides [1]

[1] Faculty of Sports and Exercise Science, UCLan University of Cyprus, Avenue 12-14, 7080 Pyla, Cyprus
[2] Faculty of Sports Studies, Incubator of Kinanthropology Research, Masaryk University, 601 77 Brno, Czech Republic
[3] Department of Anthropology, Faculty of Biology and Environmental Protection, University of Lodz, 90-237 Lodz, Poland
* Correspondence: kparpa@uclan.ac.uk

Abstract: This pilot study aimed primarily to investigate the association between perceived physical literacy (PL) and participation in organised sports and self-organised physical activity (PA) in female youth athletes and non-athletes. A secondary purpose was to investigate the association between perceived PL and physical fitness among female youth athletes. A convenient sample of 18 female youth soccer athletes (age: 14.56 ± 1.42 years) and 18 female youth non-athletes (age: 14.22 ± 1.22) underwent anthropometric measurements and responded to PL and PA questionnaires. The athletes completed physical fitness tests (e.g., cardiopulmonary, isokinetic, handgrip, and jump tests). The results indicated that the female athletes presented significantly higher scores for perceived PL and self-organised PA compared to the non-athletes. The PL components 'sense of self and self-confidence' and 'knowledge and understanding' were significantly associated with self-organised PA in both the athletes and the non-athletes, as well as with organised sports. An association was found between the total PL score for the athletes and the squat jump (r = 0.50), flexibility (r = 0.59), and left hamstring (r = 0.51) physical tests. The positive association between the self-perceived PL of female youth and their involvement in both organised sports and self-organised PA may help them fulfil their potential and also value and take responsibility for getting involved in PA for life.

Keywords: youth athlete; physical literacy; sports participation

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1. Introduction

In 2015, the International Physical Literacy Association (IPLA) defined physical literacy (PL) as the motivation, physical competence, confidence, knowledge, and understanding to value and take responsibility for being active for life [1]. Therefore, everyone who is committed to their PL journey is a motivated, confident, and skilful individual who engages in regular physical activity (PA) throughout their life. The benefits of regular participation in PA appear early in life and are associated with an increase in overall physical fitness; reduction in adipose tissue; attenuation in symptoms of depression and anxiety; enhancement of growth, development, thinking, and learning; as well as a reduction in the appearance of diseases and bad habits later in life [2–7]. Concurrently, recent studies have demonstrated a positive association between PL and health indicators such as aerobic fitness in school-aged children [8].

The new broader definition of PA states that 'PA involves people moving, acting and performing within culturally specific spaces and contexts, and influenced by a unique array of interests, emotions, ideas, instructions and relationships" [9]. Research has shown that many children and adolescents do not meet the minimum requirement of 60 min

of moderate to vigorous physical activity per day [10]. Participation in organised sports and self-organised physical activity can help children and adolescents meet this requirement [10,11]. However, this is not always sufficient to meet the full 60 min of physical activity per day. According to some studies, participation in organised sports can provide about 30 to 45 min of moderate to vigorous physical activity per day [10,11]. A common definition of 'organised PA' is engagement in sports modalities, either individual or team-sports, which involve rules, formal practice, and participation in competitions [6]. Self-organised physical activity, such as playing outside or riding a bike, can provide additional physical activity. However, not all children and adolescents have access to organised sports or safe places in which to engage in self-organised physical activity. Additionally, the increasing use of technology and sedentary behaviours such as watching television or playing video games can also contribute to reduced levels of physical activity in children and adolescents.

Soccer is one of the most popular sports modalities, with an exponential increase in the number of female players [12]. It has been recently estimated that around 40 million women and girls worldwide are playing soccer, and that number is expected to increase in future years [12]. As previously mentioned, studies suggest that organised sports participation (such as playing soccer) increases the likelihood of meeting PA recommendations [11,13]. Concurrently, sports participation has been associated with greater levels of PA [14], healthier eating habits [14], bone, skeletal and psychosocial health [15], reduced stress levels, and a reduction in bad habits such as alcohol consumption and smoking [6,16].

