

**THE IMPACT OF INDEPENDENT PHYSICAL ACTIVITY ON
PSYCHOMOTOR DEVELOPMENT AND FUNCTIONAL AUTONOMY IN
LOWER SECONDARY SCHOOL STUDENTS**

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Abstract

In the contemporary educational context, marked by an increase in sedentary lifestyles and a decline in systematic physical activity among school-aged children, physical education is required to extend its formative role beyond the limits of formal lessons. The aim of this study was to evaluate the effects of a structured independent physical activity program on psychomotor development and functional autonomy in lower secondary school students (aged 11–14), from the perspective of physical literacy. The research combined a theoretical analysis of physical literacy with a quasi-experimental study conducted between 2016 and 2019 on a sample of 300 students from three schools in Iași County, Romania. Anthropometric measurements, functional tests, and standardized motor tests were used to assess the impact of autonomous physical activity on somatic, cardiorespiratory, and motor parameters. Comparative analysis of initial and final data revealed significant improvements in speed, strength, endurance, coordination, and postural control in the experimental group, as well as a superior capacity for effort self-regulation. The results support the hypothesis that pedagogically guided independent physical activity contributes

to the development of stable psychomotor competencies and functional autonomy, confirming the educational value of integrating physical literacy as an explicit objective of lower secondary physical education.

Introduction

Physical education represents a fundamental component of general education, contributing to the harmonious development of the individual through the formation of motor skills, functional capacities, and psychosocial competencies essential for health and quality of life (Cârstea, 2000; Cucuș, 2014). However, in recent decades, profound social, technological, and cultural transformations have led to a marked decline in the level of spontaneous and organized physical activity among children and adolescents, with direct consequences for somatic growth, functional balance, and psychomotor development (Malina, Bouchard, & Bar-Or, 2004; Mualem et al., 2018).

International and national studies indicate that a significant proportion of the school population does not reach the minimum recommended level of daily physical activity of moderate to vigorous intensity, which increases the risk of hypokinesia, postural deficiencies, reduced cardiorespiratory capacity, and a low level of motor competence (Nikolić et al., 2015). From a pedagogical perspective, the limited number of physical education lessons included in the school curriculum is insufficient to ensure the optimal development and consolidation of motor skills and functional capacities, particularly during sensitive periods of growth and maturation (Dragnea & Teodorescu, 2002; Hangu, 2016).

In this context, contemporary educational paradigms emphasize the need to extend the formative influence of physical education beyond the framework of formal lessons by promoting autonomous, conscious, and systematic engagement in physical activity. A conceptual framework that integrates these requirements is the theory of physical literacy, which defines an individual's ability to move competently and confidently in a variety of situations, based on appropriate motor skills, knowledge, motivation, and responsibility for maintaining an active lifestyle (Whitehead, 2010; Cristea, 2010).

Lower secondary school age (11–14 years) represents a critical stage of development, characterized by accelerated somatic growth, intense neuromuscular reorganization, and significant changes at the cognitive and motivational levels. During this period, the foundations of basic motor qualities (speed, strength, endurance, coordination, and flexibility) and functional self-regulation mechanisms are consolidated, while attitudes toward physical activity and health-related behaviors are shaped (Leucea, 2010; Malina et al., 2004). Educational interventions that encourage independent, structured, and methodologically guided practice can

therefore play a decisive role in the formation of stable psychomotor competencies and in the development of functional autonomy.

The aim of the present study was to evaluate the impact of a structured independent physical activity program on psychomotor development and functional autonomy in lower secondary school students. The working hypothesis assumed that students who systematically participate in pedagogically guided independent physical activities would achieve significantly greater improvements in motor and functional parameters compared to students who participate exclusively in curricular physical education lessons.

Materials and methods

The research was conducted between 2016 and 2019 and followed a quasi-experimental design, including one experimental group and two control groups, a methodological approach commonly used in physical education and sport sciences. The total sample consisted of 300 lower secondary school students (148 boys and 152 girls), aged between 11 and 14 years, from three schools in Iași County, Romania: Gorban (experimental group) and Costuleni and Covasna (control groups). The groups were initially homogeneous in terms of age, sex distribution, and basic somatic and motor characteristics, in accordance with the requirements of comparative research on school populations.

