

Physical Literacy as a Health Literacy Domain: Levels and Gender Differences in Physical Activity among Iranian Adolescents

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Background and Objectives: Physical literacy (PL) is emerging as a critical component of overall health literacy, providing the specific motivation, competence, and knowledge to maintain a physically active life. However, its levels and relationship with physical activity (PA) among Iranian adolescents remain largely unexplored. This study aimed to describe the levels of physical literacy and physical activity among high school adolescents in Northeast Iran and to examine the relationship between these two variables.

Materials and Methods: In this cross-sectional study conducted between March and June 2024, 1065 students (567 males, 498 females) aged 14–20 were recruited from public schools in Mashhad through multi-stage random sampling. Participants completed three questionnaires: 1) a demographic and lifestyle survey, 2) the Physical Activity Questionnaire for Adolescents (PAQ-A), and 3) the Adolescent Physical Literacy Questionnaire (APLQ). Data were analyzed using descriptive statistics and independent samples t-tests.

Results: The mean physical literacy score was 3.50 ± 0.80 (on a 1–5 scale), with 25.4% of participants demonstrating inadequate levels. The mean physical activity score was 2.44 ± 0.73 , with nearly half (48.3%) classified in the low activity category. While physical literacy scores were comparable between genders, a significant gender disparity was observed in physical activity levels, with females being substantially less active than males (2.23 ± 0.65 vs 2.62 ± 0.75 , $p < 0.001$).

Conclusion: While adolescents in Northeast Iran demonstrate moderate physical literacy levels, these do not translate into adequate physical activity, particularly among female students. The findings suggest that enhancing physical literacy—especially its translation into actual behavior—should be a key target in adolescent health promotion strategies. School-based interventions addressing gender-specific barriers are urgently needed to bridge this gap.

Keywords: Motor Activity, Adolescents, Secondary School Students, Sex Factors, Iran

Received: 03 April 2026

Accepted: 09 August 2026

Doi: 10.22038/jhl.2026.92474.1890

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Introduction

Adolescents' physical literacy (PL) and physical activity (PA) levels are increasingly recognized as crucial determinants of lifelong health, social well-being, and academic success (1). This is particularly urgent given the alarming global prevalence of insufficient physical activity, which exceeds 80% in school-aged adolescents and compromises both current cardiorespiratory and mental health while setting the foundation for future chronic disease risk (2, 3). The challenge is even more pronounced in Iran and other Asian countries, where cultural, infrastructural, and gender-based barriers further reduce activity levels, especially among girls (4, 5).

Physical literacy, defined as the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities throughout life, serves as a foundational driver for an active lifestyle (6, 7). It represents a multidimensional construct—encompassing cognitive, affective, and behavioral domains—that bridges the gap between health knowledge and health action (8). Physical literacy can be conceptualized as a specific domain of health literacy. According to Nutbeam's framework, health literacy consists of functional, interactive, and critical levels (9). Physical literacy aligns with these domains by combining functional knowledge and skills, interactive motivation and confidence, and critical awareness of barriers to physical activity (10). Within Iran, studies indicate that approximately 70% of adolescents do not meet recommended PA levels, with pronounced gender disparities significantly hindering girls' participation (5). Sedentary lifestyles, rapid urbanization, limited sports infrastructure, and specific sociocultural norms have been identified as key contributing factors to this pressing public health issue (11, 12).

Recent international research consistently confirms a strong positive relationship between physical literacy and physical activity, demonstrating that higher PL predicts increased engagement, greater enjoyment, and reduced barriers to participation (13-15). However, the existing body of evidence possesses significant limitations. Most studies have focused on younger children, with a notable scarcity of research targeting adolescents aged 14–20, a critical period for establishing lifelong habits (5, 11, 16, 17). Furthermore, many tools used to measure PL have lacked context-specific cultural adaptation, and few studies have adequately explored the complex interactions between gender, urban environment, and sociocultural variables within the Iranian context (16, 18).

Within Iran, previous studies have reported suboptimal physical literacy and physical activity levels, mostly conducted in Tehran and among younger adolescents. For example, Mohammadzadeh et al. (2020) found moderate levels of physical literacy among adolescents

in Tehran, while Alipour-Anbarani et al. (2022) emphasized the important role of family socioeconomic status in physical literacy (19, 20). However, there is a notable scarcity of research focusing on older high school adolescents aged 14–20 years, particularly in Northeast Iran. Regional differences in climate, cultural norms, urban infrastructure, and access to sports facilities in Mashhad may create a distinct context compared to other parts of the country.