Based on the above, it is reasonable to suggest that PL could be a gateway to increasing PA and sports participation and, therefore, may be an indirect determinant of health. Therefore, further research on the relationships between PL, PA, sports participation, and physical fitness is necessary to advance knowledge in this field. To the best of our knowledge, no studies have examined the importance of PL in PA or sports participation. Furthermore, no studies have examined a possible difference in the association between perceived PL, PA, and physical fitness in youth who engage in sports compared to those who do not. Therefore, this pilot study aimed primarily to investigate the association between PL, body composition, participation in organised sports, and self-organised PA in female youth soccer athletes and non-athletes. In addition, a secondary purpose was to investigate the association between perceived PL and physical fitness among soccer players. For the first aim, it was hypothesised that youth athletes will present higher values for perceived PL and self-organised PA compared to youth non-athletes. Moreover, higher scores for perceived PL will be positively associated with better values for body composition and higher values for self-organised PA and sports participation. For the secondary aim of the study, it was hypothesised that perceived PL and physical fitness will be positively associated.

2. Materials and Methods

2.1. Sample

A stratified and convenient sample of female youth athletes and non-athletes was evaluated in this study. The athlete sample consisted of 18 female soccer players (age: 14.56 $\pm$ 1.42 years) belonging to the same team from Cyprus. The athletes trained 3–4 times per week for a duration of around 90 min per session and participated in one competitive match per week for the period of the competitive season, which lasted around nine months. The non-athlete sample consisted of 18 females (age: 14.22 $\pm$ 1.22) recruited from the same private school. Exclusion criteria included injuries or sickness preventing performance of the physical tests (for athletes) and wrongly completing the questionnaires (for both groups). Parents or legal guardians of both athletes and non-athletes signed an informed consent after being briefed on the study's purpose and significance and the involved risks (for athletes only). Approval was obtained from the ethics committee of Cyprus (EEBK EP 2022.01.290) and the study was carried out in accordance with the Declaration

of Helsinki [17]. Lastly, prior to any physical testing, the athletes had to obtain medical clearance for participation.

2.2. Study Design

Female non-athletes from the same school were required to complete the PL questionnaire and the PA and sports participation questionnaire, but were not required to perform the physical tests. Upon completion of the questionnaires, the non-athletes had their stature and body mass measured according to validated procedures [18], with the use of a wall stadiometer (Leicester; Tanita, Tokyo, Japan) and a standard digital scale. The athletes' data were collected at the end of the pre-season period. Their completion of the questionnaires was followed by the anthropometric measurements and physical tests. The athletes obtained clear instructions before the measurements were taken regarding not following any physical activity the day before the testing and being appropriately hydrated. The testing was carried out during regular training time (2:00–5:00 p.m.), while for those evaluations that the athletes were not familiar with, specific familiarisation sessions were provided.

2.3. Measurements and Data Collection Procedures

Measurements were performed in the order indicated below.

2.4. Self-Report Measures

Physical literacy (PL): The PL questionnaire consisted of 9 items rated on the basis of the Likert scale from one (strongly disagree) to five (strongly agree). The 9-item instrument was designed to assess the sense of self and self-confidence (questions 1, 4, 5), self-expression and communication with others (questions 6, 7, 8), and knowledge and understanding (questions 2, 3, 9) which are identified as key attributes of Whitehead's concept of PL [19]. Additional attributes that reinforce—and are reinforced by—these key attributes include, but are not limited to, confidence, motivation, physical competence, and interaction with the environment [19]. Questions included: 'I am physically fit, in accordance with my age' (sense of self and self-confidence), 'I have strong social skills' (self-expression and communication with others), and 'I am aware of the benefits of sports related to my health' (knowledge and understanding).

Physical activity and sports participation: The questionnaire included two questions used in previously published research [20,21] which have been demonstrated to be a valid screening tool to determine whether respondents are active enough to benefit their health [22]. The two questions were 'How many hours during the week are you training or competing in organised sport at a level that you become at least moderately out-of-breath and perspire?' and 'How many hours during the week are you physically active outside of organised sport and physical education at a level that you become at least moderately out-of-breath and perspire?' The first question was termed 'organised sport', and the second was termed 'self-organised physical activity'. The response options for these items were 'never', '1–2 h per week', '3–4 h per week', '5–7 h per week', '8–10 h per week', and '11 h or more per week'.

2.5. Anthropometric Measurements

Anthropometric measurements were recorded to determine the stature and body mass of the members of the sample. Height and body mass were measured according to validated procedures [18], with the use of a wall stadiometer (Leicester; Tanita, Tokyo, Japan) and a digital scale, and recorded to the nearest 0.1 kg and 0.1 cm, respectively.

2.6. Physical Fitness Tests

Before the performance tests, the athletes completed a 5 min warm-up on a Monark cycle ergometer (Monark 894 E Peak Bike, Weight Ergometer, Vansbro, Sweden) at a speed that was comfortable for them.

