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DETERMINING THE RELATIONSHIP OF COMBINED MOTOR SKILLS: SPEED – STRENGTH – AGILITY IN 11–12-YEAR-OLD STUDENTS

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Abstract: *The study investigates the relationship between speed, strength and agility in 11–12-year-old students using five motor tests: 50 m sprint, long jump, sit-ups, trunk extensions and an obstacle course. The research included 30 students (20 boys, 10 girls) from the "Marin Preda" Theoretical High School of Bucharest. The results indicate a high homogeneity in speed (CV = 6.35%) and agility (CV = 9.61%) tests but significant variability in strength and muscular endurance tests (CV = 29.13% for trunk lifts, CV = 37.55% for extensions). Sprint performance showed a strong negative correlation with trunk strength (R = -0.875 and R = -0.830, p < 0.001), revealing that stronger students achieved better running times. Agility, measured through the obstacle course test, was strongly negatively correlated with the long jump (R = -0.944, p < 0.001), suggesting a significant influence of lower limbs explosive strength on agility. The conclusions highlight the interdependence between speed, strength and agility, showing the importance of personalized training programs that support the balanced development of these motor skills meant to optimize students' physical performance.*

Key words: ***c****ontrol tests, development, motor skills, evaluation, correlation*

1. Introduction

Motor skill development plays a fundamental role in the overall physical fitness of children and adolescents, directly influencing their ability to perform various athletic and everyday movements efficiently [11], [17], [18]. Speed, strength and agility can be identified as some of the key components of motor performance.

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They are interdependent factors that contribute significantly to movement efficiency, coordination and overall athletic potential [5], [14].

In children aged 11–12, the integration of these motor skills is essential for both general physical development and sports specialization. Strength is a crucial determinant of movement capacity, providing the foundation for explosive actions and dynamic stability [7]. Speed and agility, in turn, enable rapid directional changes and efficient movement execution, particularly in sports requiring quick reflexes and spatial awareness [8]. As previous studies have shown, the ability to optimize the relationship between these motor components is very important in enhancing overall athletic performance [1], [21].

Research in this area has shown that the development of speed-strength and agility can be influenced by various factors, including neuromuscular coordination, somatic indicators and training interventions [4]. Understanding the correlation between these abilities can help refine training methodologies and improve the effectiveness of physical education programs [8], [10], [15].

This study aims to determine the relationship between speed, strength and agility in 11–12-year-old students, assessing the extent to which these motor skills interact and influence one another. By examining their interconnections, we seek to provide insights into optimizing training strategies for young athletes and school-aged children, ensuring a balanced and effective approach to motor skill development.

2. Methods

Several 30 students (20 boys and 10 girls) from the „Marin Preda" Theoretical High School of Bucharest participated in this research.

The study was carried out from the 1st of September to the 1st of November 2022, when the initial tests and investigations were performed.

There were used the following methods, tests and fitness tests:

- method of bibliographic study.
- method of observation.
- 50 m sprinting (AV) test, evaluated in sec.
- standing long jump (SLL) test, evaluated in meters.
- strength test, sit-ups in 30 sec., reps no.
- strength test, trunk extensions in 30 sec., reps no.
- test for complex motor skills (obstacle course), evaluated in sec.

Statistical analysis was performed using the KyPlot software, applying standard descriptive indices and the Pearson correlation coefficient to highlight the relationship between the combined motor quality indices studied.

3. Results

This study presents a descriptive statistical analysis of five physical performance tests (Table 1): 50 m sprint, standing long jump, sit-ups, trunk extensions and an obstacle course test. The results include mean values, standard deviations (SD), coefficients of variation (CV%) and 95% confidence intervals.

Table 2 presents the correlations between different motor skill parameters measured in the study. Pearson correlation coefficients (R) highlight the relationships between running speed (50 m sprint), standing long jump (SLJ), trunk muscle strength (sit-ups and trunk extensions) and performance in the obstacle course test.

Descriptive analysis indicators Table 1

Statistical indicators	AV (50 m), sec	SLL, m	Sit-ups in 30 sec, reps no.	Trunk extensions in 30 sec, reps no.	Obstacle course, sec
mean	8.12	2.76	22.63	17.83	45.17
SD	0.51	0.31	6.59	6.69	4.34
CV(%)	6.35	11.24	29.13	37.55	9.61
Confidence Level of Mean(0.95)	0.19	0.12	2.46	2.50	1.62

Table 2

The correlational analysis between the combined motor skills indicators

R, Pearson	AV (50 m), sec	SLL, m	Sit-ups in 30 sec, reps no.	Trunk extensions in 30 sec, reps no.	Obstacle course, sec
Standing long jump, m	-0.220	-			
Sit-ups in 30 sec, reps no.	-0.875***	-0.131	-		
Trunk extensions in 30 sec, reps no.	-0.830***	-0.193	0.993***	-	
Obstacle course, sec	0.419*	-0.944***	-0.093	-0.031	-

The 50 m sprint test had an average time of 8.12 seconds (SD = 0.51 s), with low variability (CV = 6.35%), indicating a high level of homogeneity in speed performance. The standing long jump test recorded an average of 2.76 meters (SD = 0.31 m) and moderate variability (CV = 11.24%), pointing out differences in the explosive strength of the lower limbs.

