Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es
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Analysis of academic performance according to levels of physical activity and life satisfaction. A systematic review

Análisis del rendimiento académico según los niveles de actividad física y satisfacción vital. Una revisión sistemática

José Luis Ubago-Jiménez[1]; Félix Zurita-Ortega[1]; Javier Cachón-Zagalaz[2]; Eduardo Melguizo-Ibáñez[1*]
[1] Departamento de Didáctica de la Expresión Musical, Plástica y Corporal. Universidad de Granada.
[2] Departamento de Didáctica de la Expresión Musical, Plástica y Corporal. Universidad de Jaén
[*] Email correspondencia: emelguizo@ugr.es

Editorial shedule: *Article received 31/05/2023 Accepted: 24/06/2023 Published: 01/09/2023*
https://doi.org/10.17979/sportis.2023.9.3.9730

For cite this article you must this reference:
Ubago-Jiménez, J.L.; Zurita-Ortega, F.; Cachón-Zagalaz, J.; Melguizo-Ibáñez, E. (2023). Analysis of academic performance according to levels of physical activity and life satisfaction. A systematic review. Sportis Sci J, 9 (3), 610-636 https://doi.org/10.17979/sportis.2023.9.3.9730

Contribución de autoría: Conceptualización, J.L.U.J. y E.M.I.; Metodología, F.Z.O., J.C.Z., J.L.U.J. y E.M.I.; Análisis formal, F.Z.O. y J.C.Z.; Investigación, F.Z.O., J.C.Z., J.L.U.J. y E.M.I.; Redacción-revisión y edición, F.Z.O., J.C.Z., J.L.U.J. y E.M.I.

Financiación: Esta investigación no posee fuente de financiamiento.

Consentimiento informado participantes del estudio: Fue obtenido debidamente el consentimiento informado de los participantes.

Conflicto de intereses: Los autores declaran que no existen conflictos de intereses.

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Abstract
Academic performance is one of the most studied variables in the educational context. Likewise, students' physical activity and quality of life have a direct incidence on their academic success. Therefore, the aim of this systematic review is to analyse the effects of physical activity and quality of life on students' academic performance. The Web of Science, SCOPUS and PubMed databases were used to select articles published between 2013 and 2023. The criteria established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement were followed for the elaboration of the systematic review, with the final sample of 17 articles. Results show how regular physical activity improves academic performance in mathematics and language. Moreover, it is also observed that quality of life also plays a key role in the drop-out or lower grade point average of students at any educational stage.

Keywords
Academic Achievement; Physical Activity; Quality of Life; Systematic Review.

Resumen
El rendimiento académico es una de las variables más estudiadas en el contexto educativo. Asimismo, la actividad física y la calidad de vida de los estudiantes tienen una incidencia directa en su éxito académico. Por ello, el objetivo de esta revisión sistemática es analizar los efectos de la actividad física y la calidad de vida en el rendimiento académico de los estudiantes. Se utilizaron las bases de datos Web of Science, SCOPUS y PubMed para seleccionar los artículos publicados entre 2013 y 2023. Para la elaboración de la revisión sistemática se siguieron los criterios establecidos por la declaración Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), siendo la muestra final de 17 artículos. Los resultados muestran cómo la práctica regular de actividad física mejora el rendimiento académico en matemáticas y lengua. Además, también se observa que la calidad de vida juega un papel clave en el abandono o la disminución de la nota media de los alumnos en cualquier etapa educativa.

Palabras clave
Logro Académico; Actividad Física; Calidad de Vida; Revisión Sistemática.

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Introduction

Happiness is the ultimate life goal. There are many factors aimed at reaching it. Psychoemotional well-being, quality of life and prevalence of some behaviours and moods have been widely studied from the research literature (Burns et al., 2022; Dadswell et al., 2022; Ramkissoon, 2022). This progress in multiple domains has helped to define the concept of quality of life, understanding it in terms of a "goal to be achieved" during the development of any person's life. Furthermore, this concept has not only been examined from the perspective of research, organisations such as World Health Organisation (WHO) have defined it as a person's self-perceived state of physical, mental and social well-being, moving away from more self-restrictive conceptions that identify it as the lack of illness (WHO, 2022). Consequently, Health Related Quality of Life (HRQL) concerns the subjective perception that people have of their lives, as well as the factors that determine their living conditions.

