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The Impact of Physical Activity Level on BMI and Motor Performance in Children Aged 9–11: A Comparative Field Study

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Abstract:

This study aims to analyze the effect of physical activity level on both Body Mass Index (BMI) and motor performance in children aged 9 to 11 years, with the objective of identifying differences associated with varying activity levels and their implications on physical health and motor abilities during late childhood. A comparative descriptive approach was adopted, involving a multi-stage cluster random sample of 142 students from elementary schools in the second education sector of Biskra Province during the 2024/2025 academic year. The participants were divided into three groups based on their physical activity level (high – moderate – low). Motor performance was assessed using the one-leg stand test (balance), the 30-meter sprint test (speed), and the vertical jump test (muscular strength), in addition to calculating the Body Mass Index. Data were analyzed using one-way ANOVA to determine significant differences among the groups. The results revealed statistically significant differences in favor of children with high physical activity levels, highlighting the importance of regular physical activity in promoting physical health and motor efficiency at this stage of development

Keywords: Physical Activity Level; Body Mass Index; Motor Performance; Late Childhood.

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1. Introduction and Problem Statement

In recent decades, sedentary lifestyles have become increasingly prevalent, particularly among children and adolescents. Defined as behavioral patterns characterized by prolonged sitting or reclining with minimal physical activity, sedentary behavior has been conclusively linked to elevated risks of cardiovascular disease, diabetes, and obesity (Henschel et al., 2017). Physical inactivity now stands recognized as a primary contributor to deteriorating child health outcomes, strongly associated with chronic conditions including metabolic disorders and cardiovascular pathologies (Maamri et al., 2025).

Global health authorities have raised urgent concerns about this trend. The World Health Organization (WHO, 2020) reports that most children fail to meet the recommended minimum of 60 minutes daily physical activity. Empirical evidence from Park et al. (2020) using triaxial accelerometer data demonstrates that excessive sedentary behavior correlates significantly with elevated Body Mass Index (BMI) and impaired performance in strength, balance, and speed assessments, underscoring the critical importance of active lifestyles for health maintenance and motor competence development during late childhood.

The longitudinal significance of early activity patterns has been further established by Monserrat-Mesquida et al. (2023), whose Spanish cohort study revealed that healthy lifestyle adoption in developmental stages predicts BMI trajectories in later life. This highlights the essential role of familial and educational environments in cultivating active living patterns as both obesity prophylaxis and physical fitness development strategy. These international findings find compelling corroboration in localized research by Belaasel et al. (2023), demonstrating that even moderate physical activity (such as Ramadan walking protocols) induces significant improvements in functional health parameters - including BMI, blood pressure, waist circumference, and cardiac metrics - among overweight adolescents (12-16 years).

While existing research has established these relationships primarily in adolescent populations, the developmental criticality of late childhood (ages 9-11) warrants particular attention. This transitional phase represents a pivotal window for both motor skill acquisition and body composition establishment, yet the precise interrelationships between physical activity gradations, BMI, and motor performance remain insufficiently explored in this age cohort. The current study accordingly seeks to advance understanding of how differential



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physical activity levels influence both anthropometric and motor development during this formative period.

This investigation addresses the following primary research question: What is the impact of physical activity level on body mass index and motor performance among children aged 9-11 years?

Derived secondary questions examine:

1. Whether statistically significant differences in BMI exist across children with varying physical activity levels (high/moderate/low)
2. Whether statistically significant differences emerge in motor performance (balance, speed, muscular strength) across physical activity levels

2. Hypotheses

1. There are statistically significant differences in body mass index among children attributed to the level of physical activity, in favor of children with high physical activity levels.
2. There are statistically significant differences in motor performance (balance, speed, muscular strength) among children attributed to the level of physical activity, in favor of children with high physical activity levels

3. Objectives and Significance

This study aims to:

- Analyze the relationship between physical activity level and Body Mass Index (BMI) among children aged 9 to 11 years.
- Compare motor performance (in terms of balance, speed, and muscular strength) among children with different levels of physical activity.
- Identify statistically significant differences in indicators of physical health (BMI) and motor fitness based on physical activity levels.
- Propose recommendations that can be incorporated into school and educational programs to encourage children to adopt a more active and healthy lifestyle.