The investigation was structured in three stages. The preliminary stage (2016–2017) focused on the analysis of specialized literature and the conceptual and methodological preparation of the study. The second stage (2017–2018) included the initial assessment of participants and the administration of a sociological questionnaire to identify students' levels of knowledge and attitudes toward independent physical activity. The experimental stage (2018–2019) consisted of the implementation of the independent physical activity program and the final evaluation of its effects.

Anthropometric measurements (body height, body mass, and arm span) were conducted to assess somatic development, in accordance with standard protocols for children and adolescents. Functional capacity was evaluated using the Ruffier test, which reflects cardiovascular adaptation and recovery capacity after exercise and is widely used in school and sports medicine. Motor performance was assessed through a battery of standardized tests: 50 m sprint (speed), standing long jump and oina ball throw (explosive strength), push-ups, sit-ups, and squats (muscular strength), 600 m run for girls and 800 m run for boys (aerobic endurance), the sit-and-reach test (flexibility), and the Matorin test (coordination and dynamic balance), all validated for the 11–14-year age group.

The independent physical activity program applied to the experimental group was organized according to the classical structure of a physical education lesson (warm-up, main part focused on the development of motor qualities, and cool-down), in accordance with the methodological principles of training and motor learning. The activities were carried out outside the regular school schedule, under teacher supervision, and were accompanied by an activity journal that allowed for the monitoring of frequency, intensity, and perceived exertion, supporting the development of self-regulation and functional autonomy. The independent physical activity program was conducted with a frequency of 2–3 sessions per week, each session lasting an average of 30–45 minutes, throughout the entire intervention period.

Statistical data processing included the calculation of arithmetic means and standard deviations, as well as the application of the independent samples t-test to identify significant differences between the experimental and control groups, in accordance with the standards of quantitative analysis in physical education research. The level of statistical significance was set at $p < 0.05$.

Students' participation in the study was carried out with the consent of parents and educational institutions, and the research complied with the ethical principles specific to educational studies.

Results

The comparative analysis of initial and final assessments revealed significant improvements in favor of the experimental group for most of the investigated variables. From a somatic perspective, all students followed normal growth patterns specific to their age range; however, those involved in the independent physical activity program showed a more balanced evolution of body mass relative to height and arm span, suggesting better control of body composition. In addition, these students achieved superior results in general motor performance tests, as illustrated in Table 1, which presents the final motor and functional performances of the experimental and control groups.

Table 1. Final motor and functional performances of the experimental and control groups

Test	Girls – Gorban (Exp)	Girls – Costuleni (Ctrl)	Girls – Covasna (Ctrl)	Boys – Gorban (Exp)	Boys – Costuleni (Ctrl)	Boys – Covasna (Ctrl)
Ruffier Index (points)	12.47	12.53	12.42	12.79	12.87	13.51
50 m sprint (s)	8.21	8.59	8.52	8.18	8.55	8.50
Push-ups (repetitions)	23.42	13.19	14.45	23.23	13.58	13.69
Oina ball throw (m)	26.28	20.73	21.76	26.40	21.46	21.84
Squats (repetitions)	43.77	21.19	24.33	41.55	21.73	22.63
Standing long jump (cm)	146.26	138.19	142.96	143.85	138.75	141.98
Sit-ups (repetitions)	54.38	31.50	33.04	49.85	32.10	32.43
Back extensions (repetitions)	46.40	28.46	32.27	44.00	29.35	30.88
600 m run – girls (min)	3.38	3.73	3.73	—	—	—
800 m run – boys (min)	—	—	—	3.40	3.73	3.71
Sit-and-reach (cm)	0.66	-0.13	-0.10	1.06	-0.52	-0.29
Matorin test – right (°)	287.74	248.33	271.37	284.26	255.77	261.22
Matorin test – left (°)	282.26	258.33	282.75	286.38	263.08	265.02

The results presented in Table 1 are illustrated in Figure 1.