Countermovement jump (CMJ) and squat jump (SJ): Lower body explosive strength was evaluated using CMJ and SJ tests. The vertical jump performance was assessed using OptojumpTM photoelectric cells (Microgate, Bolzano, Italy), and the procedure followed accorded with previously validated methods [23]. Each athlete performed three CMJs and three SJs with the same rest period between the jumps. Athletes were instructed to stand between the Optojump bars and perform an SJ with their knee joint bent approximately 100 degrees. Next, they were instructed to descend into a semi-squat position and hold that position for approximately 3 s before takeoff. The SJ was repeated following the same instructions 3 times with 15 s intervals, and the maximum score out of the 3 trials was entered for statistical analysis. After that, each female soccer player performed 3 consecutive CMJs with the same time interval (break) between the jumps. In the CMJ, the athletes were instructed to start from an upright position and initiate the downward movement, which had to be followed by an upward movement leading to takeoff. For both tests, the athletes were instructed to keep their hands on their waist, without any swinging of the arms at any part of the movement. The maximum score out of the 3 valid jumps was reported for the statistical analysis. Those athletes who were not familiar with the tests performed familiarisation trials until the movement was performed correctly.

Isokinetic strength assessment: Isokinetic knee torque was examined with the use of the Humac Norm and Rehabilitation device (CSMI, Stoughton, MA, USA) according to previously validated methods [24]. Initially, the athletes were appropriately positioned on the isokinetic machine and the device was calibrated. The right knee was always the first knee to be tested. For familiarisation with the specific testing speed, the athletes performed five sub-maximal repetitions of concentric knee flexion and extension. It should be noted that all the athletes were already familiar with the isokinetic device and isokinetic testing as this was part of their pre-season testing protocol. Before the actual test, they were instructed to push as hard as possible throughout the full range of motion. Thereafter, they performed three maximal concentric flexion and extension repetitions at an angle speed of 60°/s. Verbal encouragement was provided during the test, and the athletes were also able to receive visual feedback on the computer screen. A 1 min rest period was offered between the familiarisation and test trials. After completion of the isokinetic testing, the athletes rested for 10 min before being prepared for the cardiorespiratory testing.

Cardiorespiratory exercise testing: The athletes performed a maximal incremental exercise test until volitional exhaustion on a treadmill (HP Cosmos Quasar med, HP Cosmos Sports and Medical GmbH, Nussdorf-Traunstein, Germany). The modified Heck incremental exercise protocol, previously used in female soccer studies, was applied using previously published guidelines [24,25]. A breath-by-breath analysis was performed using the Cosmed Quark CPET (Rome, Italy) system, and laboratory conditions were stable for the duration of the measurements (temperature 20–22 °C and relative air humidity around 50–60%). The test was completed when the athletes reached volitional exhaustion or when no variation in VO2 levels was evident despite an increase in workload. Thereafter, the results were filtered in order for the VO2max to be identified, based on the highest value for an average of 10 s. The ventilatory threshold and respiratory compensation point were identified using different criteria. The ventilatory threshold was identified using the V-Slope method and was verified at the nadir of the $VE/V^{\cdot} O_2$ curve. The respiratory compensation point was identified at the nadir of the $VE/V^{\cdot} CO_2$ curve.

Handgrip strength measurement: Grip strength was measured using a digital dynamometer (Takei Scientific Instruments Co., Ltd., Tokyo, Japan) in order to assess the maximum isometric strength of the forearm and hand muscles. The testing was conducted according to previously validated methods [26]. The athletes were instructed to squeeze the dynamometer and apply as much force as possible in a smooth motion without any jerky movements. The test was repeated 3 times for each hand and the maximum score out of the 3 repetitions was included for the statistical analysis.

2.7. Statistical Analysis

The homogeneity of variance assumption was examined utilising the Brown– Forsythe test, while the normality assumption was verified using the Shapiro–Wilk test. Means were compared using an independent samples *t*-test. The Pearson product-moment correlation coefficient was used to calculate the association between organised sports/self-organised physical activity and physical literacy. Correlations were interpreted on the following basis: trivial (0–0.1), small (0.1–0.3), moderate (0.3–0.5), large (0.5–0.7), very large (0.7–0.9), nearly perfect (0.9), and perfect (1.0) [27]. All statistical analyses were performed in IBM® SPSS® Statistics, version 26.0, for Windows (SPSS Inc., Chicago, IL, USA), and significance was set at a level of 0.05.

