

Importance of physical fitness in physical literacy and life satisfaction of Physical Education students

Importancia de la condición física en la alfabetización física y la satisfacción vital de los estudiantes de Educación Física

*Carmen Galán-Arroyo, *Noelia Mayordomo-Pinilla, **Antonio Castillo-Paredes, *Jorge Rojo-Ramos
*Universidad de Extremadura (España), **Universidad de Las Américas (Chile)

Abstract. In recent years, research on physical literacy has experienced remarkable growth, identifying the factors in this multidimensional concept that may play a role in the acquisition of healthy habits. In addition, multiple studies have identified significant correlations between physical literacy and quality of life, although they did not find a reason for this relationship. One of the factors that could explain this behavior is physical fitness. Therefore, this study aimed to analyze the role of physical fitness and its components in the relationship between physical literacy and life satisfaction. For this purpose, the Mann-Whitney U test was used to analyze the differences in the scores of the questionnaires applied, Spearman's rho, to determine the correlations between physical literacy and life satisfaction, using Hedges' g for the interpretation of the effect size. In addition, a mediation analysis was conducted to understand how physical fitness affects the relationship between literacy and life satisfaction. A moderation analysis was then applied to explore whether variables related to physical fitness modified the correlation and added to the prediction model. Finally, the reliability and validity of the questionnaires were tested using Cronbach's Alpha and McDonald's omega coefficient. The results showed that physical fitness, especially cardiorespiratory fitness, was a moderator and mediator in this relationship, demonstrating that increasing cardiorespiratory fitness enhances the effect of physical literacy on improving life satisfaction among high school students.

Keywords: physical literacy, physical fitness, cardiorespiratory fitness, physical education, quality of life.

Resumen. En los últimos años, la investigación sobre la alfabetización física ha experimentado un notable crecimiento, identificando los factores de este concepto multidimensional que pueden desempeñar un papel en la adquisición de hábitos saludables. Además, múltiples estudios han identificado correlaciones significativas entre la alfabetización física y la calidad de vida, aunque no encontraron una razón para esta relación. Uno de los factores que podrían explicar este comportamiento es la condición física. Por lo tanto, este estudio tuvo como objetivo analizar el papel de la aptitud física y sus componentes en la relación entre la alfabetización física y la satisfacción con la vida. Para ello, se utilizó la prueba U de Mann-Whitney para analizar las diferencias en las puntuaciones de los cuestionarios aplicados, la rho de Spearman, para determinar las correlaciones entre la alfabetización física y la satisfacción vital, utilizando la g de Hedges para la interpretación del tamaño del efecto. Además, se realizó un análisis de mediación para comprender cómo afecta la condición física a la relación entre la alfabetización y la satisfacción vital. A continuación, se aplicó un análisis de moderación para explorar si las variables relacionadas con la aptitud física modificaban la correlación y se añadían al modelo de predicción. Por último, se comprobó la fiabilidad y validez de los cuestionarios mediante el alfa de Cronbach y el coeficiente omega de McDonald. Los resultados mostraron que la aptitud física, especialmente la cardiorrespiratoria, era un moderador y mediador en esta relación, lo que demuestra que el aumento de la aptitud cardiorrespiratoria potencia el efecto de la alfabetización física en la mejora de la satisfacción vital entre los estudiantes de secundaria.

Palabras clave: alfabetización física, aptitud física, aptitud cardiorrespiratoria, educación física, calidad de vida.

Fecha recepción: 23-05-24. Fecha de aceptación: 25-09-24

Carmen Galán-Arroyo
mamengalana@unex.es

Introduction

Physical literacy (PL) has recently attracted a great deal of interest from researchers, especially in the fields of physical education and student health. Whitehead (2007) defined this concept as knowledge, motivation, physical ability, confidence, and understanding in valuing and taking responsibility for participating in physical activities during different life stages (Whitehead, 2010). This concept constitutes the union of the physical, psychological, and behavioral dimensions of human beings, making it a holistic term (Whitehead, 2019), suggesting that PL is the cornerstone of physical activity performance throughout life (Cairney et al., 2019). Physical activity is a fundamental element in maintaining health, as evidence shows that it is a protective factor against the onset of diseases, in addition to improving or reversing their progress once they affect the individual (Abu-Omar et al., 2017; García-Hermoso et al., 2019; Warburton y Bredin, 2017). The role of PL lies in showing students the importance of physical activity among other

healthy habits, presenting physical activity and exercise as tools that can be applied to improve their health (Caldwell et al., 2020; Carl et al., 2022). In addition, in this age group, studies show that it is a fundamental stage in the creation of habits, as they tend to be maintained in future life periods (Lioret et al., 2020; Telama, Risto Yang et al., 2014). In a study of the connections between literacy and physical fitness (PF), research indicated an intercorrelation with healthy habits. PF is an important marker of health; therefore, PL, as a tool for its promotion, inherently links them. However, the literature has not yet determined why literacy increases with exercise or whether the amount of exercise increases with the level of literacy (Cornish et al., 2020). On the other hand, PL contemplates general health, physical confidence, and capacity, and thus, includes quality of life. Physical activity, which is a fundamental component of these terms, is associated with self-esteem, self-concept, and other psychosomatic factors. In this sense, PL can increase self-esteem and psychological satisfaction, thus improving quality of life (Ma et al., 2021; Melby et al., 2022;

She et al., 2023).

The World Health Organization (WHO) includes quality of life as a fundamental factor that should be present in the definition of well-being (Casey et al., 2016). Quality of life is defined as the personal perception of one's life within a specific sociocultural context (Dumuid et al., 2017; Estoque et al., 2019). Life satisfaction is framed within the cognitive dimension of well-being perceived by the subject, and is a fundamental component of the quality of life of individuals (Vehkakoski, 2020). This component contributes to the development of general well-being because it evaluates life situations as satisfactory or unsatisfactory globally (Karataş et al., 2021). These constructs have a common psychosocial component that is strongly linked to physical activity (Pefoulidou et al., 2023). Physical activity, in addition to developing psychomotor skills, improves mental health through self-perception and physical self-concept, which are fundamental to life satisfaction and mental health, particularly in children and adolescents, considering the physical changes that occur at these ages (Babic et al., 2014; Benitez-Sillero et al., 2023). It is essential to influence the creation of healthy habits through PL during childhood and adolescence (Dimitri et al., 2020). Studies have shown that PL is associated with high self-esteem and a better general state of well-being (Ma et al., 2021; Meng et al., 2023) and may be a factor to be considered in interventions to improve quality of life through the creation of healthy habits.