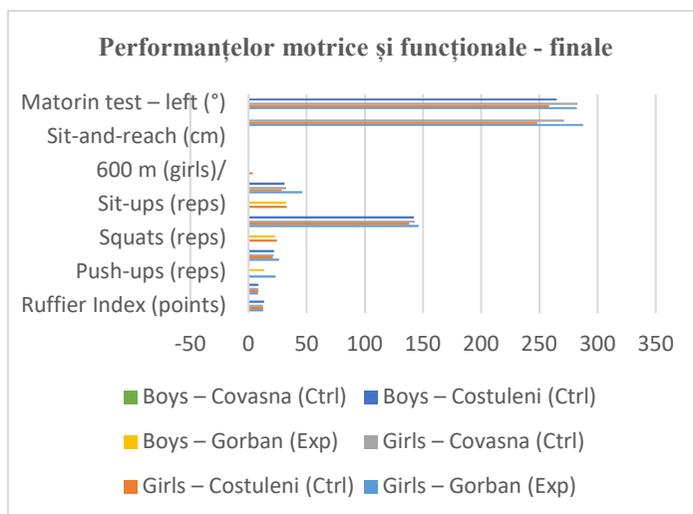


Figure 1. Graphical representation of motor and functional performances of the experimental and control groups

The findings indicate that functional assessment using the Ruffier test showed a significant decrease in index values in the experimental group, reflecting increased

cardiovascular efficiency and faster recovery after exercise. In the control groups, only moderate improvements were recorded, mainly attributable to biological maturation and regular participation in physical education lessons.

With regard to motor performance, statistically significant improvements were observed in the experimental group for speed, muscular strength, explosive strength, aerobic endurance, mobility, and coordination. The largest differences were recorded in endurance running, standing long jump, push-ups, and the Matorin test, indicating superior development of both conditional and coordinative motor qualities.

The analysis of standardized performance profiles revealed clear and consistent differences between the experimental and control groups, for both girls and boys. The experimental groups (Gorban) exhibited predominantly positive standardized scores for most of the evaluated motor and functional tests, indicating performance levels above the overall sample mean.

In contrast, the control groups (Costuleni and Covasna) recorded predominantly negative standardized scores in most tests, suggesting a lower level of performance compared to the experimental group. This trend was consistently observed in tests assessing muscular strength (push-ups, squats, sit-ups, trunk extensions), as well as in coordination (Matorin tests) and mobility assessments.

The most pronounced intergroup differences were found in muscular strength and muscular endurance tests, where the experimental groups demonstrated significantly positive values. This finding suggests superior neuromuscular adaptation, likely determined by the content and structure of the applied intervention program.

Overall, the results indicate not only isolated improvements but also a higher global performance profile, supporting the effectiveness of the intervention in developing basic motor qualities.

In speed (50 m sprint) and endurance tests (600 m for girls and 800 m for boys), the experimental groups showed more favorable outcomes compared to the control groups, despite the greater interindividual variability characteristic of these tests. Standardized values suggest enhanced functional adaptations and better aerobic capacity among students in the experimental group.

Coordination tests (Matorin – right and left) revealed consistent differences in favor of the experimental groups, indicating improved neuromotor control and segmental coordination. Additionally, flexibility assessment showed a clear favorable trend for the experimental group, particularly among boys, where differences compared to control groups were more pronounced.

Table 2. Intergroup comparison at final testing (experimental group vs. control group)

Test	Experimental (Gorban)	Control (Mean of Costuleni & Covasna)	Difference	Interpretation
50 m sprint (s)	8.20	8.56	-0.36	$p < 0.05$
Push-ups (reps)	23.33	13.73	+9.60	$p < 0.01$
Oina ball throw (m)	26.34	21.45	+4.89	$p < 0.01$
Squats (reps)	42.66	22.47	+20.19	$p < 0.001$
Standing long jump (cm)	145.06	140.97	+4.09	$p < 0.05$
Sit-ups (reps)	52.12	32.77	+19.35	$p < 0.001$
600/800 m (min)	3.39	3.72	-0.33	$p < 0.05$
Matorin test (°)	285.16	262.29	+22.87	$p < 0.01$

The results presented in table 2 are illustrated in figure 2

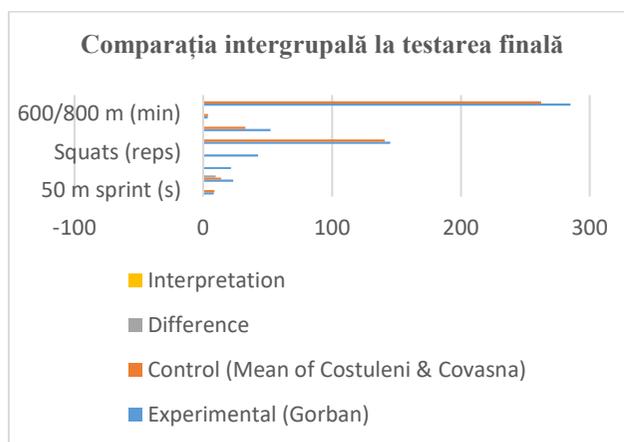


Figure 2. Intergroup comparison at final testing (experimental group vs. control group)