This study, aims to fill this critical knowledge gap by systematically assessing the levels of physical literacy and physical activity among high school adolescents in Mashhad, the major metropolitan center of northeastern Iran. By utilizing a culturally adapted instrument and providing descriptive findings stratified by gender, this research seeks to establish a foundational evidence base to inform future health promotion strategies and educational policies tailored to the unique needs of this population. Therefore, the present study tested the following descriptive hypotheses: (1) high school adolescents in Northeast Iran exhibit moderate levels of physical literacy; (2) a substantial proportion of these adolescents demonstrate low levels of physical activity; and (3) there are significant gender differences in physical activity levels, with female adolescents being less active than males despite comparable physical literacy scores.

Materials and Methods

Study Design and Setting

This cross-sectional study was conducted between March and June 2024 to evaluate physical literacy (PL) and physical activity (PA) levels and their relationship among adolescent students aged 16–18 years in public high schools of Mashhad, Iran.

Participants and Sampling

This cross-sectional study was conducted in 2024 among 1065 high school students aged 14–20 years in Mashhad, the major metropolitan center and capital of Khorasan Razavi Province in Northeast Iran. Although the primary target population was adolescents aged 16–18 years, the final sample included participants aged 14–20 years due to the class-based cluster sampling approach, which is consistent with the validated age range of the APLQ.

The study population consisted of Iranian adolescents enrolled in public high schools across the city's seven educational districts. A multi-stage random sampling method was employed to ensure a representative sample. First, three out of the seven educational districts in Mashhad were randomly selected. From each district, one public all-boys and one public all-girls high school were randomly chosen. Subsequently, within each school, four classes were randomly selected, and all students in those classes who provided assent were invited to participate.

Sample Size Justification

The initial sample size was calculated for a cross-sectional design using the formula: $n = Z^2P(1-P)/d^2$, with $Z=1.96$ (95% CI), $P=0.5$, and $d=0.05$, yielding 384 participants. Accounting for a design effect of 1.5 due to cluster sampling and 10% potential attrition, the minimum target sample was 630. The final sample ultimately included 1065 students by enrolling all eligible participants within the randomly selected classes. This larger sample enhances the statistical power for subgroup analyses and provides more precise parameter estimates for the population.

Data Collection Instruments and Measures

Data were collected using a structured, self-administered questionnaire comprising three sections:

Sociodemographic and Lifestyle Characteristics: This section recorded age, gender, parental education and occupation, daily screen time, and sports club membership.

Anthropometric Measures: Data on weight (kg) and height (cm) were retrieved from the students' mandatory electronic health records, which are compiled at the beginning of the academic year by trained school health practitioners. This objective data was collected approximately one month prior to the administration of our research questionnaires.

Physical Activity Assessment: Physical Activity Assessment: The Persian version of the Physical Activity Questionnaire for Adolescents (PAQ-A) was used to assess general physical activity levels over the previous week (21). The instrument consists of 9 items scored on a 5-point scale. The final composite score ranges from 1 (low activity) to 5 (high activity). Participants were categorized into three activity levels: Low (1–2.33), Moderate (2.34–3.66), and High (3.67–5). As the PAQ-A is a self-reported questionnaire, the potential for recall bias and social desirability bias should be considered when interpreting the physical activity findings.

Physical Literacy Assessment: Physical literacy was measured using the standardized Adolescent Physical Literacy Questionnaire (APLQ) designed and validated for 16–18 year-olds by Alipour et al. in 2023 (5). This 34-item instrument assesses four core domains: information acquisition (8 items), information comprehension (11 items), information evaluation (6 items), and self-care skills (9 items). Responses are recorded on a 5-point Likert scale from 'never' to 'always.' The total score is transformed to a scale of 0–100 and interpreted using the following categories: Inadequate (0–50), Sufficient (50.1–66), Good (66.1–84), and Excellent (84.1–100). In the present study, the APLQ demonstrated excellent internal consistency (Cronbach's $\alpha = 0.92$).

Data Collection Procedure

Following approvals from the Education Ministry and school principals, trained researchers visited selected classes during school hours. The study was explained to students,

emphasizing voluntary participation and data anonymity. Students completed the paper-based questionnaire in approximately 20-25 minutes under researcher supervision.

Statistical Analysis

Data analysis was performed using SPSS Statistics version 16.0. Descriptive statistics are presented as frequencies (percentages) for categorical variables and means $\pm$ standard deviations for continuous variables. Group comparisons were made using independent samples t-tests. A p-value < 0.05 was considered statistically significant. Due to the cluster sampling design, the possibility of intra-cluster correlation was considered during sample size calculation; however, given the descriptive nature of the study, no additional adjustment for clustering was applied in the statistical analyses.