Although most of the research on HRQoL has a strong medical emphasis (Mehawej et al., 2023; Skogen et al., 2023), focusing on the lack of pain (Mutubuki et al., 2020; Panish et al., 2023), there is a growing tendency to analyse this topic from other perspectives. Indeed, many studies are emerging from the educational field and, more specifically, in the Physical Education area, where it has been analysed how the practice of physical activity is closely linked to the improvement of quality of life (Appelqvist-Schmidlechner et al., 2021; da Silva et al., 2022; Stracciolini et al., 2020; Valdés-Badilla et al., 2022).

However, despite these advances, there are still some research gaps to examine in-depth the real effect of physical activity on quality of life, introducing other mediating factors such as the Mediterranean diet (González-Valero et al., 2019) or the consumption of harmful substances such as alcohol (López-Moreno et al., 2021) and tobacco (Mezouar et al., 2022; Moral-García et al., 2020; Saraiya et al., 2020).

In this sense, HRQOL in young people provides an opportunity to appreciate more strongly a person's functional ability in adulthood (Birch et al., 2020; Stiglic & Viner, 2019). Several research studies have observed that quality of life in young people

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has been gradually declining in recent years (Orben & Przybylski, 2019). This decrease is mainly caused by the excessive use of social media by young people (Schønning et al., 2020; Webster et al., 2021).

Likewise, the study by Ross et al. (2020) suggests that adolescent well-being should be ensured through five domains comprising all modalities of well-being, which are good health and optimal nutrition; connection, positive values and contribution to society; safety and supporting environment; learning, competence, education, skills and employability; and, finally, self-esteem and resilience. It should also be taken into account how this life stage is characterised by controversial decisions that involve a risk to a person's health and well-being. Young people are most susceptible to harmful substances such as tobacco and alcohol in order to be admitted to a peer group or, in other words, to have a better social well-being (D'Amico et al., 2020; Duko et al., 2022; Tinner et al., 2022).

According to the meta-analysis conducted by Valadão et al. (2021), students in both secondary and higher education are the population most affected by depression. It negatively affects their academic performance and, of course, their quality of life. Other findings include the reasons behind drop-out rates related to the low quality of life caused by depressive states (Valadão et al., 2021). In this regard, studies such as that of Traino et al. (2021), point out that students in this transitional stage until adulthood are faced with a great challenge, as they find themselves in a process of stress and ongoing changes that significantly affect all quality-of-life parameters.

Based on the foregoing, the aim of this systematic review was to examine the relationship between physical activity, life satisfaction and academic performance of students.

Research questions

- What is the association between academic performance and physical activity in students?

- What is the combined influence of physical activity and life satisfaction on students' performance?

- Does life satisfaction influence students' performance?

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Material and methods

The study followed a structure and organization as set out in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement criteria (Page et al., 2021). Study classification and coding process was carried out by the researchers through an independent assessment (Figure 1). Articles were eliminated when independent coding did not match on at least one occasion. The level of reliability of the proposed coding was obtained by dividing the number of matches by the total number of proposed categories and multiplying the obtained result by 100. At last, according to the guidelines, the level of concordance must be higher than 80% for the study inclusion in the systematic review.

Search procedure and strategies

This systematic review was conducted during January 2023. It focused on investigations that examined physical activity's influence on academic performance and quality of life. For this purpose, WoS, SCOPUS and PubMed databases were used. The temporal range was delimited from 2013 to 2023, considering the keywords "Academic performance" "Physical activity" and "Quality of life" with the Boolean operators "and" / "or".

Inclusion criteria: c1: peer-reviewed studies, c2: empirical research, c3: the sample is formed by students of any educational level, c4: written in English or Spanish, c5: research that analyses the relationship between physical activity and quality of life on performance; c6: published in the last 10 years.