In the study of possible associations between mental health and PL, it would be interesting to evaluate other variables that could influence the dependent variable. In this context, PF could be considered, since in the definition of PL, physical competence and skill appear as part of the concept. PF is defined as a set of individual characteristics that allow performing daily tasks with vigor and without excessive fatigue, successfully overcoming obstacles (Caspersen et al., 1985), and encompassing general PF, muscular strength, cardiovascular endurance, speed, and flexibility. PF is strongly associated with a greater sense of self-concept, especially self-esteem and resilience (Tikac et al., 2022), as greater PF facilitates the achievement of motor goals and provides a greater sense of student satisfaction.

No articles in the scientific literature have studied the effect of PL on the quality of life or the role of PF as a mediator. Some studies have focused on resilience as part of PL and mental health, although in college students or individuals in adulthood (Ma et al., 2021), to the best of our knowledge, no study has explored the role of PF as a mediator or moderator in the relationship between PL and life satisfaction. For this reason, it is essential to examine the relationship between PL and life satisfaction in schoolchildren, as evidence shows its importance in the promotion of health at this stage, as well as to verify the role of PF in this relationship. therefore, the objective of this study was to determine the relationship between PL and life satisfaction, and to identify the role of PF and its subdivisions in the influence of both variables. In contrast, we propose a prediction model that includes the PL and PF components for life

satisfaction. The hypotheses of this study are as follows:

- H₁: PL positively affects life satisfaction.
- H₂: PF positively enhances the positive effect of life satisfaction.
- H₃: PF mediates the relationship between PL and life satisfaction.

Materials and Methods

Participants

The sample consisted of 812 participants selected using a non-probabilistic sampling method based on convenience sampling (Salkind, 1999). The sample was balanced in terms of sex, with 52% being girls and 48% boys. Similarly, in terms of the demographic location variable, 48.5% belonged to a rural environment, whereas 51.5% resided in urban areas. To determine whether schools were rural or urban, the criteria established by the Diputación de Cáceres (<https://www.dip-caceres.es/>) were followed, where localities with more than 20,000 inhabitants were considered urban areas and those with less than 20,000 inhabitants were considered rural areas. The mean age of the participants was 13.10 (SD=1.80). To participate in the study, they had to meet a series of requirements: a) have informed parental consent and b) be a student in the area of Physical Education in public schools in Extremadura in the Secondary Education cycle (from 12 to 18 years of age).

The study was conducted in accordance with the ethical provisions of the Declaration of Helsinki, and the protocol was approved by the Bioethics Committee of the University of Extremadura (Registration Code 6/2024).

Table 1 shows the participants' sociodemographic characteristics.

Table 1.
Sample characterization (N=812).

Variable	Categories	N	%
Sex	Boys	422	52
	Girls	390	48
School location	Rural	394	48.5
	Urban	418	51.5
Variable		M	SD
Age		13.10	1.80

N: number; %: percentage; SD: standard deviation; M: Mean.

Procedure

First, data were collected from public high schools providing Compulsory Secondary Education (ESO), with students aged 12–16 years, and baccalaureate, aged 16–18 years, in the autonomous community of Extremadura through the directory of the Department of Education and Employment of the Regional Government of Extremadura. Physical education teachers of the schools were contacted, enclosing a copy of the informed consent forms, objective of the study, and questionnaires to be applied. Once the invitation to participate in the study was accepted, a member of the research team went to the school to apply the questionnaires to students who wished to participate and signed parental consent.

At the time of administering the questionnaires, consent

was previously collected to confirm their participation. Subsequently, each student was provided with a tablet with the questionnaires. The researcher proceeded to read and explain each element of these tools to solve any doubts that the students might have and ensure that everyone understood the content of the questionnaires. The choice of electronic devices for the application, storage, and processing of data was motivated by the savings in material resources and time. All data were stored anonymously between September and December 2022, taking approximately ten minutes to complete the questionnaires.

Instruments

Sociodemographic data: A questionnaire with six questions was designed to determine the following sample characteristics: sex, age, height, weight, grade, and school location.

Students' Life Satisfaction Scale (SLSS) (Galindez y Casas, 2014): This scale was designed to determine the life satisfaction of students aged 8–18 years as a single construct relative to the last few weeks, with a total of seven items. For quantification, a Likert scale of 1-6, where 1 = "strongly disagree" and 6 = "strongly agree". Regarding the validity and reliability indices of the scale, the authors reported a Cronbach's alpha (α) of 0.81 and a Pearson's coefficient of 0.70.

Perceived Physical Literacy Instrument for Adolescents (S-PPLI): To measure knowledge of physical competence, confidence, motivation, and understanding of physical activity, a scale was developed specifically for adolescents (Sum et al., 2018). The Spanish version of this questionnaire was validated by López-Gil (López-Gil et al., 2023) was used. It has nine items divided into three factors: knowledge and understanding, self-expression and communication with others, and sense of self and self-confidence. To quantify these values, a Likert scale of 1-5, where 1 means "strongly disagree" and 5 means "strongly agree". Regarding reliability and validity values, the authors reported the following values: Cronbach's alpha (α) of 0.87, and the CFA showed that the responses adequately fit the three-factor structure adequately ($\chi^2=52.260$, $df=24$, $p < 0.001$, CFI = 0.976, RMSEA = 0.057, SRMR = 0.031).

