

## Article

# Physical Literacy as a Determinant of Mental Health and Physical Activity Engagement Among Cypriot Youth

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## Highlights

### What are the main findings?

- Perceived physical literacy was positively associated with physical activity and negatively associated with symptoms of depression, anxiety, and stress among Cypriot children and adolescents.
- Physical activity significantly mediated the relationship between PL and mental health, indicating both direct and indirect pathways linking PL to psychological wellbeing.

### What are the implications of the main findings?

- Strengthening physical literacy from early childhood may contribute to sustained engagement in physical activity and improved mental health during adolescence.
- Integrating PL-focused frameworks within school curricula and community initiatives could support more holistic and inclusive approaches to youth health and wellbeing.

## Abstract

Over the past two decades, the concept of physical literacy (PL) has gained increasing attention across research and policy domains. Grounded in holistic and embodied theoretical frameworks, PL encompasses physical, affective, cognitive, and social dimensions that underpin lifelong engagement in movement. Global policy frameworks, including the World Health Organization's Global Action Plan on Physical Activity (2018–2030) and UNESCO's Guidelines for Quality Physical Education, highlight PL as a foundation for health and wellbeing. Despite this recognition, research examining the associations among PL, physical activity (PA), and mental health in Mediterranean contexts remains scarce. This study examined the interrelationships among perceived PL, PA, and MH in a sample of 542 Cypriot children and adolescents aged 6–18 years. Participants completed the Perceived Physical Literacy Instrument (PPLI), the Physical Activity Questionnaire for Older Children (PAQ-C), and the Depression, Anxiety, and Stress Scale (DASS-21). Structural Equation Modelling (SEM) was used to test direct and indirect effects, and multi-group analyses explored measurement and structural invariance across gender and age. Results indicated that higher perceived PL was associated with better MH, both directly and indirectly through increased PA. Boys and younger participants reported higher PA levels, whereas adolescents displayed higher symptoms of depression, anxiety, and stress. However, the structural relationships among PL, PA, and mental health were consistent across genders.



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The findings highlight the role of PL as a multidimensional determinant of youth wellbeing and underscore the importance of promoting physical literacy aligned behaviours from early childhood within educational and community settings.

**Keywords:** physical literacy; physical activity; mental health; children; adolescents; wellbeing; Cyprus

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## 1. Introduction

Mental health is a dynamic state of equilibrium that enables individuals to realise their potential, manage everyday stresses, work productively, and contribute to their communities. It encompasses cognitive and social competences, emotional awareness and regulation, empathy, resilience in the face of adversity, and a harmonious integration of body and mind [1]. Hence, supporting mental health early in life is vital for proper development, reducing the risk of future psychological difficulties, and laying the foundation for long-term well-being. Evidence demonstrates that infancy and early childhood constitute critical developmental windows, during which early experiences and interventions exert long-lasting effects on psychological functioning. For instance, research indicates that interventions targeting parental mental health in the perinatal and early years can enhance secure attachment, emotional regulation, and social competence in children, thereby reducing the likelihood of later difficulties [2]. When early signs of psychological distress remain unaddressed, however, trajectories of vulnerability can emerge, increasing the risk of adverse outcomes in adolescence and adulthood. Indeed, mental health difficulties during childhood or adolescence have been consistently associated with reduced life satisfaction, impaired social and academic functioning, and diminished health-related quality of life in adulthood [3].

Against this background, physical activity (PA) emerges as a particularly potent protective factor. Beyond its well-established physiological benefits, such as reducing cardiovascular disease risk, preventing chronic conditions, and lowering mortality, PA is strongly associated with mental health promotion and illness prevention [4]. A growing body of evidence indicates that even modest amounts of PA exert significant psychological benefits. For example, a large-scale systematic review demonstrated that engaging in as little as one hour of exercise per week could prevent approximately 12% of future cases of depression, while simultaneously enhancing overall emotional well-being [5]. The evidence thus positions PA as a cornerstone of holistic health, bridging physical, psychological, and social domains.

The developmental significance of PA is particularly pronounced during childhood and adolescence. These stages of life are characterised by rapid physical growth, cognitive expansion, and emotional maturation, all of which are influenced by levels of physical engagement [6]. Numerous studies have documented the role of PA in reducing symptoms of depression, anxiety, and stress [7,8], while also supporting self-esteem, social connectedness, and cognitive functioning [9,10]. Recently, attention has shifted from participation in PA alone toward the broader and more nuanced construct of physical literacy (PL) [11,12].