Exclusion criteria: c1: no peer review, c2: theoretical or review papers, c3: different sample than students, c4: other language, c5: other research topic; c6: prior to 2013.

All the inclusion criteria were considered, resulting in an initial sample of 511 papers in the WoS database. In order to refine the research topic, the following research areas were selected: "Sport Science", "Education and Educational Research", "Multidisciplinary Psychology" and "Psychology". After applying the aforementioned inclusion criteria, the WoS sample consisted of 48 articles.

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The SCOPUS search with the introduction of the previously mentioned keywords yielded an initial search of 424. After the application of the subject area criteria, reduced to "Social Sciences" and "Psychology", the number was reduced to 117. A screening process was then initiated based on the type of document (articles only) and language (Spanish and English for the reasons already mentioned), which reduced the sample to 94 articles. To define the final study sample, the same inclusion criteria established for WoS were used to ensure consistency in the review.

In order to carry out the systematic review, the established inclusion criteria were observed for the PubMed database. In the first round, 204 research studies were obtained that met all the criteria. The documents were read and the final sample of this database was 21 articles.

Finally, a bottom-up and top-down review was also carried out on the selected articles with the purpose of increasing the number of consulted research papers.

The title and abstract of the sample were then read critically to confirm that the selected research met the inclusion criteria. The full texts of the research were then read to confirm that the articles met the objectives of this study. A total of 908 articles were eliminated due to mismatch in coding by the independent reviewers or because the studies did not meet the established methodological and conceptual criteria. This left a final sample of 17 scientific articles that made up the sample of the present study.

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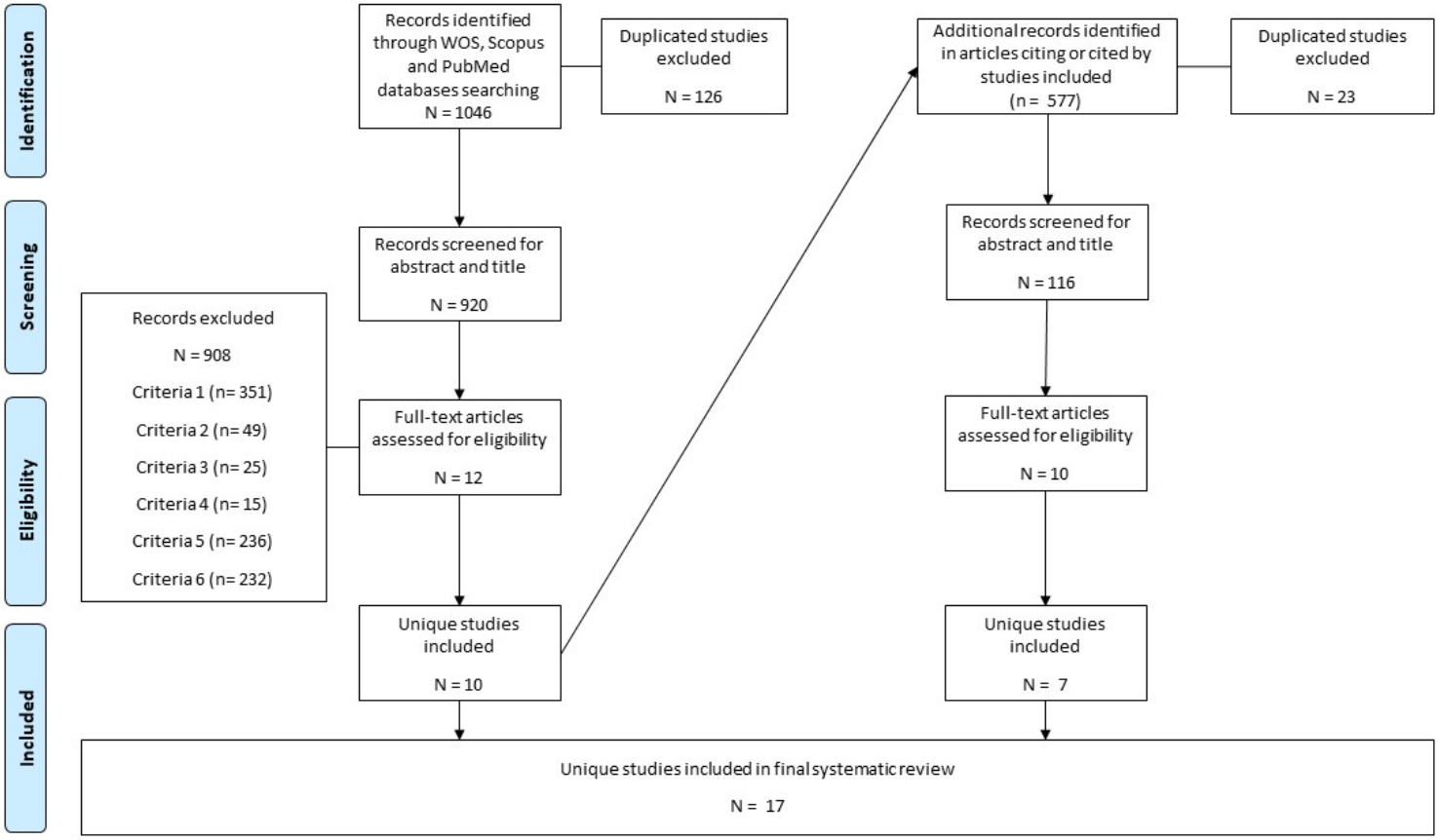