This study is of great importance in light of the rapid changes in children's lifestyles, where physical activity has become increasingly limited due to the growing reliance on digital entertainment and technological means—negatively impacting their physical and motor health.

The significance of this study lies in the following points:

- It highlights the impact of physical activity as a key determinant of children's health, particularly in relation to Body Mass Index and motor performance.
- It provides field data that can assist teachers and parents in understanding the link between regular physical activity and children's growth and motor development.
- It raises awareness of the need to integrate physical activity into children's daily school life to prevent health issues such as obesity and poor balance or movement.
- It contributes to guiding educational and health policies toward early intervention programs that enhance pupils' physical and motor capacities

4. Key Concepts and Operational Definitions

In this study, the following key concepts are defined both conceptually and operationally to ensure clarity and consistency:

4.1. Physical Activity Level

Physical activity refers to any bodily movement produced by skeletal muscles that results in energy expenditure, including actions such as playing, walking, recreational activities, and structured exercises. According to the World Health Organization (2020), it encompasses movement undertaken during work, transport, and leisure. Tremblay et al. (2017) further define physical activity as all movement produced by skeletal muscles that results in energy expenditure above resting levels, including leisure-time physical activity, exercise, sports, and physical tasks performed during daily life

Accordingly, physical activity level can be understood as the degree of involvement in bodily movement of various intensities over a given period, typically categorized as low, moderate, or high.

In this study, physical activity level is operationally defined as the total number of hours per week a child engages in moderate to vigorous physical activities, as reported through a structured questionnaire completed jointly by the child and one of their parents. Based on the total reported time, the children are classified into three levels:

- **High:** more than 7 hours/week
- **Moderate:** between 4 and 7 hours/week
- **Low:** less than 4 hours/week.



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4.2. Body Mass Index (BMI)

Body Mass Index (BMI) is a widely utilized anthropometric measure, calculated by dividing an individual's weight in kilograms by the square of their height in meters (kg/m^2). It serves as a practical tool for classifying individuals into categories such as underweight, normal weight, overweight, and obese (Khan & Smeili, 2024). According to Cole et al. (2000), BMI is defined as a weight-for-height index that facilitates the classification of individuals based on international cut-off points adjusted for age and sex.

Consequently, BMI is regarded as a simple yet reliable indicator of weight status, applicable across both clinical practice and research, particularly when assessing children and adolescents.

In this study, BMI is computed by dividing the child's weight (kg) by the square of their height (m^2), and the resulting value is interpreted using age- and sex-specific percentile charts developed by the World Health Organization for individuals aged 5 to 19 years.

4.3. Motor Performance

Motor performance is defined as the measurable execution of learned and purposeful movements involving coordination, speed, balance, agility, and muscular strength. Logan et al. (2015) describe it as a child's ability to efficiently perform motor tasks that reflect physical and neuromuscular development, highlighting its close connection with habitual physical activity. Similarly, Cattuzzo et al. (2016) consider motor performance an observable expression of motor competence, incorporating components of health-related physical fitness that enable effective interaction with the physical environment.

Accordingly, motor performance is understood as a composite indicator of motor competence and physical efficiency, reflecting the child's capacity to perform a range of movement tasks with control and effectiveness. In this study, motor performance is operationally assessed using a battery of standardized physical tests that include:

- **Balance** (One-leg stance test)
- **Speed** (30-meter sprint test)
- **Muscular strength** (Vertical jump test)

Overall motor performance is based on the combined results of the three tests and compared across activity levels.

5. The methodological procedures used in the study

5.1 Methodology

This study employed a comparative descriptive design, recognized as one of the most appropriate methodological approaches for examining differences between groups based on specific variables without researcher manipulation (Farhat & Abu Zaid, 2022). This design was applied to investigate the effect of varying levels of physical activity (high, moderate, and low) on Body Mass Index (BMI) and motor performance among children aged 9 to 11 years.

