

PHYSICAL ACTIVITY LEVELS AND PHYSICAL FITNESS IN ADOLESCENTS: IMPLICATIONS FOR TEACHING

LIVELLI DI ATTIVITÀ FISICA ED EFFICIENZA FISICA NEGLI ADOLESCENTI. IMPLICAZIONI PER LA DIDATTICA



Matteo Bibba
Università degli Studi di Foggia - University of Basilicata
matteo.bibba@unifg.it



Lorenzo Giannotta
University of Salento
lorenzo.giannotta@unisalento.it



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ABSTRACT

Regular physical activity promotes health by enhancing physical fitness (PF) in adolescents; however, daily physical activity levels (PAL) are often insufficient. This study analyzes the relationship between PAL and PF, highlighting positive correlations with cardiovascular and muscular efficiency. An active lifestyle is confirmed as a key determinant of PF during adolescence, and schools can play a crucial role in promoting adolescent health.

L'attività fisica regolare promuove la salute attraverso lo sviluppo della physical fitness (PF) negli adolescenti; purtroppo, i livelli di attività fisica (LAF) quotidiani risultano spesso insufficienti. Questo studio analizza la relazione tra LAF e PF, evidenziando correlazioni positive con l'efficienza cardiovascolare e muscolare. Uno stile di vita attivo si conferma determinante per la PF in età evolutiva e la scuola può avere un ruolo chiave nella promozione della salute degli adolescenti

KEYWORDS

Health-Promotion; School; Physical fitness; Physical education, Adolescents
Promozione della salute, Scuola, Efficienza fisica; Educazione Fisica, Adolescenti

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Introduction

Education on the body and movement today represents an essential and unavoidable direction within the educational process of young people. It is not limited to the acquisition of motor skills but constitutes a true educational path aimed at promoting healthy lifestyles and supporting the holistic development of the individual. International Recommendations and Guidelines emphasize that regular physical activity is crucial for encouraging active behaviors and supporting the psychological, socio-emotional, and cognitive development of students (Colella, 2021). In this regard, the World Health Organization recommends at least 60 minutes of moderate to vigorous physical activity (MVPA) daily, supplemented by muscle-strengthening exercises, for children and adolescents aged 5 to 17 years (WHO, 2020). However, recent data show that a large proportion of young people do not meet these recommended levels, with a progressive decline in physical activity associated with increasing age and significant gender differences (Steene-Johannessen et al., 2020). This scenario contributes to a reduction in individual motor repertoire and a loss of the protective effects of physical exercise on human body systems (Faigenbaum et al., 2018).

1. School and Health Promotion

School represents a privileged educational setting for health promotion, both through curricular pathways and extracurricular initiatives. Physical education, in particular, plays a key role by bridging motor experiences, cognitive skills, and educational values (Colella et al., 2020). It supports the acquisition of motor skills, the development of personal autonomy, and the adoption of active lifestyles, proving strategic in preventing overweight and obesity and in promoting innovative school models (Carson & Webster, 2020).

School-based physical education is aimed at fostering the acquisition of motor abilities and the development of coordinative and conditional motor capacities, while educating through movement and promoting the integration of cognitive, motor, emotional, and relational functions (Colella & Vasciarelli, 2020). In this perspective, bodily experience supports the construction of personal identity, facilitates metacognitive processes and self-awareness, and serves as a medium for learning, expression, and interpersonal relationships, capable of generating intrinsic pleasure and conveying cultural and social values (Cronin et al., 2018).

This educational approach to the body thus moves away from a merely technical-functional conception and embraces an existential dimension, in which knowledge, motor skills, and attitudes are interwoven and transferable to other areas of personal life (Pesce et al., 2016). As Arnold (1988) highlighted, the body and movement are expressions of the unity of the person, deeply connected with linguistic and cultural dimensions.

According to Arnold's triadic model, physical education is structured around three dimensions: learning about movement, learning through movement, and developing awareness in movement, guiding students toward intrinsic pleasure and the social, cultural, and expressive values of physical activity (Lipoma, 2014).

In this perspective, education of the body and movement becomes an educational path oriented toward well-being and autonomy. It integrates with other key educational domains for personal development—such as nutrition, environmental awareness, emotional education, and intercultural understanding—thus contributing to the formation of responsible citizens throughout the entire life span (Colella & Monacis, 2024).