Figure 1. *Flowchart of the systematic selection of articles for inclusion in the study*

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Results

Table 1 shows the data provided by the selected studies according to: 1) Authors and year of publication; 2) Country; 3) Design; 4) Sample; 5) Sex; 6) Population. However, it was found that most of the papers had a cross-sectional design (n=8), followed by longitudinal studies (n=4) and quasi-experimental studies (n=4). Likewise, looking at the country of the sample used in the research, Spain stands out with 6 articles. Observing the sex of the participants, it can be seen that the majority (n=11) are female. Finally, looking at the educational stage, the research was carried out in primary education (n=7), followed by secondary education (n=4) and university level (n=6). The total number of participants taking part in the selected studies amounted to 14,940.

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Table 1. Study description based on location, design and population.

Authors (Year)	Country	Design	Sample	Gender	Population (Age)
Durán-Vinagre et al. (2023)	Spain	Cross Sectional Study	1524	944 women 580 men	University Education (19.61±3.65)
Pulido-Gil et al. (2022)	Spain	Cross Sectional Study	50	22 women 28 men	Elementary Education (10.62±0.57)
Slavinski et al. (2021)	Serbia	Cross Sectional Study	875	523 women 352 men	University Education (-)
Azzi et al. (2021)	Brazil	Cross Sectional Study	703	503 women 200 men	University Education (-)
Kwok et al. (2020)	China	Longitudinal study	15	11 women 4 men	University Education (26.87±3.11)
Pulido-Martos et al. (2020)	Spain	Cross Sectional Study	707	422 women 285 men	University Education (21.1±2.9)
Jiménez-Boraita et al. (2020)	Spain	Longitudinal study	761	-	Elementary Education (14.51±1.63)
Cerda et al. (2019)	Chile	Cross Sectional Study	2010	-	High School Education (16.67±1.6)
Padulo et al. (2019)	Italy	Cross Sectional Study	80	46 women 34 men	Elementary Education (11±0.3)
Kari et al. (2017)	Finland	Longitudinal study	4168	2157 women 2011 men	High School Education (-)
Mullender-Wijnsma et al. (2016)	Netherlands	Intervention controlled and randomized	499	273 women 226 men	Elementary Education (-)
Resaland et al. (2016)	Norway	Cluster-Randomized Controlled Trial	1129	587 women 542 men	Elementary Education (-)
Pellicer-Chenoll et al. (2015)	Spain	Longitudinal study	444	226 women 218 men	High School Education (-)
Käll et al. (2015)	Sweden	Controlled Quasi-experimental Study	545	253 women 292 men	Elementary Education (-)