5.2 Study Population

The accessible population includes all 4th and 5th grade pupils aged 9 to 11 years from the 20 primary schools in the second administrative district during the 2024–2025 academic year. The total number of pupils is 2,454. This population is appropriate for studying differences in physical and motor indicators linked to varying physical activity levels

5.3 Sample Selection

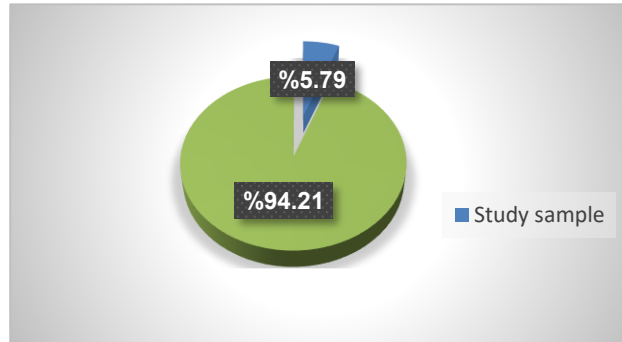
A **multi-stage cluster sampling method** was employed, suitable for the educational nature and geographical spread of the population. Sampling was carried out through the following stages:

1. **First stage:** A number of schools were randomly selected from the 20 available in the district.
2. **Second stage:** Within each selected school, 4th and 5th grade classes were chosen, as they include the target age group.
3. **Third stage:** A number of pupils were randomly selected from each class, ensuring a balance in **gender** and **age** distribution.

This method ensures proper representation of various subgroups within the school population and reduces sampling bias, thereby enhancing the generalizability of the study's results (Kumar, 2011).

To control for extraneous variables, a preliminary screening questionnaire was used to exclude children with chronic illnesses or those who regularly engage in organized physical activities outside school. This yielded a homogeneous final sample of 142 pupils from 4th and 5th grades, representing 5.79% of the total population (see Figure 1).

Fig.1. Representation of the Sample Relative to the Population



As previously mentioned, the sample was selected using a multi-stage cluster random method. The pupils' ages ranged from 9 to 11 years. Table 1 presents the mean and standard deviation for the age variable.

Table 1. Mean and Standard Deviation of Age in the Study Sample

Age Range (years)	Frequency (n)	Age × Frequency	Deviation from Mean	Squared Deviation	Frequency × Sq. Dev.
9 – < 10	48	456.0	-0.95	0.9025	43.32
10 – < 11	54	567.0	0.05	0.0025	0.135
11 – < 12	40	460.0	1.05	1.1025	44.10
Total	142	1483.0			87.56

The **mean age** was **10.45** years, with a **standard deviation** of **± 0.79**

The level of physical activity was measured using a questionnaire composed of two sections:

- **The first section** is directed to the parent or guardian and collects information about the family's socio-cultural background, the child's health condition and his academic rate, and participation in organized sports activities outside of school.
- **The second section** is completed by the child with the assistance or supervision of the parent and includes items related to the type and frequency of physical activity performed over the past seven days, both inside and outside the school setting.

Based on the responses, the physical activity level is determined as follows:

Table 2. Physical Activity Levels Based on Average Weekly Activity

Physical Activity Level	Weekly Activity Estimate
Low	Less than 4 hours per week
Moderate	Between 4 and 7 hours per week
High	More than 7 hours per week

The study sample of children was divided into three groups according to their level of physical activity. This classification (low, moderate, high) is based on weekly averages derived from the Physical Activity Questionnaire for Children (PAQ-C) and aligns with recent validation studies (e.g., Saint-Maurice et al., 2016) as well as the recommendations of the World Health Organization (2020) regarding physical activity levels for children aged 5 to 17

Table 3. Distribution of Sample by Physical Activity Level

Activity Level	Number of Pupils (n)	Percentage (%)
Low	53	37.33%
Moderate	61	43.00%
High	28	19.67%
Total	142	100%