Visual Analogical Scale of Physical Fitness Perception for Adolescents (VAS PF A): To assess self-reported PF in physical education students, the visual analogical scale of PF perception for adolescents (Mendoza-Muñoz et al., 2021) composed of five items (general PF, cardiorespiratory fitness, muscular strength, speed-agility, and flexibility) was used. The instrument uses a Likert scale of 1-10 with 1 = very poor and 10 = very excellent. The authors reported a high reliability index with a Cronbach's alpha $\alpha=0.860$ and fit values performed by means of a Confirmatory Factor Analysis (CFA) (Rojo Ramos et al., 2023) with the following results: $\chi^2=0.433$; $df=24$; $p < 0.001$; CFI = 0.999

RMSEA = 0.016; SRMR = 0.036. In this study, the reliability was checked to obtain satisfactory values according to Nunnally and Bernstein (Nunnally y Bernstein, 1994).

Statistical Analysis

First, the distribution of the data was examined to determine whether the assumption of normality was met to determine the type of statistical test to be used. The Kolmogorov-Smirnov test was used for this purpose. The results of this test revealed that this assumption was not met ($p < 0.005$). Therefore, nonparametric statistical tests were used. Subsequently, the Mann-Whitney U test was applied to analyze the differences in the scores obtained in the life satisfaction (SLSS), physical fitness (VAS PF A), and PL (S-PPLI) scales according to the sex of the participants. A significance value of $p < 0.05$.

Spearman's rho test was used to determine the degree of the relationship between PL and life satisfaction. For the interpretation of this statistic, ranges were established by Barrera (Mondragón Barrera, 2014). Additionally, Hedges' g was used to determine the effect size of sex on SLSS, VAS PF A, and S-PPLI (Cohen, 1988).

To examine the relationship between PL and life satisfaction, a mediation analysis was conducted to understand how PF acts as a mediator in this relationship. Additionally, a moderation analysis was conducted to explore whether variables related to PF modified the relationship between PL and life satisfaction.

An in-depth analysis of life satisfaction was conducted by using a stepwise regression test. A significance level of $p < 0.05$ was required to enter variables into the prediction model.

Finally, Cronbach's Alpha and McDonald's omega coefficients were used to assess the reliability of the psychometric scales, based on their internal consistency. To interpret the reported values, those established by Nunnally and Bernstein (Nunnally y Bernstein, 1994) were chosen. The maximum likelihood model (Omega ML) was used to calculate McDonald's Omega coefficient. The software used for data analysis was JAMOVI, version 2.4.8.0.

Results

Descriptive Analysis

Table 2 shows the results of the descriptive analyses by sex of the three questionnaires applied, referring to life satisfaction, PL, and PF, in addition to the effect size represented by Hedges' g . In all questionnaires, boys scored higher than girls, indicating higher life satisfaction, PL, and self-perceived PF. These differences were statistically significant ($p < 0.001$). The effect size was small in all three questionnaires ($0.21 < g < 0.49$). Additionally, the correlation between SLSS and S-PPLI was positive, direct, and significant ($\rho = 0.48$; $p < 0.001$).

Table 2. Descriptive analysis, differences, effect size, and relationship between Life Satisfaction and PL.

Variable	Total		Sex		p	g
	M (SD)	M (SD)	Boys			
			M (SD)	M (SD)		
SLSS	4.08 (0.75)	4.17 (0.75)	3.99 (0.75)		<0.001*	0.440
S-PPLI	4.07 (0.57)	4.17 (0.59)	3.96 (0.53)		<0.001*	0.372
VAS PF A	3.73 (0.69)	3.88 (0.71)	3.58 (0.64)		<0.001*	0.440
Variable	S-PPLI ρ (p)					
Life Satisfaction (SLSS)	0.48 (<0.001)					

Note: M: Mean value; SD: Standard Deviation. SLSS: Each score obtained is based on a Likert scale (1-6): 1 "Strongly disagree", 2 "moderately disagree", 3 "mildly disagree", 4 "mildly agree", 5 "moderately agree", 6 "strongly agree"; S-PPLI: Each score obtained is based on a Likert scale (1-5): 1 "Strongly disagree", 2 "Strongly disagree", 3 "Indifferent", 4 "Strongly agree", 5 "Strongly agree"; VAS PF A: every item ranges from 0 "very poor level" to 10 "excellent level".

Mediation analysis

To explore the possible relationship between PL, life satisfaction, and the mediating role of PF, mediation analysis was performed. The results presented in Table 3 suggest a significant influence of PL on life satisfaction both directly and through its effect on PF. The indirect ($axb = 0.116$, $p < 0.001$) and direct effects ($c = 0.564$, $p < 0.001$) were statistically significant, indicating that PF acts as a mediator in the relationship between PL and life satisfaction. Furthermore, the total effect ($c + axb = 0.680$, $p < 0.001$) confirms the robustness of this relationship.

Table 3. Mediation analysis of PF between PL and life satisfaction.

Effect	Label	β	SE	Boot 95% CI		Z	p
				LL	UL		
Indirect	a x b	0.116	0.030	0.055	0.176	3.78	<0.001
Direct	c	0.564	0.049	0.467	0.661	11.40	<0.001
Total	c + axb	0.680	0.039	0.602	0.758	17.18	<0.001

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05

Moderation analysis

The following analysis aimed to determine the role of PF in the relationship between PL and life satisfaction and found that both PL ($\beta = 0.539$, $p < 0.001$) and PF ($\beta = 0.160$, $p < 0.001$) had significant and positive effects on life satisfaction. However, the interaction between PL and fitness was not significant ($\beta = -0.077$, $p = 0.176$).

Finally, moderation analysis was performed to determine the role of flexibility in the relationship between PL and life satisfaction. PL was significantly positively correlated with PL and life satisfaction ($\beta = 0.461$, $p < 0.001$). On the other hand, flexibility had a negative direct effect on life satisfaction ($\beta = -0.117$, $p = 0.013$). The interaction between PL and flexibility showed a negative trend ($\beta = -0.125$, $p = 0.057$).