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Käll et al. (2014)	Sweden	Cross Sectional Study	238	-	Elementary Education (-)
Ardoy et al. (2014)	Spain	Group-Randomized Controlled Trial	67	24 women 43 men	High School Education (-)
Keating et al. (2013)	USA	Retrospective Nonexperimental Research	1125	692 women 433 men	University Education (22.21±4.82)

Table 2.
Study description based on their aims, variables, instruments and conclusions.

Authors (Year)	Aims	Variables	Instruments	Conclusions
Durán-Vinagre et al. (2023)	To analyse the motivational processes and the intention to be physically active of university students when engaging in physical activity according to gender and different fields of study	Sociodemographic Variables	Sociodemographic Questionnaire	The findings show that men are characterized by more self-regulated behaviour than women
		Physical activity motivation	BREQ-3	
		Physical activity intention	MIFAU	
Pulido-Gil et al. (2022)	To analyse the effects of a programme made of physically active lessons on primary education students' level of school physical activity, physical fitness, school life satisfaction and academic performance	Physical Activity level	Xiaomi Mi Brand 3	The implementation of a physical activity lessons methodology in school curricula could progressively contribute to the students' inactivity. The influence of this type of intervention on the students' academic performance
		Health-Related Physical Fitness Level	Alpha-Fitness	
		Academic performance	Science test	
		Children well-being	ISCWeb	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Slavinski et al. (2021)	To determine differences in LS among university students in Serbia in relation	Academic performance	Last year Grade Point Average	Students who perform physical activity express higher

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	to academic performance, demographic, educational characteristics and involvement in sport activities	Life satisfaction	BMSLSS	levels of overall life satisfaction. Engagement in sport activities along with being a student in a field of study related to business, were found to be a predictor of higher satisfaction with oneself.
		Physical activity	Weekly time spent in Physical activity	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Azzi et al. (2021)	To perform a cluster analysis in a large sample of undergraduate students, considering sociodemographic data, physical activity frequency, study areas, burnout, Quality of Life and perception of online education	Physical Activity	Self-prepared Questionnaire	The students with higher scores in all domains of Quality of Life and better online learning perception, with greater frequency of physical activity and lower burnout scores
		Burnout	BCSQ-12-SS	
		Quality of life	WHOQOL-BREF	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Kwok et al. (2020)	To investigate how internet gaming and social media impact on physical activity, sleep quality, quality of life and academic performance of university students in Hong Kong. To investigate how physical activity and sleep associate with quality of life and academic performance of university students in Hong Kong	Physical Activity	Actigraph GT9X; IPAQ	Internet gaming was negatively correlated with physical activity and psychological quality of life. Smartphone addiction was negatively correlated to sleep and academic performance. Physical activity was positively correlated to psychological quality of life.
		Social Media adiction	BSMAS	
		Internet gaming adiction	IGDS-SF9	
		Qaulity of Life	WHOQOL-BREF	
		Sleep time	PSQI	
		Academic performance	Self-reported	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Pulido-Martos et al. (2020)	To analyse the construct validity of the Shirom-Melamed Vigour Measure for	Vigour	SMVM-S	The physical activity affects the academic
		Physical Activity	IPAQ-SF	