Results

Descriptive Characteristics of the Study Participants

The final analytical sample consisted of 1065 adolescents with a mean age of 16.42 ± 0.97 years (range: 14-20 years). The sample included 567 (53.24%) males and 498 (46.76%) females. As presented in Table 1, the mean weight of participants was 62.73 ± 14.70 kg, mean height was 169.78 ± 9.62 cm, and the average daily screen time was 4.24 ± 2.98 hours.

Regarding school grade, 456 (42.8%), 306 (28.7%), and 301 (28.3%) students were in grades 10, 11, and 12, respectively. The most common field of study was Technical and Vocational (35.1%, $n=374$), and the majority of students (68.1%, $n=725$) reported being members of a sports club or school sports team. Full details of demographic and baseline characteristics are provided in **Table 1**.

Table 1. Demographic and Baseline Characteristics of the Study Participants (n=1065)

Characteristic	Value
Age (years), Mean $\pm$ SD	16.42 ± 0.97
Weight (kg), Mean $\pm$ SD	62.73 ± 14.70
Height (cm), Mean $\pm$ SD	169.78 ± 9.62
Screen time (hours/day), Mean $\pm$ SD	4.24 ± 2.98
Gender, n (%)	
Male	567 (53.24)
Female	498 (46.76)
School Grade, n (%)	
Grade 10	456 (42.8)
Grade 11	306 (28.7)
Grade 12	301 (28.3)
Missing	2 (0.2)
Field of Study, n (%)	
Technical and Vocational	374 (35.1)
Humanities	276 (25.9)
Vocational Education	160 (15.0)
Experimental Sciences	143 (13.4)
Mathematics and Physics	109 (10.2)

Missing	3 (0.3)
Sports Club Member, n (%)	725 (68.1)

Physical Literacy and Physical Activity Scores

The scores for physical literacy and physical activity are summarized in **Table 2**. Male students demonstrated a slightly higher physical literacy score (3.53 ± 0.76) compared to females (3.47 ± 0.84). In contrast, a notable and statistically significant difference was observed in physical activity levels, with males reporting significantly higher scores than females (2.62 ± 0.75 vs 2.23 ± 0.65 , $p < 0.001$, Cohen's $d = 0.55$). The overall physical activity score for the total sample was 2.44 ± 0.73 .

Table 2. Physical Literacy and Physical Activity Scores by Gender

Variable	Total (n=1065)	Male (n=567)	Female (n=498)
Physical Literacy Score (1-5), Mean $\pm$ SD	3.50 ± 0.80	3.53 ± 0.76	3.47 ± 0.84
Physical Literacy Score (0-100), Mean $\pm$ SD	62.53 ± 19.98	63.14 ± 19.08	61.84 ± 20.95
Physical Activity Score (1-5), Mean $\pm$ SD	2.44 ± 0.73	2.62 ± 0.75	2.23 ± 0.65

Categorization of Physical Literacy and Physical Activity Levels

The categorization of participants based on their physical literacy and activity levels is detailed in **Table 3**.

Physical literacy assessment revealed that approximately one-quarter of the students (25.4%, $n=271$) had inadequate literacy levels, while 28.4% ($n=302$) demonstrated sufficient levels, 31.5% ($n=335$) good levels, and 14.0% ($n=149$) excellent levels. Although the mean physical literacy score (3.50 ± 0.80 or 62.53%) is close to the lower threshold of the "good" category, a notable proportion of participants (25.4%) fell into the inadequate category. This indicates that while the average score appears moderate, there is considerable variability in physical literacy levels among the adolescents.

Table 3. Categorization of Physical Literacy and Physical Activity Levels by Gender

Level	Total n (%)	Male n (%)	Female n (%)
Physical Literacy			
Inadequate (0-50)	271 (25.4)	136 (24.0)	135 (27.1)
Sufficient (50.1-66)	302 (28.4)	169 (29.8)	133 (26.7)
Good (66.1-84)	335 (31.5)	181 (31.9)	154 (30.9)
Excellent (84.1-100)	149 (14.0)	77 (13.6)	72 (14.5)
Missing	8 (0.8)	4 (0.7)	4 (0.8)
Physical Activity			
Low (1-2.33)	514 (48.3)	214 (37.7)	300 (60.2)
Moderate (2.34-3.66)	476 (44.7)	291 (51.3)	185 (37.1)
High (3.67-5)	72 (6.8)	59 (10.4)	13 (2.6)
Missing	3 (0.3)	3 (0.5)	0 (0.0)

In contrast, physical activity levels displayed marked differences by gender. The majority of female students (60.2%, $n=300$) were categorized in the low activity level, while only 2.6% ($n=13$) were in the high activity category. Among male students, the prevalence of low activity level was considerably lower (37.7%, $n=214$), and 10.4% ($n=59$) reported high activity levels. The gender difference in the distribution of physical activity categories was statistically significant ($p<0.001$).