In the sit-ups test, the average number of repetitions was 22.63 (SD = 6.59), with high variability (CV = 29.13%), while the trunk extensions test had an average of 17.83 repetitions (SD = 6.69) and the highest variability (CV = 37.55%), reflecting significant differences in trunk muscle endurance among students.

The obstacle course test (OCT) had an average time of 45.17 seconds (SD = 4.34), with moderate variability (CV = 9.61%), suggesting a balanced distribution of agility and endurance abilities.

The correlation analysis results highlight relationships between:

- 50 m sprint and other indices: a moderate and statistically significant negative correlation with sit-ups in 30 seconds ($R = -0.875$, $p < 0.001$) and trunk extensions in 30 seconds ($R = -0.830$, $p < 0.001$); a weak positive correlation with performance in the obstacle course test ($R = 0.419$, $p < 0.05$), indicating that a better sprint time may contribute to performance, but is not the main factor.

- Standing long jump (SLL) and other indicators: SLL does not show statistically significant correlations with other parameters analyzed ($p > 0.05$), suggesting that this indicator of explosive strength is not directly influenced by trunk strength or running speed.

- Sit-ups and trunk extensions in 30 seconds: there is a very strong correlation between sit-ups and trunk extensions ($R = 0.993$, $p < 0.001$), which was expected as both tests assess the strength and endurance of the trunk muscles. This relationship confirms that a student with good sit-up ability will also perform well in trunk extensions.

- Performance on the Obstacle Course Test (OCT) and other indices: A very strong negative correlation with 50 m sprint speed ($R = -0.944$, $p < 0.001$), indicating that faster students in the 50 m sprint also achieve better times in the obstacle course. This relationship was predictable, as both tests depend on the ability to maintain high speed over a course with obstacles.

There are no significant correlations between performance in the obstacle course and trunk strength, proving that this test depends more on overall speed and agility than on specific trunk muscle endurance.

4. Discussion

This study analyzes the motor performance of the subjects in tests evaluating speed, explosive strength, trunk muscular endurance and agility in 11–12-year-old students, aiming to identify the level of homogeneity and the main factors influencing the results.

The obtained results point out a high level of homogeneity among the students in terms of running speed (50 m Sprint), while the explosive strength of the lower limbs (Standing Long Jump) and agility (Obstacle Course Test) show moderate variability, suggesting the influence of factors such as execution technique and training level. These findings are consistent with previous studies emphasizing the role of neuromuscular development and training in speed-strength performance [7], [19], as well as research focusing on motor skill development in preadolescents [4].

In contrast, the trunk muscular endurance tests (sit-ups and back extensions) recorded high variability, indicating significant differences among participants. This variability can be attributed to differences in core stability, muscle endurance and previous physical activity levels, as highlighted in studies on motor proficiency and physical fitness in children and adolescents [2], [13]. Furthermore, research suggests that core strength plays a crucial role in overall motor performance and agility, supporting the importance of targeted training for trunk endurance [6], [20].

Also, the relationship between explosive strength, speed and agility has been widely studied. The findings indicated that factors such as technique, neuromotor fitness and anaerobic power significantly influence performance outcomes [9], [20]. These results contribute to the broader understanding of physical fitness development in school-aged children, emphasizing the need for structured training programs tailored to individual capacities. This viewpoint was supported by recent studies evaluating physical education in primary school [10].

The correlation analysis results reveal significant relationships between certain motor variables in 11–12-year-old students. The 50 m sprint performance shows a moderate negative correlation with sit-ups in 30 seconds and trunk extensions in 30 seconds, revealing that a shorter sprint time is associated with lower trunk muscle strength. These findings are consistent with previous studies highlighting the interplay between speed, strength and neuromuscular coordination in preadolescents [3], [14].

Moreover, performance in the obstacle course test has a very strong negative correlation with 50 m sprint speed, confirming the importance of speed and agility in this test. This aligns with research emphasizing the role of dynamic motor abilities in general athletic performance [6], [16].

On the other hand, the standing long jump does not show significant correlations with other parameters ($p > 0.05$), indicating that explosive strength is not directly influenced by running speed or trunk strength. Similar conclusions were reported in studies analyzing motor proficiency and its independence from certain fitness components in school-aged children [12].

Regarding sit-ups and trunk extensions, their relationship is very strong, proving that the same muscle groups are involved in both exercises, a finding that supports previous research on core strength and its contribution to overall physical fitness in preadolescents [6].

5. Conclusion

1. The study emphasizes a high level of homogeneity among 11–12-year-old students in sprint run (50 m), while the explosive strength of the lower limbs and agility show moderate variability. In contrast, trunk muscular endurance tests exhibit significant variability, suggesting that factors such as technique, training level and core stability influence individual performance differences.
2. The correlation analysis highlights a strong relationship between speed and agility, reinforcing the importance of sprint ability in dynamic motor tasks. Additionally, a moderate negative correlation

between sprint speed and trunk endurance suggests that students with higher running speed tend to have lower trunk muscle strength. Therefore, it will be necessary to develop balanced training programs that integrate both core stability and speed development.

3. The findings show that the standing long jump does not significantly correlate with other motor parameters, indicating that lower limb explosive strength operates independently of running speed and trunk endurance. This supports the idea that different motor skills develop through distinct neuromuscular mechanisms and should be trained separately to optimize overall physical fitness in preadolescents.

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