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	students by testing a structural model of the relations among physical activity, academic performance, and mental health by including vigour as a mediator	Mental Health	GHQ	performance, mental health and life satisfaction of students through the effect of physical activity on vigour.
		Academic Performance	Self-reported	
		Life Satisfaction	SWLS	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Jiménez-Boraita et al. (2020)	To analyze the differences between a population of adolescents, both migrants and nationals migrant and national adolescents in a northern Spanish city from an integrated health perspective, assessing their health habits, and evaluating their life habits, as well as different indicators of their physical, psychological and social health.	Self-Steem	Rosemberg scale	The results reflect lower levels of physical activity, VO2 max, health-related quality of life, self-esteem, Mediterranean diet, academic performance and socioeconomic status in migrant students.
		Quality of life	KIDSCREEN-27	
		Mediterranean diet	KIDMED	
		Physical Activity	PAQ-A	
		Academic Performance	Self-reported	
		Anthropometric data	Course-Navette test; BMI	
		Socio-economic status	FAS	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Cerda et al. (2019)	To analyse the impact of physical activity and self-esteem on the academic performance of high school students.	Sociodemographic Variables	Sociodemographic Questionnaire	The results demonstrated a positive causal relationship between academic performance, self-esteem and sports activities.
		Academic performance	Self-prepared Survey of Academic Performance, Sports Activity and Physical Education	
		Physical Activity		
		Self-Steem	Rosemberg scale	

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Padulo et al. (2019)	To examine the relationship between physical activity and school achievement by investigating eventual correlations between physical tests results and school marks and disclosing eventual mutual relationships between socio-demographics, family context, lifestyle, and school performance information using a structural modelling approach.	Academic performance	Marx Activity Rating Scale	Strong correlations between sports marks and physical tests. Lifestyle was found to fully moderate the impact of the family context on school achievement.
		Physical Activity	Battery of physical test	
		Lifestyle	Self-prepared Questionnaire	
		Family context	Self-prepared Questionnaire	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Kari et al. (2017)	To examine whether physical activity in adolescence is associated with academic achievement at the end of compulsory basic education and with post compulsory education later in life.	Academic performance	Self-reported	Adolescent physical activity may predict better learning outcomes starting from basic education and continuing until education in adulthood.
		Physical Activity	Self-reported	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Mullender-Wijnsma et al. (2016)	To investigate the effects of an innovative physically active academic intervention on academic achievement of children.	Academic performance	One-Minute test; Speed test Arithmetic	Participation in the Fit & Academically Proficient at School physically active math and language intervention positively contributed to math and spelling performance of elementary school children.
		Physical Activity	Intervention program	
		Sociodemographic Variables	Sociodemographic Questionnaire	
Resaland et al. (2016)	To investigate the effect of a seven-month, school-based cluster-randomized controlled trial on academic performance in 10-year-old children.	Academic performance	Norwegian Directorate for Education and Training	Physical activity may be one way of improving academic performance in numeracy in some children whose performance in numeracy is lowest.
		Physical Activity	ActiGraph GT3X+	
		Anthropometric data	BMI	
		Sociodemographic Variables	Sociodemographic Questionnaire	

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Pellicer-Chenoll et al. (2015)	To examine the relationship among the physical activity level, physical fitness and academic performance with self-organizing map analysis throughout the secondary school stage	Academic performance	Grade Point Average	The physically active and fit students exhibit better academic performance. The students with low performance profiles can develop more positive behaviours.
		Physical Activity	IPAQ	
		Sociodemographic Variables	Qualitative questionnaire	
		Physical fitness	BMI; CMJ; Cooper test; Handgrip	
Käll et al. (2015)	To investigate whether the curriculum-based physical activity intervention enabled by a governmental investment is correlated with children's academic achievement, psychological well-being, and health-related quality of life and physical fitness and structural development of the brain	Sociodemographic Variables	Self-prepared Questionnaire	A government investment to increase curriculum-based physical activity has great promise to improve children's academic outcome, particularly among girls. Girls also seem to derive greater psychological benefits from extended school-based physical activity.
		Academic achievement	National tests	
		Health Related Quality of Life	KIDSCREEN-2	
		Emotion & behavior	SDQ	
		Cardiorespiratory fitness	Astrand-Rhyming cycle ergometer test	
		Brain volume magnetic resonance imaging	3 T Philips Achieva	
Käll et al. (2014)	To determine the impact of a school based physical activity intervention protocol on academic achievement in children.	Academic performance	4 year Grade Point Average	Promoting physical activity in school by means of a curriculumbased intervention program may improve children's educational outcome.
		Physical Activity	Intervention program	
		Sociodemographic Variables	Self-prepared Questionnaire	
Ardoy et al. (2014)	To analyse the effects of an intervention focused on increasing the time and intensity of Physical Education, on adolescents' cognitive performance and academic achievement	Academic performance	Grade Point Average	Increased Physical Education can benefit cognitive performance and academic achievement. The intensity of Physical Education sessions might play a role in the
		Cognitive performance	IGF-M	
		Physical Activity	EDUFIT	