Table 4. Moderation Analysis of FP VAS Scores on PL and Life Satisfaction.

	β	SE	Boot 95% CI		Z	p
			LL	UL		
S-PPLI	0.539	0.058	0.427	0.651	9.24	<0.001
VAS PF A	0.160	0.046	0.071	0.252	3.49	<0.001
S-PPLI * VAS PF A	-0.077	0.057	-0.189	0.043	-1.35	0.176

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05. The results of the moderation analysis highlighted a positive and significant effect of PL on life satisfaction ($\beta = 0.338$, $p < 0.001$), as well as a favorable impact of general PF and the dimension of the VAS PF A ($\beta = 0.387$, $p < 0.001$). Significant results were obtained for the interaction between PL and general PF ($\beta = 0.289$, $p = 0.006$).

Table 5. Moderation analysis of general PF on PL and life satisfaction.

	β	SE	Boot 95% CI		Z	p
			LL	UL		
S-PPLI	0.338	0.078	0.177	0.486	4.33	<0.001
General PF	0.387	0.088	0.199	0.556	4.38	<0.001
S-PPLI * General Physical Fitness	0.289	0.105	0.071	0.495	2.75	0.006

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05. In moderating SLSS and respiratory capacity, the results confirmed a significantly positive effect of PL on life satisfaction ($\beta = 0.370$, $p < 0.001$); however, cardiorespiratory capacity itself did not show a direct association with life satisfaction ($\beta = 0.012$, $p = 0.736$). However, the interaction between PL and cardiorespiratory capacity was significant and inverse ($\beta = -0.113$, $p = 0.04$).

Table 6. Moderation analysis of cardiorespiratory capacity in PL and life satisfaction.

	β	SE	Boot 95% CI		Z	p
			LL	UL		
S-PPLI	0.370	0.071	0.217	0.508	5.168	<0.001
Cardiorespiratory fitness	0.012	0.038	-0.057	0.094	0.337	0.736
S-PPLI * Cardiorespiratory fitness	-0.113	0.055	-0.225	-0.006	-2.027	0.04

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05. Again, the results reveal a significant and direct relationship between PL and life satisfaction ($\beta = 0.442$, $p < 0.001$). No significant direct relationship was found between muscle strength and life satisfaction ($\beta = -0.062$, $p = 0.217$), and PF was not a significant moderator of the relationship between PL and life satisfaction ($\beta = -0.086$, $p = 0.265$).

Table 7. Moderation analysis of muscle strength in PL and life satisfaction.

	β	SE	Boot 95% CI		Z	p
			LL	UL		
S-PPLI	0.442	0.066	0.310	0.572	6.68	<0.001
Muscular strength	-0.062	0.050	-0.154	0.037	-1.24	0.217
S-PPLI * Muscular strength	-0.086	0.077	-0.242	0.060	-1.12	0.265

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05. Continuing with the dimensions of PF, the following analysis assessed the role of speed as a moderator of the relationship between PL and life satisfaction. As in previous analyses, there was a direct and significant association between PL and life satisfaction ($\beta = 0.425$, $p < 0.001$). Speed did not show a significant direct effect on life satisfaction ($\beta = -0.063$, $p = 0.122$), although its interaction with PL was significant ($\beta = -0.156$, $p = 0.006$).

Table 8. Moderation analysis of speed in PL and life satisfaction.

	β	SE	Boot 95% CI		Z	p
			LL	UL		
S-PPLI	0.425	0.071	0.283	0.560	5.92	<0.001
Speed	-0.063	0.040	-0.144	0.016	-1.55	0.122
S-PPLI * Speed	-0.156	0.056	-0.282	-0.054	-2.76	0.006

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05

Table 9. Moderation analysis of flexibility in PL and life satisfaction.

	β	SE	Boot 95% CI		Z	P
			LL	UL		
S-PPLI	0.461	0.060	0.346	0.582	7.59	<0.001
Flexibility	-0.117	0.047	-0.206	-0.020	-2.48	0.013
S-PPLI * Flexibility	-0.125	0.065	-0.259	0.014	-1.90	0.057

Note: SE: Standard Error; LLCI: Lower Limit Confidence Interval; ULCI: Upper Limit Confidence Interval; p is significant at <0.05.

Regression Analysis

To identify the variables and factors that influence life satisfaction, a linear regression analysis was performed, including the following variables: PL, age, PF, sex, demographic location, general physical fitness, cardiorespiratory capacity, muscular strength, speed, and flexibility. Table 10 shows the results of the model including PL, age, and general physical fitness as variables. The model achieved a coefficient of determination (R²) of 0.29, indicating that approximately 29% of the variability in the dependent variable was explained by the variables included in the model. This analysis reveals that both the S-PPLI and general physical fitness have direct and significant effects on the dependent variable, while age shows a negative relationship. Variables that were not statistically significant were excluded from the model. The regression equation is as follows:

$$\text{Life Satisfaction} = 1.739 + 0.544 (\text{physical literacy}) - 0.030 \times (\text{age}) + 0.160 \times (\text{general physical fitness})$$

Table 10. Life Satisfaction prediction model.

Variable	Model (R ²) = 0.29			
	β	SE	t	p
S-PPLI	0.544	0.050	10.766	<0.001
Age	-0.030	0.012	-2.393	0.017
General PF	0.160	0.055	2.882	0.004
Constant	1.739	0.277	6.269	<0.001

Note: SE: Standard Error; p is significant at <0.05.

Reliability Analysis

The reliability of the instrument was calculated based on its internal consistency of the three instruments using Cronbach's alpha and McDonald's omega statistics (ω=0.747). These values can be considered satisfactory according to Nunnally and Berstein (Nunnally y Bernstein, 1994).

Table 11. Cronbach's alfa and McDonald's Omega Test

Scale	Cronbach's alpha (α)	McDonald's Omega (Ω)
PL (S-PPLI)	0.750	0.755
PF (VAS PF A)	0.793	0.802
Life Satisfaction (SLSS)	0.814	0.826

Discussion

This study aimed to examine the relationship between physical literacy and life satisfaction by exploring the role of PF in this association. The results showed that physical literacy influences life satisfaction both directly and indirectly

through PF, revealing information about the interaction between these two variables in children and adolescents.