PL has increasingly been recognised as a multidimensional and lifelong determinant of active living. Originally articulated through pedagogical frameworks, PL has expanded over the past two decades into a holistic concept comprising four interrelated domains: physical competence, cognitive understanding, affective dispositions, and social engagement. Unlike narrower approaches that equate physical development with motor skills alone, PL emphasises the integration of motivation, confidence, knowledge, and movement

competence, thereby promoting sustained engagement across diverse physical activities. This person-centred orientation aligns with contemporary health promotion paradigms, which value holistic development and lifelong participation over performance outcomes. The international recognition of PL is reflected in influential policy frameworks. The World Health Organization's Global Action Plan on Physical Activity 2018–2030 [13] and UNESCO's Guidelines for Quality Physical Education [14] highlight PL as a critical foundation for both public health and educational practice. Moreover, the recent UNESCO (2024) report [15], reinforces the imperative to embed PL into physical education globally, thereby promoting inclusion, equity, and lifelong participation in movement. Such documents not only reflect but also shape the paradigmatic shift from performance-oriented physical education toward inclusive and developmentally supportive approaches that foreground PL. Research evidence increasingly supports the association between PL and mental health. Melby et al. (2022) argue that PL development fosters positive attitudes toward movement, enhances resilience, and mitigates risks associated with inactivity, low self-esteem, and social exclusion [16]. A recent systematic review and meta-analysis also confirmed that PL interventions exert significant positive effects on the motivational and confidence domains, suggesting considerable potential for applied practice [17]. Furthermore, PL's heuristic and adaptable nature enables its application across diverse cultural, developmental, and educational contexts, enhancing its relevance for global and local health agendas. Importantly, due to its heuristic value and open nature, the concept of PL can be adapted and applied across diverse populations, age groups, and settings [11,17].

Emerging empirical work underscores the potential of PL to support mental health outcomes. A recent large-scale study with more than 1,000 Chinese adolescents (aged 10–18) revealed that higher PL was associated with better self-rated mental health [18]. Notably, this relationship was partly mediated by resilience, with more active adolescents demonstrating stronger connections between PL and resilience. Interestingly, PA did not directly moderate the relationship between PL and mental health, suggesting that PL functions as an independent and multidimensional determinant of psychological well-being. These findings highlight the importance of considering PL alongside, rather than merely as a facilitator of, PA engagement. Nonetheless, the broader evidence base remains fragmented, particularly with respect to long-term adherence and psychosocial outcomes, and very little is currently known about these relationships in Mediterranean populations.

The developmental transition from childhood to adolescence needs particular attention, as research suggests that attitudes toward PA often decline during adolescence, accompanied by reduced participation rates and more critical self-assessments of physical ability. Despite these trends, relatively few studies have examined the interplay between PL, PA, and mental health across childhood and adolescence, particularly in relation to group differences such as age and gender [19]. Existing work has often focused on these variables in isolation rather than integrating them into a coherent developmental framework [20]. Cairney et al. (2019) emphasise the need to explore these interrelationships more systematically, as doing so could yield insights that inform age- and gender-sensitive intervention strategies [21]. Deepening our understanding of these dynamics could provide valuable insights for designing interventions and strategies that promote healthier developmental outcomes. In particular, strengthening PL in tandem with supporting mental health may create more targeted and effective programs that enhance both movement competence and psychological wellbeing in children and adolescents [22].

When considering Cyprus, the relationship between PA, PL, and mental health remains largely unexplored [19], with existing evidence tending to address these areas separately rather than examining their interrelationships. Investigating these associations in Cypriot youth is particularly important, as findings from other populations may not be directly

transferable to the Cypriot context. Cultural, social, and educational factors are likely to shape children’s and adolescents’ engagement in PA as well as their mental wellbeing, underscoring the need for research tailored to this population. Such work could generate critical insights for designing interventions that enhance both PL and mental health outcomes. This is particularly important given that many mental health disorders first emerge during adolescence [23], making early investigation and intervention especially timely.

The present study is designed to address these gaps by examining the associations between perceived PL, PA, and mental health outcomes among Cypriot children and adolescents. Specifically, it sought to investigate age and gender differences in these relationships, recognising that both developmental stage and gendered experiences of PA can profoundly shape patterns of engagement and psychological well-being. Specifically, the present study aims to address the following research questions (RQ):

**RQ1.** *What are the latent correlations among perceived PL, PA, and mental health in Cypriot children and adolescents?*

**RQ2.** *Does perceived PL directly predict mental health outcomes, or is this relationship mediated through PA?*

**RQ3.** *Do the measurement properties of perceived PL, PA, and MH scales demonstrate invariance across age groups (children vs. adolescents) and gender (girls vs. boys)?*

**RQ4.** *Are there significant group differences (i.e., age, gender) in perceived PL, PA, and MH?*

## 2. Materials and Methods

### 2.1. Study Design

This study adopted a cross-sectional design to explore potential group differences in PL, PA, and mental health at a single point in time. Data were collected in 2022 from primary and secondary school students in Cyprus. The questionnaire was administered online, and the first author was present throughout the process. On average, participants required approximately 20 min to complete the online questionnaire. The administration took place in the presence of both the first author and the students’ teachers. The study was carried out in accordance with the Declaration of Helsinki and received approval from the Cyprus National Bioethics Committee (EEBK EII 2022.01.108). Parents and their children were informed about the purpose of the study and provided written informed consent. Participants were also assured that their involvement was voluntary and that all responses would remain anonymous and confidential.