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https://doi.org/10.17979/sportis.2023.9.3.9730

		Anthropometric data	BMI	positive effect of physical activity on cognition and academic success.
		Sociodemographic Variables	Sociodemographic Questionnaire	
Keating et al. (2013)	To examine the association between weekly strength exercise frequency and grade point average and the demographic characteristics of weekly strength exercise frequency among undergraduate students at a large southern state university in the United States.	Academic performance	Grade Point Average	Students who more frequently engaged in strength exercise had significantly higher-Grade Point Average. Regular engagement in strength exercise may not only have physical health benefits but is also associated with academic achievement in higher education.
		Quality of life	Online self-reported survey	
		Physical Activity	Online self-reported survey	
		Sociodemographic Variables	Sociodemographic Questionnaire	

Note: Behavioral Regulation in Exercise Questionnaire (BREQ-3); Intention to be Physically Active in the University Context (MIFAU); International Survey on Children's Well-Being (ISCWeB); Brief Multidimensional Students' Life Satisfaction Scale (BMSLSS); World health organization quality of life-brief version (WHOQOL-BREF); Burnout clinical subtype questionnaire students survey (BCSQ-12-SS); Internet Gaming Disorder Scale-Short Form (IGDS-SF9); Bergen Social Media Addiction Scale (BSMAS); Smartphone Application Based Addiction Scale (SABAS); International Physical Activity Questionnaire (IPAQ); Pittsburgh Sleep Quality Index (PSQI); Shirom-Melamed Vigor Measure (SMVM); General Health Questionnaire (GHQ); Satisfaction with Life Scale (SWLS); Family Affluence Scale (FAS); Mediterranean Diet Quality (KIDMED); Physical Activity Questionnaire for Adolescents (PAQ-A); Body Mass Index (BMI); Countermovement Jump (CMJ); Strengths and Difficulties Questionnaire (SDQ); Overall and Factorial Intelligence Test (IGF-M); Education for fitness (EDUFIT).

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Table 3 shows the distribution of the selected research according to country of the sample. It can be seen that most of the studies belong to Europe (n=11; 64,7%). Next, Spain is the country that contributes the most research (n=6; 35,3%), followed by Sweden (n=2; 11,7%), and all other countries each with one study.

Table 3.

Research 'distribution according to country of the sample

Sample country	Percentage
Spain	35,3% (n=6)
Sweden	11,7% (n=2)
Serbia	5,8% (n=1)
China	5,8% (n=1)
Chile	5,8% (n=1)
Italy	5,8% (n=1)
Brazil	5,8% (n=1)
Finland	5,8% (n=1)
Netherlands	5,8% (n=1)
Norway	5,8% (n=1)
United States of America	5,8% (n=1)
Total	100% (n=17)

Figure 2.