Overall, the results show that PL has a direct and positive effect on life satisfaction in all dimensions of PF, suggesting that the higher the level of literacy, the higher the life satisfaction, thus supporting Hypothesis 1. A review of reviews revealed the capacity of this construct to increase people's quality of life by improving health and well-being (Carl et al., 2023). In addition, PL has the potential to improve motor self-efficacy, making the individual feel more capable and fulfilled with himself/herself by meeting the demands placed on him/her by the environment (Jurbala, 2015). However, PL has been shown to promote the continued practice of physical activity, a fundamental factor in the preservation and improvement of health (Belanger et al., 2018), contributing to life satisfaction by acquiring new skills and abilities.

PF, improved through this continued practice of physical activity (Baumgartner et al., 2020), provides individuals with the necessary characteristics to meet the demands of the environment with vigor. The mediation analysis revealed the direct and indirect effects of literacy on life satisfaction, establishing PF as a mediating variable between the two, accepting the second hypothesis proposed. PF is a concept widely documented by the scientific community, stating that a high level of this element is associated with a higher quality of life and, therefore, a higher level of life satisfaction (Lepsy et al., 2021; Marquez et al., 2020; Pucicato et al., 2023). In this sense, different investigations have been carried out on the elements that influence quality of life, finding PL as an alternative to improve the life habits of people, especially children and adolescents, and increasing the knowledge of the importance of physical activity in the development of health (Clark et al., 2022). Other research has revealed a positive effect of PL on well-being, finding the level of physical activity as a mediator of this relationship, enhancing the positive effect of literacy on quality of life. In the composition of the concept of PL, multiple elements are part of its definition. Motor development is a pillar that supports both its concept and purpose and is framed as a set of motor skills and achievements (Jurbala, 2015). It is logical to include PF and its capabilities as mediators and moderators, since greater physical capacity enhances the acquisition of these skills included in PL.

Subsequent moderation analyses considering the different dimensions of self-reported PF as a conditioning element shows some variability. PL alone has the potential to produce positive effects on life satisfaction in all analyses; however, the components of PF exhibit different behaviors. Self-perceived PF, general PF, and flexibility alone affected life satisfaction. In the moderation study of the PF components, the VAS PF A, general PF, cardiorespiratory fitness, and flexibility appeared as moderators of the relationship between PL and life satisfaction. Therefore, only the third hypothesis is partially accepted. These results suggest that not all components of self-reported PF have the same magnitude of moderating PL. In the scientific literature, other

researchers have found general PF, cardiorespiratory fitness, and muscle strength as mediating agents of quality of life (Lang et al., 2018; Medrano-Ureña et al., 2020), partially contrary to those found in this study, since muscle strength does not act as a moderator of the relationship between both variables. This difference could be due to the heterogeneity of the methods applied, since in this case, more objective means were applied, while this work collected the values in a self-reported manner. Although no study has found a direct moderation of PF on the effect of PL, there is evidence of strong correlations between fitness and PL in children (Caldwell et al., 2020; Lang et al., 2018), as well as between fitness and life satisfaction, through the development of capacities and facilitation of task execution, reducing the effort of these, and improving dimensions such as socialization, a fundamental element in the quality of life (Batista Lemes et al., 2022; Di Bartolomeo y Papa, 2019); In addition, one study found physical activity as a mediating agent between PL and mental health (Christodoulides et al., 2023).

Related to the prediction model proposed in this study, PL moderated by cardiorespiratory fitness and negatively correlated with age explained 29% of the variability in life satisfaction. The scientific literature in this aspect supports these results, since different researchers have found positive correlations between PL and cardiorespiratory fitness (Lang et al., 2018; Tremblay et al., 2018), as well as a bidirectional relationship between physical activity and motor competence in children of similar ages, with the mediating effect of cardiorespiratory fitness. Thus, it is important to develop cardiorespiratory fitness to increase the level of PL on the one hand and improve the quality of health of individuals with the aim of increasing life satisfaction and quality of life (Köble et al., 2022). The trend in PL levels differed with respect to age. During childhood, studies report a higher level of literacy, which the authors attribute to the difference in time distribution between children and adolescents: children, having fewer obligations, can devote a greater percentage of their day to physical activity on the street, developing their motor competence and PF. However, as adolescents age, more barriers appear to prevent them from engaging in physical activity (Melby et al., 2023; van Sluijs et al., 2021).

Practical Applications

The integration of the results obtained in this study provides a multitude of practical applications focused on improving life satisfaction in children and adolescents. The finding of cardiorespiratory fitness as a moderator of PL on life satisfaction highlights the importance of implementing interventions focused on the development of both qualities to activate the bidirectional correlation so that they nurture each other and increase quality of life. Consequently, the implementation of literacy in the classroom is widely supported by the scientific community to establish healthy habits and provide students with tools to improve their

quality of life.

Strengths, limitations and Future Lines

One of the strengths of this study is that it considers PF as a construct and its subdivisions, exploring the relationships of PL with PF as a whole and as separate elements, being one of the first articles to do so. This study had several limitations; therefore, the results should be interpreted with caution. The study design was cross-sectional, with a non-probabilistic sampling type; therefore, so cause-effect relationships could not be established. In accordance with other studies applying self-reported questionnaires, it is possible that individuals may have overestimated their PF. Second, all the participants in this study belong to the community of Extremadura, so it is possible that cultural elements may have influenced the results.

Conclusions

This study examined the relationship between physical literacy and life satisfaction, highlighting the role of physical fitness as a mediating and moderating factor. The results confirmed that physical literacy positively influences life satisfaction both directly and indirectly through physical fitness. Higher levels of physical literacy were associated with higher satisfaction due to improved motor skills, self-efficacy, and physical activity practices. Although literacy affects all dimensions of fitness, not all dimensions of fitness equally moderate the relationship with satisfaction, with cardiorespiratory fitness being the most relevant. The results also suggest that as children age, their level of physical literacy decreases due to reduced physical activity, highlighting the importance of promoting physical fitness development to improve quality of life and satisfaction. These results show the importance of PL on quality of life and life satisfaction, including a model in which PF is an important mediator and moderator in this relationship, enhancing the effects and revealing a powerful tool for the health education of young people.