3. Results

Table 1 demonstrates the descriptive characteristics of age and anthropometric measurements, perceived PL, and self-organised PA in athletes and non-athletes. Athletes were significantly taller [t(34) = 2.86, p = 0.007] and had significantly lower body weight [t(34) = −2.77, d = 0.9, p = 0.009] and BMI [t(34) = −5.47, p = 0.00]; presented higher values for the PL attributes of 'sense of self and self-confidence' [t(34) = 4.67, p = 0.00)] and 'knowledge and understanding' [t(34) = 6.34, p = 0.00); and reported significantly more weekly hours of participation in self-organised physical activities [t(34) = 2.97, d = 0.9, p = 0.005] compared to non-athletes.

Table 1. Descriptive characteristics, PL, and self-organised PA in athletes and non-athletes (mean ± SD).

	Athletes (n = 18)	**Non-Athletes (n = 18)**	***t* Value**
Descriptive			
Age (yrs)	14.56 ± 1.42	14.22 ± 1.22	0.76
Height (cm)	160.98 ± 5.64	156.90 ± 2.21	2.86 **
Weight (kg)	53.03 ± 5.60	57.39 ± 3.64	−2.77 **
BMI (kg/m^2)	20.44 ± 1.84	23.31 ± 1.24	−5.47 **
PL			
Total PL score	36.33 ± 4.86	28.61 ± 5.81	4.66 **
Sense of self and self-confidence	12.33 ± 2.19	9 ± 2.09	6.64 **
Self-expression and communication with others	11 ± 1.81	10.39 ± 1.81	0.99
Knowledge and understanding	13 ± 1.84	9.22 ± 1.55	4.67 **
Self-Organised PA			
Hours per week			
1–2 h/week			
3–4 h/week		33.3% (n = 6)	
5–7 h/week	55.6% (n = 10)	50.0% (n = 9)	
8–10 h/week	44.4% (n = 8)	16.7% (n = 3)	
11+ h/week			

** t test is significant at the level of 0.01 (2-tailed); BMI: body mass index; PL: physical literacy; PA: physical activity.

The associations between PL and self-organised PA and sports participation are presented in Table 2. A positive and significantly large association was found between perceived PL and weekly hours of participation in self-organised PA in both the athlete and the non-athlete groups. Additionally, a positive and significantly large association was indicated between perceived PL and weekly hours of involvement in sports participation (soccer modality).

Table 2. Associations between perceived PL and participation in organised sports and self-organised physical activity.

	Self-Organised PA			Sports Participation (n = 18)
	Total (n = 36)	Athletes (n = 18)	Non-Athletes (n = 18)	
Total PL Score	0.70 **	0.60 **	0.60 **	0.69 **
Sense of self and self-confidence	0.65 **	0.59 **	0.48 *	0.70 **
Self-expression and communication with others	0.49 **	0.38	0.54 *	0.43
Knowledge and understanding	0.68 **	0.50 **	0.68 **	0.56 *

** Correlation is significant at the level of 0.01 (2-tailed); * correlation is significant at the level of 0.05 (2-tailed). PA: physical activity; PL: physical literacy; Total: athletes and non-athletes grouped together.

The associations between perceived PL and body composition and physical fitness are presented in Table 3. Negative and significant (moderate) associations were found between the total perceived PL score and BMI and weight for the total number of participants (athletes and non-athletes grouped together). When the participants were analysed separately, the total perceived PL score was significantly associated (negative and large associations) with BMI and weight only in the non-athlete group. Moreover, perceived PL in athletes was positively and significantly associated with some of the physical fitness tests, such as the squat jump, flexibility, and left hamstring torque, but not with handgrip strength, quadriceps torque production, running time on the treadmill, and VO2max.

Table 3. Associations between perceived PL and weight, BMI, and physical fitness parameters.

	Physical Literacy Total Score		
	Total (n = 36)	Non-Athletes (n = 18)	Athletes (n = 18)
BMI (kg/m^2)	−0.56 **	−0.51 **	−0.06
Weight (kg)	−0.43 **	−0.63 **	0.03
Squat jump (cm)			0.50 *
Flexibility (cm)			0.59 *
Left hamstring torque (Nm)			0.51 *
Right hamstring torque (Nm)			0.40
Left quadriceps torque (Nm)			0.38
Right quadriceps torque (Nm)			0.16
Right handgrip strength (kg)			0.24
Left handgrip strength (kg)			0.27
VO2max (ml/kg/min)			0.21
Running time (min)			0.43

* Correlation is significant at the level of 0.05 (2-tailed); ** Correlation is significant at the level of 0.01; (2-tailed); BMI: body mass index.