The intergroup comparison at final testing highlights the existence of statistically significant differences between the experimental group (Gorban) and the control group (mean values of Costuleni and Covasna) for all applied tests. In all cases, the mean values recorded by the experimental group were superior to those of the control group, indicating a higher level of motor performance.

In the 50 m sprint test, the experimental group achieved a lower mean time compared to the control group (8.20 s vs. 8.56 s), with the difference being statistically significant ($p < 0.05$). Upper limb strength tests, represented by push-ups and the oina ball throw, revealed pronounced differences between groups in favor of the experimental group, with high levels of statistical significance ($p < 0.01$).

Regarding lower limb strength and endurance, the results obtained in the squat test indicated a very large and highly statistically significant difference between groups ($p < 0.001$), while the standing long jump showed a moderate but statistically significant advantage for the experimental group ($p < 0.05$). Similarly, in the sit-up test, the experimental group recorded considerably higher mean values than the control group, with a highly statistically significant difference ($p < 0.001$). Performance in the endurance test (600/800 m) indicated a lower mean time for the experimental group, with the difference being statistically significant ($p < 0.05$). Furthermore, the results of the Matorin test showed higher mean values in the experimental group, with statistically significant differences ($p < 0.01$), reflecting a superior level of coordination and mobility.

Discussion

The results confirm the hypothesis that independent physical activity, structured and pedagogically guided, contributes significantly to the development of psychomotor competencies and functional autonomy in lower secondary school students. The superiority of the experimental group cannot be explained solely by growth and biological maturation, as the control groups, although having undergone the same developmental stages, did not achieve comparable levels of progress, a finding also reported in other studies on motor development during puberty.

From the perspective of physical literacy, improvements in motor performance were accompanied by increased motivation for movement and enhanced self-regulation capacity, facilitated by the use of activity journals and the progressive organization of training tasks. These findings are consistent with previous research emphasizing the formative value of autonomous practice and its role in consolidating long-term engagement in physical activity.

The standardized performance profile indicates that the applied intervention had a systemic effect on the development of motor capacities, rather than an isolated impact on specific tests. The presence of predominantly positive values for the experimental groups across most assessments suggests a global improvement in physical fitness levels.

Although the results reveal clear differences between groups, their interpretation should consider the absence of effect size indicators (e.g., Cohen's d), which could further strengthen conclusions regarding the magnitude and practical relevance of the observed differences.

Among the limitations of the study are the lack of complete randomization of groups and the inability to rigorously control all physical activities performed outside the proposed program.

Conclusions

The findings of the present study highlight the positive impact of pedagogically guided and structured independent physical activity programs on psychomotor development and functional autonomy in lower secondary school students. Compared to students who participated exclusively in curricular physical education lessons, those in the experimental group achieved significantly greater improvements in most of the evaluated motor and functional parameters.

The differences observed between the experimental and control groups reflect superior development of basic motor qualities, namely speed, strength, endurance, coordination, and mobility, as well as favorable functional adaptations, evidenced by improvements in cardiorespiratory capacity and recovery efficiency after exercise. These results confirm the effectiveness of the applied intervention and support the role of independent physical activity in optimizing students' physical fitness levels. From the perspective of physical literacy, the integration of autonomous practice contributed to the development of stable psychomotor competencies and to the strengthening of effort self-regulation, fostering greater responsibility for engaging in physical activity. The progressive organization of tasks and the use of individual monitoring tools supported the development of functional autonomy and motivation for movement.

The obtained results support the need to extend the influence of physical education beyond the framework of formal lessons by including independent physical activity as a complementary educational objective in lower secondary education. Such an approach may contribute to the consolidation of active behaviors and the promotion of a healthy lifestyle over the long term.

From a future perspective, further research should focus on longitudinal studies and on the integration of additional analytical indicators, such as effect size measures and the assessment of motivational and cognitive components of physical literacy, in order to deepen the understanding of the mechanisms through which independent physical activity influences students' overall development.

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