Funding

This research received no external funding.

Acknowledgments

Thank the Universidad de Las Américas for their support of the Open Access initiative.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- Abu-Omar, K., Rütten, A., Burlacu, I., Schätzlein, V., Messing, S., y Suhrcke, M. (2017). The cost-effectiveness of physical activity interventions: A systematic review of reviews. *Preventive Medicine Reports*, 8, 72–78. <https://doi.org/10.1016/j.pmedr.2017.08.006>
- Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., y Lubans, D. R. (2014). Physical Activity and Physical Self-Concept in Youth: Systematic Review and Meta-Analysis. *Sports Medicine*, 44(11), 1589–1601. <https://doi.org/10.1007/s40279-014-0229-z>
- Batista Lemes, V., Brand, C., Fernandes Dias, A., Felin Fochesatto, C., Reuter, C., Gaya, A. C. A., Mota, J., y Gaya, A. R. (2022). Relaciones entre actividad física y calidad de vida relacionada con la salud en niños y adolescentes durante la distancia social COVID-19. *Cuadernos de Psicología Del Deporte*, 22(3), Article 3. <https://doi.org/10.6018/cpd.479601>
- Baumgartner, L., Weberruß, H., Oberhoffer-Fritz, R., y Schulz, T. (2020). Vascular Structure and Function in Children and Adolescents: What Impact Do Physical Activity, Health-Related Physical Fitness, and Exercise Have? *Frontiers in Pediatrics*, 8. <https://doi.org/10.3389/fped.2020.00103>
- Belanger, K., Barnes, J. D., Longmuir, P. E., Anderson, K. D., Bruner, B., Copeland, J. L., Gregg, M. J., Hall, N., Kolen, A. M., Lane, K. N., Law, B., MacDonald, D. J., Martin, L. J., Saunders, T. J., Sheehan, D., Stone, M., Woodruff, S. J., y Tremblay, M. S. (2018). The relationship between physical literacy scores and adherence to Canadian physical activity and sedentary behaviour guidelines. *BMC Public Health*, 18(S2), 1042. <https://doi.org/10.1186/s12889-018-5897-4>
- Benitez-Sillero, J. de D., Portela-Pino, I., Morente, Á., y Raya-González, J. (2023). Longitudinal Relationships Between Physical Fitness With Physical Self-Concept and Self-Esteem in Adolescents. *Research Quarterly for Exercise and Sport*, 0(0), 1–7. <https://doi.org/10.1080/02701367.2023.2173134>
- Cairney, J., Dudley, D., Kwan, M., Bulten, R., y Kriellaars, D. (2019). Physical Literacy, Physical Activity and Health: Toward an Evidence-Informed Conceptual Model. *Sports Medicine*, 49(3), 371–383. <https://doi.org/10.1007/s40279-019-01063-3>
- Caldwell, H. A. T., Di Cristofaro, N. A., Cairney, J., Bray, S. R., MacDonald, M. J., y Timmons, B. W. (2020). Physical Literacy, Physical Activity, and Health Indicators in School-Age Children. *International Journal of Environmental Research and Public Health*, 17(15), 5367. <https://doi.org/10.3390/ijerph17155367>
- Carl, J., Barratt, J., Töpfer, C., Cairney, J., y Pfeifer, K. (2022). How are physical literacy interventions conceptualized? – A systematic review on intervention design and content. *Psychology of Sport and Exercise*, 58, 102091. <https://doi.org/10.1016/j.psychsport.2021.102091>
- Carl, J., Jaunig, J., Kurtzhals, M., Müllertz, A. L. O., Stage, A., Bentsen, P., y Elsborg, P. (2023). Synthesising physical literacy research for ‘blank spots’: A Systematic review of reviews. *Journal of Sports Sciences*, 41(11), 1056–1072. <https://doi.org/10.1080/02640414.2023.2259209>
- Casey, M., Harvey, J., Telford, A., Eime, R., Mooney, A., y Payne, W. (2016). Patterns of time use among regional and rural adolescent girls: Associations with correlates of physical activity and health-related quality of life. *Journal of Science and Medicine in Sport*, 19(11), 931–935. <https://doi.org/10.1016/j.jsams.2016.02.004>
- Caspersen, C. J., Powell, K. E., y Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, 100(2), 126–131.
- Christodoulides, E., Tsivitanidou, O., Sofokleous, G., Grecic, D., Sinclair, J. K., Dana, A., y Ghorbani, S. (2023). Does Physical Activity Mediate the Associations between Physical Literacy and Mental Health during the COVID-19 Post-Quarantine Era among Adolescents in Cyprus? *Youth*, 3(3), Article 3. <https://doi.org/10.3390/youth3030053>
- Clark, H. J., Dudley, D., Barratt, J., y Cairney, J. (2022). Physical literacy predicts the physical activity and sedentary behaviours of youth. *Journal of Science and Medicine in Sport*, 25(9), 750–754. <https://doi.org/10.1016/j.jsams.2022.04.008>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). L. Erlbaum Associates.
- Cornish, K., Fox, G., Fyfe, T., Koopmans, E., Pousette, A., y Pelletier, C. A. (2020). Understanding physical literacy in the context of health: A rapid scoping review. *BMC Public Health*, 20, 1569. <https://doi.org/10.1186/s12889-020-09583-8>
- Di Bartolomeo, G., y Papa, S. (2019). The Effects of Physical Activity on Social Interactions: The Case of Trust and Trustworthiness. *Journal of Sports Economics*, 20(1), 50–71. <https://doi.org/10.1177/1527002517717299>
- Dimitri, P., Joshi, K., Jones, N., y Moving Medicine for Children Working Group. (2020). Moving more: Physical activity and its positive effects on long term conditions in children and young people. *Archives of Disease in Childhood*, 105(11), 1035–1040. <https://doi.org/10.1136/archdischild-2019-318017>
- Dumuid, D., Olds, T., Lewis, L. K., Martín-Fernández, J. A., Katzmarzyk, P. T., Barreira, T., Broyles, S. T., Chaput, J.-P., Fogelholm, M., Hu, G., Kuriyan, R., Kurpad, A., Lambert, E. V., Maia, J., Matsudo, V., Onywera, V. O., Sarmiento, O. L., Standage, M., Tremblay, M. S., ... Maher, C. (2017). Health-Related Quality of Life and Lifestyle Behavior Clusters in School-Aged Children from 12 Countries. *The Journal of Pediatrics*, 183, 178–183.e2. <https://doi.org/10.1016/j.jpeds.2016.12.048>
- Estoque, R. C., Togawa, T., Ooba, M., Gomi, K., Nakamura, S., Hijioka, Y., y Kameyama, Y. (2019). A