4. Discussion

To the best of our knowledge, this is one of the first studies investigating the association between perceived PL and body composition, participation in organised sports, and self-organised PA in female youth athletes and non-athletes. In addition, the association between PL and physical fitness was examined in our study. Based on our hypotheses, the study's key observations were that (1) female youth soccer athletes presented significantly higher scores for total perceived PL and self-organised PA compared to non-athletes;

(2) positive and large associations were indicated between PL and self-organised PA (athletes and non-athletes) and organised sports; and (3) PL was moderately associated with the squat jump, flexibility, and left hamstring torque.

Indeed, sports participation has previously been demonstrated to be associated with higher levels of PA [7,12], and this has been confirmed by our results. Female youth athletes involved in the organised soccer modality presented well-developed physical literacy, which could positively influence the extent of their involvement in self-organised activities, in turn leading to higher levels of PA compared to non-athletes. Moreover, it can be speculated that sports participation could play an important role in potentialising the 'sense of self and self-confidence' and 'knowledge and understanding' (components of PL) perceptions in female youth. As such a comparison has not been made before, these observations need to be interpreted with caution, considering the characteristics of the participants in our study.

The association between perceived PL and PA was investigated in previous studies, which indicated that higher levels of PL reduce sedentary behaviour and increase participation in physical activities [28–30]. Choi and colleagues (2018) studied male and female adolescents between the ages of 12 and 18, indicating a significant but low (r = 0.23) association between PL and PA [29]. In our study, the associations between PA (self-organised physical activity and organised sports participation) and the total score for PL were considered large (r = 70 for the total group and r = 60 for non-athletes). The higher association demonstrated in our study may be due to the inclusion of only female youth, even though studies suggest a nonsignificant difference in PL between genders [30]. Furthermore, the authors of the 2018 study explained that the low association between PL and PA they reported might be attributed to the fact that PL is a new concept in their country (China), and therefore that the adolescents might not have been fully aware of it. One could claim that this applies to Cypriot adolescents as well.

Regarding the relationship between PL and physical fitness in female youth athletes, significant positive associations were demonstrated between perceived PL and jumping performance, flexibility, and left hamstring torque. Interestingly, no significant association was found for VO2max measured by a cardiorespiratory test. A previous study suggested that cardiorespiratory fitness could be considered one of the most relevant and influential factors in the PL total score in children and adolescents [31]. Similar research indicated an association between PL and aerobic fitness in children, and those associations were directly explained by moderate to vigorous physical activity [16]. Cardiorespiratory testing has often been used as a physical fitness parameter; however, power and flexibility tests are also part of physical fitness determination. As no previous study tested the association between perceived PL and power and flexibility, it was not possible to speculate on the results of our study. Lastly, one previous study, which included 222 children, indicated a significant positive association ($R^2 = 0.23$, $p < 0.001$) between PL and percentage of body fat. While our pilot study did not assess body fat, we demonstrated significant and negative associations between total PL score and BMI (r = −0.56) and weight (r = −0.43) for the whole group. When athletes and non-athletes were analysed separately, the total perceived PL score was associated negatively only with BMI and weight in the non-athletic group.

Limitations

In addition to the small sample size, the PL and PA scores were self-reported. Given that PA levels were not directly measured, those values might have been over- or under-reported.

5. Conclusions

The results of our pilot study highlighted that the total perceived PL score of the athletes was significantly higher than that of the non-athletes. Both 'sense of self and self-confidence' and 'knowledge and understanding' were the components of PL that were significantly associated with self-organised PA (soccer players and non-athletes)

and organised sports. Furthermore, this pilot study indicated an association between PL score and jump performance, flexibility, and hamstring strength, suggesting a possible association between PL and physical fitness. Lastly, we demonstrated significant negative associations between total PL score and BMI and weight in the non-athlete group. Despite these significant findings, our results should be viewed with caution, as correlation does not mean causation. Furthermore, considering the small sample size, future studies with larger sample sizes are encouraged to verify our findings. On the basis of our results, sports experts, coaches, and families should focus on promoting and developing PL in youth. The focus should be on promoting PL in youth so that they acquire competencies and attitudes that will increase their PA for life.

The involvement of female youth in organised sports can potentialise the physical literacy attitude. Promoting the practice of sports participation and encouraging self-organised PA can help female youth to acquire a major sense of self and self-confidence and an attitude of knowledge and understanding, and to follow this pattern towards adulthood. Future studies are encouraged to better elucidate PL in youth, its possible effect on those involved in sports compared to non-athletes, as well as its long-term implications and impact.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethical Committee (EEBK EP 2022.01.290).

Informed Consent Statement: Informed consent was obtained from all legal guardians of the participants involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

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