Bodily mediation, necessary for living and interacting through one's own corporeality, also facilitates the development of higher-order cognitive skills and social competences, which are increasingly crucial in today's work environments (Rosa & De Vita, 2018).

Corporeality, therefore, is not merely a physical expression, but a complex dimension of being a person. It enables self-perception and the activation of transformative knowledge in relation to the world (D'Alessio, 2018); it is the convergence of experiences lived through the body and movement.

The various dimensions—biological, psychological, emotional, affective, expressive, relational, cognitive, social, and personal—are activated through motor experiences, supporting the development of identity, communication, critical thinking, and civic awareness (Rosa & De Vita, 2018).

From this perspective, corporeality serves as a privileged medium for transversal learning, while physical education becomes a bridge between different disciplinary fields, enhancing bodily experience as a starting point and pathway for executive functions and transversal competences (Colella, 2018).

To reinforce these educational processes, methodological interventions are needed to increase the time devoted to motor engagement at school and to promote daily, conscious physical activity as a lifelong habit.

2. Physical Fitness and Active Lifestyles

Numerous international studies have warned that the decline in physical activity levels among children and adolescents leads to a deterioration in motor performance (Ekelund et al., 2011), consequently reducing the preventive and protective effects of physical exercise. This decline also affects health-oriented physical fitness levels. Robust evidence indicates that physical fitness is a significant health marker during developmental age (Ortega et al., 2008). Among its components, cardiorespiratory endurance and muscular strength are most closely associated with health outcomes (Garcia-Hermoso et al., 2019; 2020), while other dimensions, such as flexibility and body composition, complete the overall picture of physical condition (Ortega et al., 2023).

Cardiorespiratory endurance, also referred to as aerobic capacity or aerobic fitness, relates to the ability of the circulatory and respiratory systems to deliver oxygen to skeletal muscle mitochondria for energy production during physical activity.

Another health-oriented component of physical fitness is the ability of the body to exert maximal force against external resistance (i.e., muscular strength) or to perform repeated submaximal efforts (i.e., muscular endurance). Flexibility refers to the range of motion around a joint or group of joints.

Physical fitness is associated with total and abdominal adiposity, influences major cardiovascular risk factors, and contributes positively to skeletal health. Moreover, fitness improvement is essential even in pediatric oncology patients, helping to reduce fatigue and improve quality of life. Physical fitness also has favorable effects on self-esteem, anxiety, mood, and academic performance (Ortega et al., 2008).

Scientific literature has extensively analyzed the benefits of health-oriented physical fitness components.

Muscular strength is an important protective factor against metabolic diseases during youth, even in less physically active individuals (Gomes et al., 2017). High levels are linked to a lower risk of metabolic syndrome, whereas low strength is associated with abdominal obesity, dyslipidemia, hyperglycemia, and hypertension, regardless of BMI (Fraser et al., 2016; Chuang et al., 2023). Strength also contributes to cardiovascular and skeletal health by promoting bone growth and mineral density (Garcia-Hermoso et al., 2019). On a cognitive level, it improves attention and executive functions, and is associated with higher self-esteem, perceived well-being, and quality of life in youth (Robinson et al., 2023; Bolados et al., 2021).

Finally, insufficient strength, combined with poor fundamental motor skills (FMS) and low physical activity levels, increases the risk of dynapenia—a condition marked by early deterioration of muscle function (Faigenbaum et al., 2019). Limited strength development may hinder participation in moderate or vigorous physical activity and, in turn, undermine motivation, confidence, and perceived competence among adolescents (Faigenbaum et al., 2020)

Cardiorespiratory fitness is a fundamental component of physical fitness, associated with numerous health benefits from early childhood. Low endurance in children is linked to higher BMI and greater abdominal fat accumulation, making it an early indicator of health risk. High levels of cardiorespiratory fitness are associated with a reduced incidence of hypertension, type 2 diabetes, atrial fibrillation, inflammatory diseases, and lower all-cause mortality (Laukkanen et al., 2022). Even in school-aged children, it is associated with healthier cardiovascular profiles, lower insulin resistance, and improved liver and kidney function (Diaz et al., 2021). Poor fitness is related to higher blood pressure, regardless of body weight or waist circumference (Chuang et al., 2023), and limits physical activity participation, thus encouraging sedentary behavior. Beyond its physical benefits, cardiorespiratory endurance supports quality of life, academic performance, and future work capacity, positively affecting self-perception, concentration, and learning (Laakso et al., 2024).