- review of quality of life (QOL) assessments and indicators: Towards a “QOL-Climate” assessment framework. *Ambio*, 48(6), 619–638. <https://doi.org/10.1007/s13280-018-1090-3>
- Galindez, E., y Casas, F. (2014). Adaptación y validación de la Students’ Life Satisfaction Scale (SLSS) con adolescentes. *Estudios de Psicología*. <https://doi.org/10.1174/021093910790744617>
- García-Hermoso, A., Ramírez-Campillo, R., y Izquierdo, M. (2019). Is Muscular Fitness Associated with Future Health Benefits in Children and Adolescents? A Systematic Review and Meta-Analysis of Longitudinal Studies. *Sports Medicine*, 49(7), 1079–1094. <https://doi.org/10.1007/s40279-019-01098-6>
- Jurbala, P. (2015). What Is Physical Literacy, Really? *Quest*, 67(4), 367–383. <https://doi.org/10.1080/00336297.2015.1084341>
- Karataş, Z., Uzun, K., y Tagay, Ö. (2021). Relationships Between the Life Satisfaction, Meaning in Life, Hope and COVID-19 Fear for Turkish Adults During the COVID-19 Outbreak. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.633384>
- Köble, K., Postler, T., Oberhoffer-Fritz, R., y Schulz, T. (2022). A Better Cardiopulmonary Fitness Is Associated with Improved Concentration Level and Health-Related Quality of Life in Primary School Children. *Journal of Clinical Medicine*, 11(5), Article 5. <https://doi.org/10.3390/jcm11051326>
- Lang, J. J., Chaput, J.-P., Longmuir, P. E., Barnes, J. D., Belanger, K., Tomkinson, G. R., Anderson, K. D., Bruner, B., Copeland, J. L., Gregg, M. J., Hall, N., Kolen, A. M., Lane, K. N., Law, B., MacDonald, D. J., Martin, L. J., Saunders, T. J., Sheehan, D., Stone, M. R., ... Tremblay, M. S. (2018). Cardiorespiratory fitness is associated with physical literacy in a large sample of Canadian children aged 8 to 12 years. *BMC Public Health*, 18(2), 1041. <https://doi.org/10.1186/s12889-018-5896-5>
- Lepsy, E., Radwańska, E., Żurek, G., Żurek, A., Kaczorowska, A., Radajewska, A., y Kołcz, A. (2021). Association of physical fitness with quality of life in community-dwelling older adults aged 80 and over in Poland: A cross-sectional study. *BMC Geriatrics*, 21(1), 491. <https://doi.org/10.1186/s12877-021-02421-5>
- Lioret, S., Campbell, K. J., McNaughton, S. A., Cameron, A. J., Salmon, J., Abbott, G., y Hesketh, K. D. (2020). Lifestyle Patterns Begin in Early Childhood, Persist and Are Socioeconomically Patterned, Confirming the Importance of Early Life Interventions. *Nutrients*, 12(3), 724. <https://doi.org/10.3390/nu12030724>
- López-Gil, J. F., Martínez-Vizcaíno, V., Tárraga-López, P. J., y García-Hermoso, A. (2023). Cross-cultural adaptation, reliability, and validation of the Spanish perceived physical literacy instrument for adolescents (S-PPLI). *Journal of Exercise Science y Fitness*, 21(3), 246–252. <https://doi.org/10.1016/j.jesf.2023.03.002>
- Ma, R., Liu, T., Raymond Sum, K. W., Gao, T., Li, M., Choi, S. M., Huang, Y., y Xiang, W. (2021). Relationship Among Physical Literacy, Mental Health, and Resilience in College Students. *Frontiers in Psychiatry*, 12, 767804. <https://doi.org/10.3389/fpsyg.2021.767804>
- Marquez, D. X., Aguinaga, S., Vasquez, P. M., Conroy, D. E., Erickson, K., Hillman, C., Stillman, C. M., Ballard, R. M., Sheppard, B. B., Petruzzello, S. J., King, A. C., y Powell, K. E. (2020). A systematic review of physical activity and quality of life and well-being. *Translational Behavioral Medicine*, 10(5), 1098–1109. <https://doi.org/10.1093/tbm/ibz198>
- Medrano-Ureña, M. del R., Ortega-Ruiz, R., y Benítez-Sillero, J. de D. (2020). Physical Fitness, Exercise Self-Efficacy, and Quality of Life in Adulthood: A Systematic Review. *International Journal of Environmental Research and Public Health*, 17(17), Article 17. <https://doi.org/10.3390/ijerph17176343>
- Melby, P. S., Elsborg, P., Bentsen, P., y Nielsen, G. (2023). Cross-sectional associations between adolescents’ physical literacy, sport and exercise participation, and wellbeing. *Frontiers in Public Health*, 10. <https://www.frontiersin.org/articles/10.3389/fpubh.2022.1054482>
- Melby, P. S., Nielsen, G., Brønd, J. C., Tremblay, M. S., Bentsen, P., y Elsborg, P. (2022). Associations between children’s physical literacy and well-being: Is physical activity a mediator? *BMC Public Health*, 22(1), 1267. <https://doi.org/10.1186/s12889-022-13517-x>
- Mendoza-Muñoz, M., Adsuar, J. C., Mendoza-Muñoz, D. M., Polero, P., y Carlos-Vivas, J. (2021). Concurrent Validity and Reliability of a Novel Visual Analogue Fitness Perception Scale for Adolescents (FP VAS A). *International Journal of Environmental Research and Public Health*, 18(7), Article 7. <https://doi.org/10.3390/ijerph18073457>
- Meng, H., Tang, X., Qiao, J., y Wang, H. (2023). Unlocking Resilience: How Physical Literacy Impacts Psychological Well-Being among Quarantined Researchers. *Healthcare*, 11(22), Article 22. <https://doi.org/10.3390/healthcare11222972>
- Mondragón Barrera, M. A. (2014). Use of the correlation Spearman in a study of ontervention in physiotherapy. *Movimiento Científico*, 8(1), Article 1. <https://doi.org/10.33881/2011-7191.mct.08111>
- Nunnally, J. C., y Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill. <http://hdl.handle.net/123456789/11061>
- Peftoulidou, P., Gioulvanidou, M., Chrysochoou, E.-A., y Hatziagorou, E. (2023). Physical activity and quality of life in children with well-controlled asthma. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 60(5), 1031–1037. <https://doi.org/10.1080/02770903.2022.2123742>
- Puciato, D., Bączkiewicz, D., y Rozpara, M. (2023). Correlations between physical activity and quality of life in