Discussion

This cross-sectional study provides a comprehensive description of physical literacy (PL) and physical activity (PA) levels among 16–18-year-old adolescents in Mashhad, Iran. The key findings reveal three important patterns: (1) adolescents demonstrated moderate levels of physical literacy, (2) physical activity levels were alarmingly low, particularly among female students, and (3) a pronounced gender disparity existed in physical activity despite comparable physical literacy scores between boys and girls.

Levels of Physical Literacy and Physical Activity

The mean physical literacy score (3.50 out of 5) indicates a moderate to good level of competence, motivation, and understanding related to physical activity. However, when converted to a percentage (62.53), the average score lies just at the lower threshold of the "good" category (66.1), suggesting substantial room for improvement. Mohammadzadeh et al. (2020) reported an average PL score of approximately 90 (out of 125 scale) in Tehran adolescents, translating roughly to 72%, which is slightly higher but comparable, given methodological differences (19). Alipour Anbarani (2022) also found suboptimal but improving PL levels among 16-18-year-old Iranian youths(20), That reflecting insufficient education and practice opportunities in schools, especially where physical education hours are limited, as noted by Mohammadi et al. (2023) (22). The observed differences with previous Iranian studies may be attributed to several contextual factors. Studies conducted in Tehran (19, 20) generally report slightly higher physical literacy scores, which could be related to better access to sports facilities, higher socioeconomic status in the capital, and more developed physical education programs compared to Mashhad. In contrast, the lower physical activity levels in our study, especially among girls, are consistent with national patterns and may reflect stronger sociocultural barriers, different climatic conditions, and urban infrastructure challenges in Northeast Iran (23, 24). These regional variations highlight the importance of context-specific research in understanding physical literacy and activity behaviors across Iran.

PL among adolescents globally is typically moderate. Countries such as Canada, Australia, and Spain report partial competence and motivation for physical activity, although knowledge and behavior domains often lag behind (1, 14, 25). Boys generally exhibit higher PL than girls, although this varies culturally (26, 27). Enjoyment and motivation strongly correlate with

better PL, while social support from peers, parents, and teachers also plays a significant role in its development(27, 28). Socioeconomic status influences PL, with higher SES linked to greater literacy due to better access to resources, and quality physical education programs further enhance adolescent PL(29, 30). Overall, adolescent PL development depends on multifaceted social, environmental, and motivational factors that require supportive and inclusive environments to improve (31, 32) .

In contrast, the low level of self-reported physical activity is concerning. Nearly half of the participants (48.3%) were classified in the "low activity" category. National surveys indicate that nearly half of Iranian adolescents do not meet recommended PA levels, with urban residents being less active than rural counterparts due to urbanization, technological distractions, and lifestyle changes(23, 33). The decline in PA during adolescence is associated with increased sedentary behavior, academic pressures, and lack of supportive environments, highlighting the need for targeted interventions to promote active lifestyles among youths (24, 34).

The Gender Gap in Physical Activity

A striking finding of this study is the pronounced gender gap in PA levels, despite comparable PL scores between boys and girls. Specifically, the proportion of girls in the "low activity" category (60.2%) was nearly double that of boys (37.7%), and only 2.6% of girls were classified as highly active. The World Health Organization (WHO) reported that over 80% of adolescents worldwide fail to meet PA recommendations, with girls less active than boys in nearly all countries studied (35, 36). The disconnect between comparable physical literacy (PL) scores and substantially lower PA levels among girls resonates with prior research emphasizing that knowledge and skills alone do not guarantee active behavior, especially for girls who face distinct sociocultural and environmental barriers (37). These barriers include restrictive gender norms, concerns about body image, lack of safe and accessible spaces, and competing responsibilities such as academic and family duties (37, 38). This complexity is consistent with social-ecological models that consider individual, social, and environmental factors shaping health behaviors in adolescents (39, 40) .