Flexibility, in turn, is essential for daily motor function and participation in recreational activities. In children and adolescents, low flexibility has been associated with increased risk of musculoskeletal injuries and postural issues such as hyperlordosis, hyperkyphosis, and chronic low back pain (De Lima et al., 2019). Regular physical activity helps maintain adequate muscular and joint elasticity, especially in contexts requiring large ranges of motion, such as sports or expressive movement activities.

Although not a direct indicator of metabolic risk, flexibility plays a key role in promoting youth health by supporting motor skill development and encouraging greater participation in physical activity. This, in turn, contributes to improved overall physical fitness (De Lima et al., 2019). Scientific evidence also confirms that all health-oriented fitness components are crucial for motor skill acquisition during adolescence, with flexibility playing a pivotal role in this process (Chagas & Barnett, 2023).

Despite the recognized importance of physical fitness for youth health, recent studies report a marked decline in fitness levels among children and adolescents (Ortega et al., 2023).

Low fitness levels during adolescence are strongly associated with a sedentary lifestyle, both during the same developmental stage and later in adulthood.

Fitness thus emerges as a bidirectional factor: on the one hand, it is influenced by lifestyle; on the other, it serves as both an indicator and a promoter of active behaviors, especially when supported by regular engagement in moderate-to-vigorous physical activity (MVPA) (Hamdani et al., 2022).

The adoption of sedentary habits during youth triggers a vicious cycle in which decreasing physical activity progressively reduces movement opportunities—both structured (e.g., sports, physical education) and informal (e.g., free play, recreational and social activities)—thereby hindering motor literacy and the balanced development of motor skills (Faigenbaum, Rebullido & Macdonald, 2018). This underscores the close link between physical fitness and lifestyle, highlighting the need for educational interventions aimed at breaking this cycle and promoting sustainable active behavior patterns.

The early adoption of physically active habits is a crucial protective factor for adolescent health, with benefits that extend to physical, psychological, and cognitive well-being. Regular MVPA is associated with improved body composition and the prevention of overweight and obesity (Al-Khudairy et al., 2017). These benefits also include enhanced overall psychophysical balance (Hosker et al., 2019) and the strengthening of cognitive and emotional development, with positive effects on self-regulation, memory, and emotional control (Singh et al., 2019).

3. Materials and Methods

This study employed a cross-sectional observational design aimed at investigating physical activity levels (PAL) and physical fitness (PF) in a sample of upper secondary school students. The main objective was to analyze the correlations between PAL and PF, also taking into account Body Mass Index (BMI) as a variable, to highlight potential implications for physical education teaching practices.

The sample consisted of 246 adolescents (Mean age: 16.36 ± 1.40 years), enrolled in upper secondary schools located in the Apulia region (Italy). Participants were divided into subgroups based on BMI cut-off points, calculated according to the

criteria of the International Obesity Task Force (IOTF), to distinguish between normal-weight and overweight/obese individuals (Table 1).

Gender	Group	N	Age	Weight	Height	BMI
Males	Nw	59	16,61±1,41	62,50±7,46	1,71±0,07	20,90±2,12
	Ow-Ob	24	16,41±1,41	88,24±15,18	1,76±0,07	27,91±3,95
Females	Nw	116	16,23±1,41	54,03±6,49	1,62±0,06	20,56±2,03
	Ow-Ob	47	16,13±1,41	71,97±11,20	1,61±0,06	27,83±2,86
Tot		246				

Table 1. Sample Description

To assess physical activity levels (PAL), a self-administered questionnaire (PAQ-A) validated for the Italian adolescent population was used. The questionnaire collected information on the frequency and duration of physical activity performed during the week, both in school and out-of-school contexts.

Physical fitness (PF) was measured through the administration of four standardized motor tests, selected to assess different components of physical fitness:

- Standing Long Jump (Eurofit) (Council of Europe, 2006): Participants jump horizontally from a standing position (two-foot take-off) for the maximum possible distance, using arm swing and knee flexion to aid propulsion. The best of two attempts is recorded. Distance is measured in centimeters (cm) from the take-off line to the heel's landing point.
- 6-Minute Walking Test (American Thoracic Society, 2002): This submaximal test measures the total distance walked in six minutes. Initially developed to assess functional capacity in patients with cardiopulmonary conditions, it has been adapted for the pediatric population (Geiger et al., 2007). The American Thoracic Society (ATS) provides standardized procedures for test administration, and recent studies have established reference values for school-aged children.
- Shuttle Run 10×5 (Eurofit) (Council of Europe, 2006): This standardized Eurofit protocol measures speed and agility. It requires participants to run back and forth over a 5-meter distance ten times, covering a total of 50 meters. The test is widely used to assess quickness in directional changes and anaerobic endurance and is particularly suitable for children and adolescents.
- Sit-Ups (Eurofit) (Council of Europe, 2006): Participants lie in a supine position with knees bent at 90°, feet flat on the ground (held by a partner),

and fingers interlocked behind the neck. They perform as many full sit-ups as possible in 30 seconds. A valid repetition consists of lifting the torso to a fully upright seated position with shoulders off the mat and elbows touching the knees. Only one trial is administered. The result is the number of sit-ups completed in 30 seconds. This test is commonly used to assess abdominal strength and endurance.

All tests were conducted in appropriately equipped school environments, following standardized protocols and under the supervision of graduates with a Master's degree in Sports and Exercise Sciences.

The collected data were analyzed using the JASP statistical software. Means and standard deviations were calculated for each variable. Pearson's correlation coefficient was used to assess the relationships between physical activity levels (PAL) and physical fitness (PF). Differences between subgroups (normal weight vs. overweight/obese) were analyzed using the independent samples Student's t-test. The statistical significance level was set at $p < 0.05$.

4. Results

Data analysis revealed that 40.57% of the adolescents in the sample were classified as overweight or obese.

The results showed significant gender differences: in all physical fitness tests, males scored significantly higher than females ($p < 0.001$). Furthermore, regarding self-assessed physical activity levels (PAQ-A), the data indicated gender differences in two groups ($p < 0.001$), with males reporting higher scores than females (Table 2).

	Group	N	Mean	SD	SE	Coefficient of variation
SALTO IN LUNGO (M)	F	155	1.32	0.23	0.02	0.17
	M	96	1.82	0.37	0.04	0.20
SIT UP	F	136	16.10	3.80	0.33	0.24
	M	90	19.49	4.59	0.48	0.24
6' WALKING TEST	F	155	622.50	83.32	6.69	0.13
	M	96	731.70	108.58	11.08	0.15
NAVETTA (10X5)	F	155	21.98	3.76	0.30	0.17
	M	96	19.88	3.06	0.31	0.15
LAF	F	155	2.03	0.57	0.05	0.28
	M	96	2.50	0.66	0.07	0.26

Table 2. Physical fitness test results by gender

The results of the motor tests indicate that normal-weight participants achieved significantly higher scores in all tests compared to their overweight/obese peers ($p < 0.001$).

Regarding self-assessed physical activity levels (PAQ-A), no statistically significant differences were found between the two groups ($p > 0.05$) (Table 3).

	Group	N	Mean	SD	SE	Coefficient of variation
6' WALKING TEST	Nw	169	681.56	111.03	8.54	0.16
	Ob	82	628.63	90.96	10.05	0.14
SIT UP	Nw	159	18.21	4.33	0.34	0.24
	Ob	67	15.64	4.24	0.52	0.27
NAVETTA (10X5)	Nw	169	20.62	3.68	0.28	0.18
	Ob	82	22.33	3.33	0.37	0.15
LAF	Nw	169	2.21	0.64	0.05	0.29
	Ob	82	2.22	0.66	0.07	0.30
SALTO IN LUNGO (M)	Nw	169	1.58	0.38	0.03	0.24
	Ob	82	1.37	0.33	0.04	0.24

Table 3. Physical Fitness Test Results by Weight Status Group

More specifically, in the cardiovascular endurance test (6-Minute Walk Test), normal-weight (NW) males covered an average distance of 756.47 meters (± 99.46), while overweight (OW) males averaged 669.79 meters (± 77.38). NW females covered an average of 649.06 meters (± 83.47), compared to 592.51 meters (± 64.51) for OW females.

In the lower limb strength test (Standing Long Jump), NW males achieved an average distance of 1.89 meters (± 0.26), whereas OW males reached 1.61 meters (± 0.33). NW females recorded a mean of 1.37 meters (± 0.22), compared to 1.21 meters (± 0.17) for OW females.