### 2.2. Participants

Participants were recruited through convenience sampling. A total of 542 students, aged 6–18, from 7 private English-speaking primary and secondary schools in Cyprus participated in this study, of whom 283 (52.2%) were girls and 259 (47.8%) were boys (Table 1).

**Table 1.** Demographic characteristics of the participants stratified by gender.

	Group	Boys	Girls	Total
N		259 (47.8%)	283 (52.2%)	542 (100.0%)
Age	6–12 years	126 (48.6%)	131 (46.3%)	257 (47.4%)
	13–18 years	133 (51.4%)	152 (53.7%)	285 (52.6%)

### 2.3. Measures

#### 2.3.1. Physical Literacy

Physical Literacy was assessed using the Perceived Physical Literacy Instrument (PPLI) [24]. The PPLI consists of nine items on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). These nine items are evenly distributed across three subscales: Knowledge and comprehension (3 items), Self-expression and communication with others (3 items), and Sense of self and self-confidence (3 items). Mean (M) and standard deviation (SD) values were calculated for each subscale and across all nine items, yielding an overall PL score. Previous research has demonstrated satisfactory internal consistency for the instrument's three-factor structure both internationally (e.g., Cronbach's  $\alpha$  ranging from 0.70 to 0.78 [24]) and in a Cypriot sample (Cronbach's  $\alpha$  ranging from 0.78 to 0.86 [19]). Cronbach's  $\alpha$  coefficients for the three subscales and the overall PL score ranged from 0.705 to 0.888, with comparable values observed for MacDonal's  $\omega$ , indicating satisfactory internal consistency across all subscales.

#### 2.3.2. Mental Health

Participants' mental health was assessed using the Depression, Anxiety, and Stress Scale-21 (DASS-21) [25], a widely used self-report instrument designed to evaluate three common emotional states associated with mental health issues: depression, anxiety, and stress. The scale contains 21 items, divided equally across three subscales with seven items assessing each construct. The Depression subscale assesses feelings such as hopelessness, sadness, and loss of interest in previously enjoyed activities. The Anxiety subscale evaluates symptoms including fear, nervousness, and panic, whereas the Stress subscale reflects perceptions of stress and tension experienced during the previous week. Responses are recorded on a four-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time), indicating the degree to which each statement applied to the respondent over the past week. Subscale scores were calculated by summing the relevant seven items, with higher scores indicating greater symptom severity. As the DASS-21 represents the shorter version of the original DASS (which has 42 items), the final scores for each subscale (Depression, Anxiety, and Stress) were multiplied by two. Scores are presented both as a total mental health score and as scores for every subscale separately [25]. Previous evidence from a Cypriot sample supported the psychometric properties of DASS-21, demonstrating good fit for the final 21-item 3-factor DASS model in both children and adolescents (e.g., overall Cronbach's *alpha* ( $\alpha$ ) 0.95, [19]). In the present study, Cronbach's  $\alpha$  ranged between 0.886 and 0.961, and McDonald's  $\omega$  ranged between 0.874 and 0.962, indicating excellent internal consistency across all factors.

#### 2.3.3. Physical Activity

Participants' PA levels were assessed using the self-administered Physical Activity Questionnaire for Older Children (PAQ-C) and Physical Activity Questionnaire for Adolescents (PAQ-A) [26,27]. The PAQ-C is intended to measure general PA levels in older children by asking respondents to recall their physical activities over the previous seven days. The PAQ-A was developed for adolescents in high school (typically grades 9–12, ages 14–19) and similarly assesses general PA over the past week. Both instruments are simple to administer in classroom settings, making them practical tools for assessing PA levels among children and adolescents. The questionnaires consist of eight items scored on a five-point Likert scale, with the cumulative score reflecting the participant's general level of PA. It should be noted that the PAQ-A includes an additional (ninth) dichotomous item relating to unusual activity patterns (e.g., illness); however, this item was excluded from the Likert-scale scoring and was not included in the calculation of the average PA score or in

subsequent analyses. Final PAQ-C & PAQ-A scores were calculated in accordance with the scoring instructions provided by Kowalski et al. (2004) [26]. Previous studies have recorded adequate reliability ( $\alpha$  ranging from 0.70 to 0.89) and validity for both the PAQ-C & PAQ-A, supporting their usefulness for measuring PA levels in children and adolescents [19,27]. In the present study, Cronbach's  $\alpha$  was calculated at 0.842 and McDonald's  $\omega$  at 0.847, indicating very good internal consistency.