Evolution of the total scientific production and the body of the study by years

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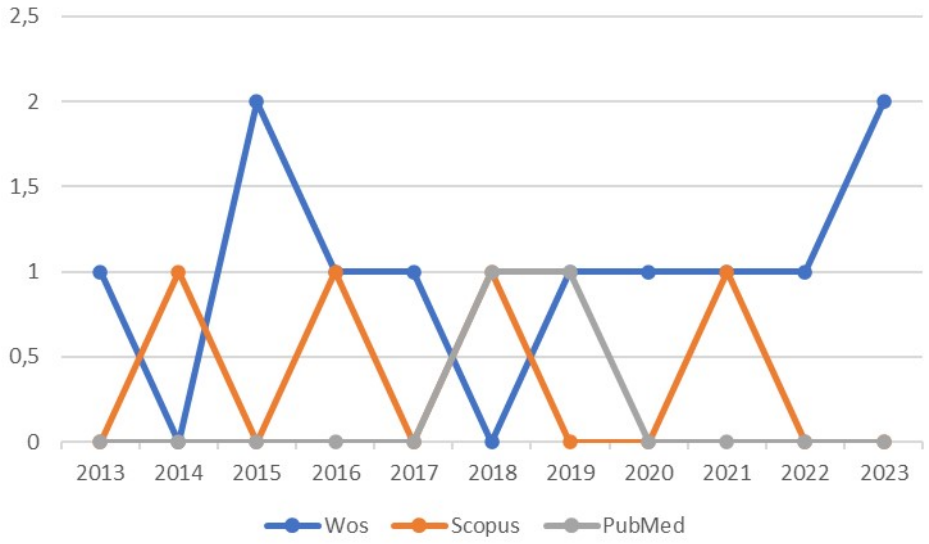

Discussion

The aim of this review is to examine the relationship between physical activity, life satisfaction and students' academic performance. Therefore, a systematic review of the literature (Page et al., 2021) was carried out in the WoS, Scopus and Pubmed databases, providing 17 articles that fulfilled the inclusion and exclusion criteria. Below, findings are presented and discussed in this process based on the three research questions that define the main purpose of this study.

What is the relationship between academic performance and physical activity in students?

In this review, 17 studies have identified a positive relationship between students' academic performance and the practice of physical activity at all educational levels. According to the findings, it has been found that physical activity improves students' cognitive performance, which increases their academic performance in different areas, with an important role in mathematics and language as instrumental subjects. At the same time, it also promotes initiating and developing self-regulation processes, which favors academic success. These findings are in line with the systematic review and meta-analysis developed by Ferreira-Vorkapic et al. (2021), where they found that 80% of the studies reviewed indicated a positive effect of physical activity on

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cognition. Similarly, the systematic review by Singh et al. (2019) found that physical activity improved academic performance, with more benefits concentrated around the area of mathematics.

What is the impact of physical activity and quality of life together on students' performance?

Among the research papers that examined the joint effects of physical activity and quality of life on academic performance, it was found that their combined consideration had benefits for students' academic success, in line with previous studies (Kayani et al., 2018). The benefits found include adequate emotional management and regulation, which the literature has related to the tendency to acquire coping strategies necessary for academic performance (Augusto-Landa et al., 2022). These factors also promote the emergence of academic engagement, a performance-enhancing factor (García-Martínez et al., 2021).

Does life satisfaction influence on students' performance?

In line with previous studies (Wilcox & Nordstokke, 2019), evidence from the studies included in this review shows that there is a direct relationship between life satisfaction and students' academic performance. Specifically, it is observed that high levels of life satisfaction, together with other factors such as self-efficacy or mental health, are associated with students' higher academic performance compared to those who have a lower perception of their life conditions or have poorer mental health (Faraji Kahkesh et al., 2019).

Limitations and Future Perspectives

Indeed, this systematic review shared the research limitations of other work of this nature. Due to the fact of conducting a review according to very specific research criteria, it implies a restriction of the research area. Therefore, the inclusion of other factors in the analysis of academic performance according to physical activity parameters, broken down by pre-university and university stages, is one of the main paths to follow, with a view to continuing to provide arguments that place physical

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education in its rightful place due to the multiple benefits it provides for academic performance and the development of students in general. Furthermore, future work examining components of academic performance such as motivation, mental agility, memory or learning styles from the perspective of physical education will contribute to a deeper understanding of student learning and academic achievement.

Conclusions

This systematic review study reveals a growing trend of publication in the various databases consulted on the subject of analysis. Likewise, most of the studies indicate that an active and healthy lifestyle brings benefits in key executive functions in order to achieve higher academic performance. It would be interesting to include a meta-analysis to study the effect of intervention programmes on the academic area.

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Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity
Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es
OPEN ACCESS Creative Commons

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