Regarding abdominal muscular strength, NW males performed an average of 20.47 repetitions (± 3.33), while OW males completed 16.67 repetitions (± 4.41). NW females averaged 16.19 repetitions (± 3.92), compared to 15.11 repetitions (± 3.41) among OW females.

In the 10x5 shuttle run test, NW males recorded a mean time of 18.96 seconds (± 2.46), compared to 20.99 seconds (± 2.88) for OW males. NW females averaged 21.49 seconds (± 3.39), while OW females recorded 22.87 seconds (± 3.50).

Correlation analysis revealed a positive relationship between physical activity levels and physical fitness. Specifically, a significant correlation was found between PAL and cardiovascular fitness in females (NW: $r = 0.26$; OW: $r = 0.57$; $p < 0.05$) and males (NW: $r = 0.35$; OW: $r = 0.45$; $p < 0.05$), as well as between PAL and muscular

fitness in females (NW: $r = 0.23$; OW: $r = 0.46$; $p < 0.05$) and in males (NW: $r = 0.36$; $p < 0.05$).

Conclusion

Physical education, implemented at all school levels, contributes to health promotion through a wide range of motor experiences. It supports the development of all components of motor competence, encourages the adoption of active lifestyles, and helps prevent diseases associated with sedentary behavior.

Given the importance of healthy lifestyles and physical fitness, there is an urgent need for targeted educational interventions aimed at promoting regular physical activity, especially among individuals at risk of physical inactivity.

School constitutes a privileged context for implementing such interventions. Physical education not only fosters the development of motor skills but also contributes to the acquisition of key transversal competences essential for students' personal growth, such as self-discipline, cooperation, and emotional regulation.

Recent studies have shown that physical activity can enhance executive cognitive functions (Castelli, 2022), including attention, memory, and planning abilities, thereby positively influencing academic performance (Pérez-Ramírez et al., 2024). Curricular design in physical education requires a didactic approach grounded in scientific evidence and best practices, aimed at updating subject content, defining clear objectives and methodologies, and enhancing motor learning even in non-formal contexts. The positive effects of physical activity on personal development, especially during the developmental age, do not depend solely on the amount of exercise. They also require a careful selection of tasks, targeted methodological choices, and effective instructional communication between teacher and student (Colella, 2016).

Studies on motor learning (Schmidt & Wrisberg, 2000) highlight the importance of the interaction between the individual, the task, and the context, emphasizing how environmental information influences the execution of practical activities.

The model proposed by Mosston and Ashworth (2008) describes a methodological continuum ranging from teacher-centered approaches—where motor proposals are directive and structured—to modalities that prioritize student initiative and active participation, fostering autonomy and creativity.

More directive strategies, such as command and practice styles, are effective for acquiring specific motor skills and enhancing conditional capacities. In contrast, exploratory approaches—such as guided discovery or problem-solving—encourage the development of motor creativity, adaptability, and personalized learning.

A well-structured use of these styles helps strengthen practitioners' perception of competence, promoting positive and motivating attitudes toward physical activity. The selection of the most appropriate teaching style should be adapted to the educational objectives, the characteristics of the students, and the specific context. Therefore, effective teaching in physical education requires methodological flexibility and the ability to tailor educational interventions in order to foster a balanced development of motor, cognitive, and relational skills (Colella, 2016).

The effectiveness of physical education in schools is closely linked to the quality of teaching and to teachers' ability to tailor motor activities to students' individual characteristics. It is essential to adopt instructional strategies that are inclusive, engaging, and adapted to individual differences—strategies that can enhance gender diversity, varying levels of motor competence, and the specific needs of each student.

Furthermore, physical education should be an integral part of a broader educational project that actively involves families and communities, with the goal of promoting healthy and active lifestyles beyond the school environment. The synergy between school, family, and the local community can significantly enhance the impact of educational interventions, contributing to the creation of a context that supports regular physical activity and fosters a shared culture of movement.

In conclusion, the findings of this study underscore the need to recognize physical education as a key educational tool for promoting the health and well-being of adolescents. Investing in the quality of teaching, adopting inclusive didactic methodologies, and fostering collaboration between schools and communities are essential strategies to counteract sedentary behaviors and to support the holistic and integrated development of young people.

Author contributions

The article is the result of a study jointly designed and developed by the Authors, with the following contributions: Matteo Bibba is the author of the following sections: Introduction; 1, 2, 3, 4. Lorenzo Giannotta also contributed to sections 3 and 4. Conclusions and study limitations are shared among all the Authors.

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