#### 2.4. Data Analysis

Statistical analyses were performed using IBM SPSS and AMOS version 30.0 (IBM SPSS Corp., Armonk, NY, USA). Descriptive statistics were first calculated to summarize the data, with means (M) and standard deviations (SD) used to provide an overall picture of the variables under study. Prior to conducting group comparison analyses, the normality of the data distribution was assessed by examining the skewness and kurtosis of the dependent variables, confirming suitability for parametric analysis.

Pearson correlation coefficients ( $r$ ) were then computed to investigate the bivariate relationships among mental health, physical literacy, and PA variables. Statistical significance was set at  $p < 0.05$ .

To examine the hypothesized pathways between perceived PL, PA, and mental health, structural equation modelling (SEM) utilizing maximum likelihood estimation was employed. The measurement model proposed by Christodoulides et al. (2023) [19] was specified with latent variables indicated by observed scale items from the relevant instruments (PPLI for physical literacy, PAQ-C & PAQ-A for PA, and DASS-21 for mental health). Model fit was assessed using multiple fit indices, including the chi-square statistic ( $\chi^2$ ) and ratio to degrees of freedom ( $\chi^2/df$ ), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Normed Fit Index (NFI), Incremental Fit Index (IFI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA). Criteria for acceptable model fit included  $\chi^2/df < 3$  [28], CFI, TLI, NFI, IFI  $\geq 0.90$ , and SRMR, RMSEA  $< 0.06$  [29,30]. Structural paths were tested for significance, with  $p$ -values less than 0.05 considered statistically significant.

In addition, multi-group Confirmatory Factor Analysis (CFA) with maximum likelihood estimation was performed to assess measurement invariance of the SEM model across gender (boys vs. girls) and age groups (children vs. adolescents). Measurement invariance was evaluated sequentially through configural (same factor structure), metric (factor loading equality), and structural (covariance between factors) invariance models. Changes in CFI, RMSEA, and Root Mean Square Residual (RMR) between nested models were inspected to confirm invariance or detect differences. Model fit was evaluated using CFI, RMSEA and RMR. A criterion change  $\geq -0.010$  in CFI supplemented by a change  $\geq 0.015$  in RMSEA or a change  $\geq 0.030$  in RMR would indicate that the null hypothesis of invariance should be rejected [31].

Independent samples  $t$ -tests were conducted to compare PA levels between gender and age groups. Multivariate Analysis of Covariance (MANCOVA) was utilized to examine group differences in mental health outcomes (depression, anxiety, stress) and perceived PL subscales, with gender and age group as independent variables and PA level as a covariate to control for potential influence. For purposes of interpretation, significant multivariate effects were followed by univariate  $F$ -ratios [analysis of variance (ANOVA)] with Tukey's follow-up corrections, as well as multiple regressions for the PA covariate. To control whether the design was unbalanced, the equality of covariance matrices using Box's  $M$  test was used. The Box- $M$  test of equality of covariance for all MANCOVA for the independent variables were not statistically significant ( $p > 0.05$ ) and the normality assumption was assumed for all following analyses. Effect sizes were reported using partial eta squared

( $\eta^2$ ) for MANCOVA and Cohen’s *d* for *t*-tests, with thresholds interpreted as small (0.01), moderate (0.06), and large (0.14) for  $\eta^2$  [32], and small (0.2), moderate (0.5), and large (0.8) for *d* (Cohen, 1988) [33].

### 3. Results

All descriptive statistics of the (sub)scales used for the entire sample (*N* = 542) are presented in Table 2. In general, the students showed average levels of PA, PL, and overall mental health.

**Table 2.** Descriptive statistics and Cronbach  $\alpha$  indices of PPLI, DASS-21, and PAQ-C & PAQ-A scores for the entire sample.