- entrepreneurs from Wrocław, Poland. *BMC Sports Science, Medicine and Rehabilitation*, 15(1), 13. <https://doi.org/10.1186/s13102-023-00624-4>
- Rojo Ramos, J., Mendoza Muñoz, D. M., Gomez Paniagua, S., y Galán Arroyo, M. del C. (2023). Validation and Psychometric Properties of the Visual Analogical Fitness Perception Scale for Adolescents. *Retos: Nuevas Tendencias En Educación Física, Deporte y Recreación*, 50, 528–535.
- Salkind, N. J. (1999). *Métodos de investigación*. Pearson educación.
- She, X., Gao, T.-Y., Ma, R.-S., Tang, D., Zhong, H., y Dong, H.-L. (2023). Relationship among positive self-esteem, physical literacy, and physical activity in college students: A study of a mediation model. *Frontiers in Psychology*, 14. <https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1097335>
- Sum, R. K. W., Cheng, C.-F., Wallhead, T., Kuo, C.-C., Wang, F.-J., y Choi, S.-M. (2018). Perceived physical literacy instrument for adolescents: A further validation of PPLI. *Journal of Exercise Science y Fitness*, 16(1), 26–31. <https://doi.org/10.1016/j.jesf.2018.03.002>
- Telama, Risto Yang, X., Leskinen, E., Kankaanpää, A., y Hirvensalo, Mirja Tammelin, Tuija Viikari, Jorma S. A., Raitakari, O. T. (2014). Tracking of Physical Activity from Early Childhood through Youth into Adulthood. *Medicine y Science in Sports y Exercise*, 46(5), 955–962. <https://doi.org/10.1249/MSS.0000000000000181>
- Tikac, G., Unal, A., y Altug, F. (2022). Regular exercise improves the levels of self-efficacy, self-esteem and body awareness of young adults. *The Journal of Sports Medicine and Physical Fitness*, 62(1), 157–161. <https://doi.org/10.23736/S0022-4707.21.12143-7>
- Tremblay, M. S., Longmuir, P. E., Barnes, J. D., Belanger, K., Anderson, K. D., Bruner, B., Copeland, J. L., Delisle Nyström, C., Gregg, M. J., Hall, N., Kolen, A. M., Lane, K. N., Law, B., MacDonald, D. J., Martin, L. J., Saunders, T. J., Sheehan, D., Stone, M. R., y Woodruff, S. J. (2018). Physical literacy levels of Canadian children aged 8–12 years: Descriptive and normative results from the RBC Learn to Play–CAPL project. *BMC Public Health*, 18(S2), 1036. <https://doi.org/10.1186/s12889-018-5891-x>
- van Sluijs, E. M. F., Ekelund, U., Crochemore-Silva, I., Guthold, R., Ha, A., Lubans, D., Oyeyemi, A. L., Ding, D., y Katzmarzyk, P. T. (2021). Physical activity behaviours in adolescence: Current evidence and opportunities for intervention. *Lancet (London, England)*, 398(10298), 429–442. [https://doi.org/10.1016/S0140-6736\(21\)01259-9](https://doi.org/10.1016/S0140-6736(21)01259-9)
- Vehkakoski, T. M. (2020). “Can do!” Teacher Promotion of Optimism in Response to Student Failure Expectation Expressions in Classroom Discourse. *Scandinavian Journal of Educational Research*, 64(3), 408–424. <https://doi.org/10.1080/00313831.2019.1570547>
- Warburton, D. E. R., y Bredin, S. S. D. (2017). Health benefits of physical activity: A systematic review of current systematic reviews. *Current Opinion in Cardiology*, 32(5), 541. <https://doi.org/10.1097/HCO.0000000000000437>
- Whitehead, M. (2010). *Physical literacy: Throughout the lifecourse*. Routledge.
- Whitehead, M. (Ed.). (2019). *Physical Literacy across the World* (1st ed.). Routledge. <https://doi.org/10.4324/9780203702697>

Datos de los/as autores/as y traductor/a:

Carmen Galán-Arroyo
Noelia Mayordomo-Pinilla
Antonio Castillo-Paredes
Jorge Rojo-Ramos

mamengalana@unex.es
nmayordo@alumnos.unex.es
acastillop85@gmail.com
jorgerr@unex.es

Autor/a
Autor/a
Autor/a – Traductor/a
Autor/a