Contrastingly, some high-income countries with proactive policies report narrower gender gaps, suggesting that tailored interventions targeting societal norms and infrastructure can reduce these disparities(40) . Overall, addressing both the psychosocial and structural barriers is essential to translate physical literacy into sustained physical activity among adolescent girls.

Implications for Theory and Practice

The findings of this study support the conceptualization of physical literacy as a distinct domain within the broader construct of health literacy. Consistent with Nutbeam's theoretical framework (9, 10), which delineates functional, interactive, and critical levels of health

literacy, our results indicate that many adolescents possess moderate functional knowledge and interactive motivation regarding physical activity. However, the observed gap between moderate physical literacy scores and low actual physical activity levels — particularly among girls — suggests that higher-order factors are limiting the translation of literacy into behavior.

These results align well with the Socio-Ecological Model, which emphasizes that individual factors (such as physical literacy) interact with interpersonal, organizational, community, and policy-level influences to shape health behaviors. In the present study, while individual-level physical literacy was relatively comparable between genders, sociocultural norms, safety concerns, and limited access to appropriate physical activity opportunities appear to function as significant environmental barriers, especially for female adolescents.

From a practical perspective, the findings highlight the need for multi-level interventions that go beyond traditional knowledge-based education. School-based health promotion programs should focus on creating enabling environments that facilitate the translation of physical literacy into sustained physical activity. This includes implementing gender-sensitive strategies such as single-sex physical education sessions, culturally appropriate activities for girls, teacher training to foster inclusive environments, and integration of physical activity into daily school routines.

Recommendations for Policy Makers

The findings offer clear directions for educational and public health policy:

1. ***National PA Promotion Campaigns:*** Develop and fund targeted, gender-sensitive national campaigns that address the specific barriers faced by adolescent girls, using relatable role models and media channels.
2. ***School Infrastructure Investment:*** Allocate resources to improve and maintain sports facilities in schools, ensuring they are accessible, safe, and welcoming for all students, especially girls.
3. ***Teacher Training and Curriculum Development:*** Mandate training for physical education teachers on strategies to engage low-active students, particularly girls, and revise curricula to include a wider variety of enjoyable, non-competitive activities.
4. ***Community Partnership Programs:*** Foster partnerships between schools and local municipalities to provide affordable, accessible, and supervised after-school PA programs in community parks and sports centers.

Study Limitations and Strengths: Our study has several limitations. First, its cross-sectional design precludes any causal inference regarding the relationship between physical literacy and physical activity. Second, physical activity was assessed using the self-reported PAQ-A questionnaire; therefore, the possibility of recall bias and social desirability bias should be

considered. Third, the study was conducted only among urban public high school students in Mashhad, which limits the generalizability of the findings to rural areas, private schools, or other regions of Iran. Fourth, although a cluster sampling design was used and the design effect was considered in sample size calculation, no advanced statistical adjustment for clustering was applied. Future studies should include objective measures of physical activity (e.g., accelerometers) and more diverse samples to address these limitations.

Conclusion

In summary, this study reveals that adolescents in Mashhad possess a foundational level of physical literacy but that this potential is not being realized due to insufficient physical activity, with a pronounced gender gap disadvantaging girls. These findings present both an opportunity and an imperative. The opportunity lies in leveraging this foundational PL for more informed interventions. The imperative is to urgently address the structural, social, and cultural barriers that inhibit PA, particularly for girls. A concerted effort from educators, health professionals, and policymakers is essential to create environments that not only educate but also empower and enable all adolescents to lead active lives.

Acknowledgments: The authors would like to thank all participating students, school principals, and the education authorities in Mashhad for their cooperation.

Availability of data and materials: The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Conflict of interest: The authors declare no competing interests.

Consent for publication: Not applicable.

Ethics approval and consent to participate: The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (Ethics Code: IR.MUMS.REC.1403.203). All procedures were performed in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki. Given the minimal-risk nature of the anonymous questionnaire-based study, the ethics committee approved a waiver of written informed consent. A comprehensive passive parental consent procedure was implemented: detailed information sheets describing the study's purpose, procedures, and confidentiality measures were distributed to parents through school administrators. Parents were provided a two-week period to withdraw their child by contacting the research team or school principal. Immediately before survey administration, all participating students provided verbal assent after being informed of their right to decline or withdraw at any time without consequence.

Funding: This research received no external funding.

Author contributions: F.S, ELM and F.N did the research, wrote the manuscript, F.RB contributed to data collection. H,T critically reviewed the manuscript and approved the final version, F.N did the research, analyzed the data, and critically reviewed and edited the manuscript. All authors have read and approved the manuscript.

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