Variables	Min	Max	M (SD)	Cronbach $\alpha$ –McDonald $\omega$
Mental Health (DASS-21)	0.00	56.00	16.55 (11.30)	0.961–0.962
Depression	0.00	56.00	15.85 (12.71)	0.927–0.927
Anxiety	0.00	56.00	16.57 (11.34)	0.874–0.874
Stress	0.00	56.00	17.23 (11.48)	0.886–0.887
Physical Literacy (PPLI)	1.00	5.00	3.69 (0.86)	0.888–0.877
Sense of self and self-confidence	1.00	5.00	3.58 (1.00)	0.805–0.812
Self-expression and communication with others	1.00	5.00	3.55 (0.99)	0.705–0.711
Knowledge and understanding	1.00	5.00	3.94 (0.96)	0.783–0.790
Physical Activity (PAQ-C/A)	1.00	4.86	2.91 (0.78)	0.842–0.847

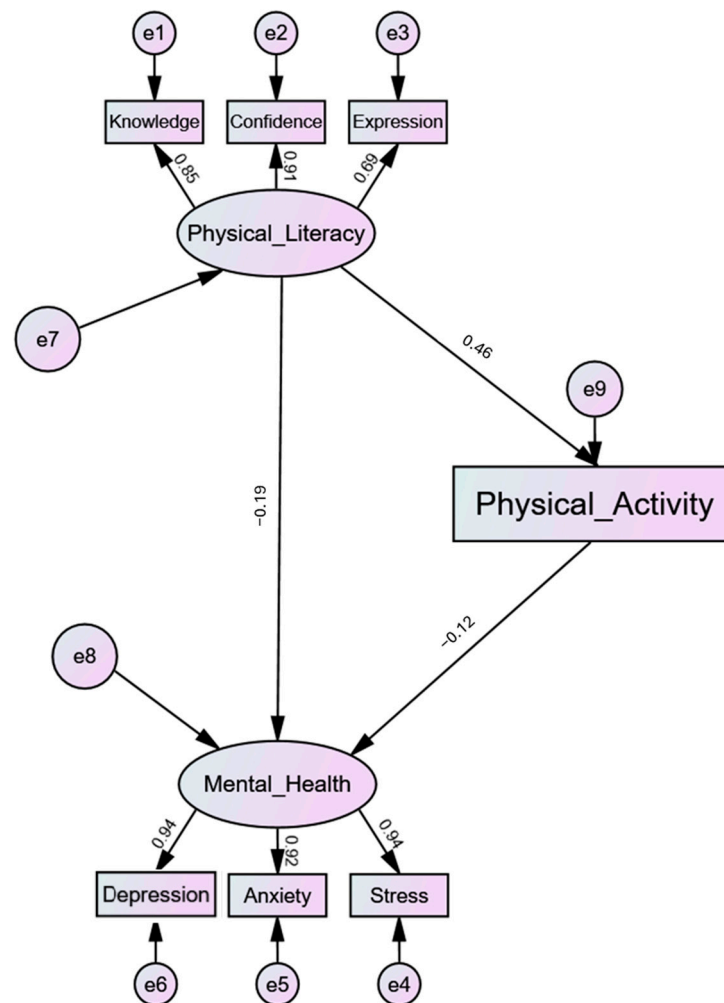
Following the initial descriptive analysis of the data, Pearson *r* correlations were calculated to examine potential relationship between the variables. Statistically significant negative correlations were observed between all mental health and PL variables, as well as mental health and PA (*p* < 0.001). In addition, PA was statistically significantly and positively correlated with PL variables (*p* < 0.001). All correlation results are presented in Table 3.

**Table 3.** Pearson *r* correlations between mental health, PL, and PA.

Variables	Physical Literacy	Knowledge and Understanding	Sense of Self and Self-Confidence	Self-Expression and Communication with Others	Physical Activity
Mental health	−0.243, <0.001	−0.164, <0.001	−0.205, <0.001	−0.271, <0.001	−0.196, <0.001
Depression	−0.250, <0.001	−0.173, <0.001	−0.210, <0.001	−0.276, <0.001	−0.210, <0.001
Anxiety	−0.224, <0.001	−0.145, <0.001	−0.191, <0.001	−0.255, <0.001	−0.183, <0.001
Stress	−0.218, <0.001	−0.148, <0.001	−0.183, <0.001	−0.244, <0.001	−0.167, <0.001
Physical activity	0.425, <0.001	0.334, <0.001	0.448, <0.001	0.338, <0.001	-

After establishing significant correlations between the tested variables, a SEM was implemented to test the significance of the hypothesized model. The measurement model provided an almost excellent fit [ $\chi^2 = 38.888$ , *df* = 12, *p* < 0.001,  $\chi^2 / df = 3.240$ , CFI = 0.990, IFI = 0.990, TLI = 0.982, NFI = 0.985, SRMR = 0.039, RMSEA = 0.064 (90% CI = 0.042–0.087)]. As Figure 1 shows, PL negatively affected mental health (*B* = −2.446,  $\beta$  = −0.186, *p* < 0.001). Additionally, PA significantly mediated the effect between PL (*B* = 0.441,  $\beta$  = 0.460, *p* < 0.001) and mental health (*B* = −1.585,  $\beta$  = −0.115, *p* = 0.018). Thus, the results revealed two possible pathways that influence mental health. The first pathway reveals the significant direct negative effect of PL (and all three associated factors) towards mental health (i.e.,

stress, anxiety, and depression). The second pathway shows the indirect positive effect of PL on PA, which in turn negatively affects mental health.



**Figure 1.** SEM results for the associations among PL, PA, and mental health in Children and Adolescents, with standardized path coefficients. Measurement errors are indicated with e1–e9.

Results from multi-group CFA (Table 4) indicated no significant reduction in model adjustments between the configural, metric, and structural invariance solutions for gender groups. Results from the metric invariance model suggested that all factor loadings were invariant for boys and girls ( $\Delta\text{CFI} = 0.001$ ;  $\Delta\text{RMSEA} = -0.006$ ;  $\Delta\text{RMR} = 0.002$ ). Furthermore, results from the structural invariance model demonstrated that the proposed model had similar correlations for gender ( $\Delta\text{CFI} = -0.003$ ;  $\Delta\text{RMSEA} = 0.009$ ;  $\Delta\text{RMR} = 0.003$ ).

The results from multi-group CFA for age-specific groups (i.e., children and adolescents) were slightly different, especially relative to structural invariance. More specifically, structural invariance was estimated above the acceptable thresholds for two of the three indices ( $\Delta\text{CFI} = -0.057$ ;  $\Delta\text{RMSEA} = 0.080$ ;  $\Delta\text{RMR} = 0.020$ ), indicating that structural parameters (e.g., factor variances, covariances, regression paths) might differ across age groups.

Following SEM and measurement invariance testing, comparisons between age groups were performed. Initially, the PA levels of boys and girls, and children and adolescents, were compared with independent sample t-tests.

A statistically significant difference with moderate effect size was observed for PA levels of boys and girls ( $t = -6.262$ ,  $p < 0.001$ ,  $d = 0.755$ , 95% CI =  $-0.710$  to  $-0.367$ ), with boys ( $M = 3.12$ ,  $SD = 0.77$ ) having higher PA levels than girls ( $M = 2.71$ ,  $SD = 0.75$ ).

Also, children ( $M = 3.02, SD = 0.72$ ) had significantly higher PA levels ( $t = 3.107, p = 0.002, d = 0.775, 95\% CI = 0.098$  to  $0.437$ ) than adolescents ( $M = 2.81, SD = 0.83$ ).

**Table 4.** Goodness-of-fit indices for the chosen fitted factor structure of the proposed model, as well as tests of measurement invariance for gender and age group.

Models	CFI	ΔCFI	RMSEA (90% CI)	ΔRMSEA	RMR	ΔRMR
Gender						
Configural invariance	0.989	-	0.046 (0.029–0.064)	-	0.030	-
Metric invariance	0.990	0.001	0.040 (0.023–0.057)	−0.006	0.032	0.002
Structural invariance	0.986	−0.003	0.055 (0.042–0.068)	0.009	0.063	0.003
Age group						
Configural invariance	0.982	-	0.054 (0.038–0.071)	-	0.034	-
Metric invariance	0.981	−0.001	0.050 (0.035–0.065)	−0.004	0.035	0.001
Structural invariance	0.925	−0.057	0.134 (0.122–0.146)	0.080	0.054	0.020

Note. CFI = Comparative fit index; ΔCFI = Difference comparative fit index; RMSEA = Root mean square error of approximation; ΔRMSEA = Difference root mean square error of approximation; RMR = Root mean square residual; ΔRMR = Difference root mean square residual; CI = Confidence interval.

The initial MANCOVA for the three mental health outcomes (i.e., depression, anxiety, and stress), with gender and age group as independent variables, and PA level as covariate, did not reveal statistically significant differences for the interaction between gender and age group [Wilk’s  $\Lambda = 0.990, F(3, 535) = 1.767, p = 0.152, \eta^2 = 0.010$ ]. The main effect of gender remained non-significant [Wilk’s  $\Lambda = 0.988, F(3, 535) = 2.180, p = 0.089, \eta^2 = 0.012$ ]. On the other hand, the main effect of age group was statistically significant [Wilk’s  $\Lambda = 0.579, F(3, 535) = 129.81, p < 0.001, \eta^2 = 0.421$ ]. The MANCOVA was followed up by post hoc ANOVA (Table 5), which showed that adolescents had significantly higher depression [ $F(1, 541) = 314.90, p < 0.001, \eta^2 = 0.370$ ], anxiety [ $F(1, 541) = 336.90, p < 0.001, \eta^2 = 0.386$ ], and stress levels [ $F(1, 541) = 341.05, p < 0.001, \eta^2 = 0.388$ ], compared to children, with large effect sizes.

**Table 5.** Follow-up ANOVA with Tukey correction for age groups on depression, anxiety and stress levels (adjusted for PA).

Variables	Age	M	SD	Univariate F	p	Partial $\eta^2$
Depression	Children	7.83	0.62	314.90	<0.001	0.370
	Adolescents	23.09	0.59			
Anxiety	Children	9.23	0.55	336.90	<0.001	0.386
	Adolescents	23.18	0.52			
Stress	Children	9.76	0.56	341.05	<0.001	0.388
	Adolescents	23.98	0.53			

PA level significantly mediated all mental health outcomes [Wilk’s  $\Lambda = 0.974, F(3, 535) = 4.728, p = 0.003, \eta^2 = 0.026$ ]. PA, as a covariate, was a significant negative predictor of depression ( $B = -1.999, p < 0.001, 95\% CI = -3.115$  to  $-0.884, \eta^2 = 0.023$ ), anxiety ( $B = -1.189, p = 0.018, 95\% CI = -2.177$  to  $-0.201, \eta^2 = 0.010$ ), and stress ( $B = -1.001, p = 0.049, 95\% CI = -2.000$  to  $-0.002, \eta^2 = 0.007$ ), indicating that as PA increased, participants’ mental health levels ameliorated.

Regarding the perceived PL results (i.e., knowledge and comprehension, self-expression and communication with others, and sense of self and self-confidence), the MANCOVA with gender and age group as independent variables, controlling for PA level, did not reveal any statistically significant overall effect [Wilk’s  $\Lambda = 0.994, F(3, 535) = 1.118, p = 0.341, \eta^2 = 0.006$ ]. In addition, the main effects of gender [Wilk’s  $\Lambda = 0.996, F(3,$

535) = 0.682,  $p = 0.563$ ,  $\eta^2 = 0.004$ ] and age group [Wilk's  $\Lambda = 0.990$ ,  $F(3, 535) = 1.763$ ,  $p = 0.153$ ,  $\eta^2 = 0.010$ ] were not statistically significant, indicating that PL did not differ significantly among groups.

On the other hand, once more, PA significantly mediated all perceived PL outcomes [Wilk's  $\Lambda = 0.792$ ,  $F(3, 535) = 46.807$ ,  $p < 0.001$ ,  $\eta^2 = 0.208$ ]. PA, as a covariate, was a significant positive predictor of Knowledge and comprehension ( $B = 0.424$ ,  $p < 0.001$ , 95% CI = 0.322 to 0.527,  $\eta^2 = 0.111$ ), Self-expression and communication with others ( $B = 0.422$ ,  $p < 0.001$ , 95% CI = 0.317 to 0.527,  $\eta^2 = 0.104$ ), and Sense of self and self-confidence ( $B = 0.601$ ,  $p < 0.001$ , 95% CI = 0.499 to 0.702,  $\eta^2 = 0.202$ ), indicating that as PA increased, participants' perceived PL levels also increased.

#### 4. Discussion

PL is increasingly recognised as a crucial foundation for promoting lifelong PA and supporting mental health in young people [34]. Through its integration of physical, cognitive, affective, and social dimensions, PL provides children and adolescents with the skills, confidence, and motivation to engage meaningfully in PA. Emphasising PL's importance aligns with global health and education policies that advocate for holistic approaches to physical education and youth wellbeing [15]. Thus, the present study examined the interrelationships among perceived PL, PA, and mental health (MH) in Cypriot children and adolescents, with particular attention to gender- and age-related differences.

The findings indicate that PL plays a central role in shaping both PA participation and mental health outcomes (Figure 1). Higher levels of perceived PL were associated with greater engagement in PA and lower levels of Depression, Anxiety, and Stress. These relationships suggest that children and adolescents who perceive themselves as confident and capable movers are more likely to maintain active lifestyles and experience enhanced emotional wellbeing (Tables 2 and 3). This aligns with previous research demonstrating that PL is positively linked to resilience, motivation, and psychological health in youth populations [16]. Moreover, the results demonstrated that PA mediates the relationship between PL and mental health, suggesting that the benefits of PL on mental wellbeing are partly explained through increased engagement in physical activity. This finding reinforces the multidimensional character of PL, emphasising that it functions not only as an indicator of physical competence but also as a psychosocial resource supporting emotional health [35].

Gender-based analyses (Table 4) revealed that although boys reported higher levels of PA compared to girls, the structural relationships between PL, PA, and mental health remained consistent across genders. This suggests that while the extent of participation may vary, the underlying mechanisms linking PL to wellbeing function similarly for both boys and girls. However, persistent gender disparities in PA participation remain a concern. A systematic review by Duffey et al. [35] identified several key barriers contributing to adolescent girls' lower PA levels, including insufficient support from peers, family, and teachers, as well as a perceived lack of time. The authors emphasised that effective strategies should focus on developing inclusive curricula that challenge traditional gender norms and provide adequate training for educators to foster equitable participation [35]. In line with these observations, the present findings underscore the ongoing need to address the social and environmental barriers that restrict girls' engagement in PA, particularly those related to social expectations, self-efficacy, and access to supportive contexts.

On the other hand, age-related differences were more pronounced (Tables 4 and 5). Children reported higher PA levels than adolescents, while adolescents experienced higher levels of Depression, Anxiety, and Stress (Table 5). The absence of full structural invariance across age groups further suggests that the strength or nature of associations among

PL, PA, and mental health may evolve during development. This lack of equivalence implies that the underlying constructs might be organized or related differently in children compared to adolescents, reflecting potential developmental shifts in the construct or in the way it is measured. Consequently, caution is warranted when comparing structural relationships across these age groups, as different developmental stages may influence factor interrelations. Future research could aim to identify which specific structural paths differ and to explore the developmental mechanisms driving these age-specific dynamics, potentially by testing for partial invariance or employing longitudinal designs to track changes over time.

In addition, this finding aligns with developmental theories which posit that cognitive, emotional, and social processes evolve with age and may influence how different factors interact. For example, while the underlying factors may show strong relationships in adolescents, these relationships may be weaker or differently structured in children, reflecting their developmental stage. This result further suggests that adolescence represents a sensitive period during which motivational and behavioural pathways linked to PL and wellbeing may weaken. Early development of perceived PL during childhood could therefore lay the groundwork for sustained engagement and mental resilience during adolescence [36,37]. Embedding PL-focused interventions in primary education and community sport may act as an early protective factor against declining activity levels and the onset of mental health difficulties [38,39]. In practical terms, these findings highlight the importance of prioritizing the early development of physical literacy across educational and organized sport settings, while also giving particular attention to supporting adolescents and reducing barriers to participation for girls. In this regard, higher education institutions should consider how PE teachers, coaches, and practitioner preparation programs can better equip future professionals to develop physical literacy as a foundation for both physical activity participation and mental wellbeing.

Overall, this study contributes novel evidence from a Mediterranean context, confirming that PL is both directly and indirectly related to youth mental health through PA engagement. These results strengthen the conceptualisation of PL as a multidimensional determinant of holistic wellbeing and advocate for its integration into educational and public health strategies.

## 5. Conclusions

This study provides new empirical evidence on the associations among perceived PL, PA, and mental health in Cypriot children and adolescents. The findings illustrate that PL is a meaningful determinant of both behavioural and psychological wellbeing, exerting direct and indirect effects on mental health through PA engagement. The results highlight the importance of embedding PL principles within educational settings and community initiatives to support active and mentally healthy lifestyles from an early age.

Despite these valuable insights, the limitations of this study should be acknowledged. The cross-sectional design precludes causal inference, as associations observed between PL, PA, and mental health represent a single time point. The reliance on self-report measures may have introduced response bias, particularly given the young age of participants and potential differences in self-perception. Moreover, the sample, although sizeable, was drawn from private English-speaking schools and may not fully represent the broader Cypriot youth population. Future studies should employ longitudinal or experimental designs to examine causal pathways and developmental trajectories across different contexts and educational systems.

Further research could also explore additional mediating and moderating variables, such as social support, perceived competence, and cultural attitudes towards physical

activity, to deepen understanding of the mechanisms through which PL contributes to well-being. Expanding this line of inquiry across diverse European and non-European settings would enhance the generalisability of findings and inform evidence-based strategies for the promotion of PL as a cornerstone of youth mental health and holistic development.

Future research should also examine how targeted interventions, such as curriculum-based PL programmes, teacher training initiatives, and community sport schemes, can be systematically implemented and evaluated. Collaborative, cross-sectoral efforts between educators, health professionals, and policymakers are needed to translate evidence into sustainable practice. Broader, cross-cultural studies would further advance theoretical and practical understanding of how PL can underpin lifelong wellbeing and support inclusive participation in physical activity across diverse youth populations.

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## Abbreviations

The following abbreviations are used in this manuscript:

PA	Physical Activity
PL	Physical Literacy
DASS-21	Depression, Anxiety, and Stress Scale-21
PPLI	Perceived Physical Literacy Instrument
PAQ-C	Physical Activity Questionnaire for Older Children
SEM	Structural Equation Modelling
CFA	Confirmatory Factor Analysis

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