To ensure the validity and reliability of the comparisons between the three physical activity groups (high, moderate, and low), it was essential to verify that they were statistically comparable in key demographic and background variables. Homogeneity across groups helps eliminate the influence of confounding factors that could otherwise bias the results. Therefore, the groups were tested for differences in chronological age, height, academic achievement, socioeconomic status, and gender distribution using appropriate statistical tests. The results are presented in Tables 4 and 5



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Table 4. Differences in Demographic, Academic Variables Among Activity Levels

Variable	High Activity (n=28)	Moderate Activity (n=61)	Low Activity (n=53)	F Value	Sig. (p)
Age (years)	10.1 ± 0.58	10.9 ± 0.61	10.45 ± 0.55	0.47	0.625
Height (cm)	137.2 ± 5.4	136.5 ± 5.7	137.0 ± 5.6	0.39	0.679
Academic Score (/10)	7.55 ± 1.22	6.91 ± 1.18	7.12 ± 1.29	0.58	0.561
Socioeconomic Index	2.45 ± 0.51	2.42 ± 0.48	2.47 ± 0.54	0.34	0.711

The non-significant p-values ($p > 0.05$) indicate no statistically significant differences, confirming that the groups are comparable.

Table 5. Gender Distribution Across Activity Groups (Chi² Test)

Gender	High Activity	Moderate Activity	Low Activity	Total
Male	10	34	24	68
Female	18	27	29	74
Total	28	61	53	142

The Chi² test (Chi² = 0.245, $p = 0.885$) indicates no statistically significant difference in gender distribution across activity groups ($p > 0.05$)

This suggests that males and females are evenly represented in the high, moderate, and low activity groups. Therefore, gender is unlikely to be a confounding variable in the study's results.

5.4 Study Domains, Variables, and Assessment Methods

The research encompasses the following domains:

- **Human Domain:**

Children of both sexes, aged between 9 and 11 years, enrolled in the fourth and fifth grades of public primary schools within the second district of Biskra during the 2024–2025 academic year.

- **Spatial Domain:**

All officially recognized primary schools located within the second administrative district of Biskra, as defined by the Directorate of Education.

- **Temporal Domain:**

The study was conducted during the second trimester of the 2024–2025 academic year.

- **Thematic Domain:**

The research falls within the field of motor education, with a focus on examining the differences in motor performance and BMI indicators according to the level of physical activity among children in late childhood.

As for the study variables, they are as follows:

- **Independent Variable:**

Level of physical activity, categorized into three levels (high, moderate, and low) based on a structured questionnaire completed by parents and children.

- **Dependent Variables:**

- Motor performance indicators, assessed through a battery of physical tests (balance, speed, strength).
- Body Mass Index (BMI), calculated using the standard formula based on weight and height measurements.

- **Controlled Variables:**

Certain individual characteristics such as age, gender, socioeconomic status, academic achievement, and health condition were accounted for and statistically controlled during the data analysis to ensure valid comparisons across physical activity levels

5.5 Instruments Used

a. Description and Methodology

Body Mass Index (BMI):

BMI was calculated by measuring each student's height and weight using precise medical tools (digital scale and stadiometer), and applying the



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standard formula:

$$BMI = \frac{\text{weight (kg)}}{\text{height (M)}^2}$$

Motor Performance Indicators Assessment Tools:

A set of validated tests was used to assess children's motor fitness, including:

- **Static Balance Test (One-Leg Stance Test):**
Used to assess static balance. The child is asked to stand on one leg with arms at their sides. The time (in seconds) the child can maintain balance without the lifted foot touching the ground is recorded. The test is repeated on both legs, and the best score is retained.
- **Speed Test (30m Sprint Test):**
Measures motor speed. The child runs 30 meters at maximum effort on a flat surface. The time taken is recorded in seconds using a digital stopwatch.
- **Muscular Strength Test (Vertical Jump):**
This test evaluates the explosive power of the lower limbs. The child performs a vertical jump from a stationary standing position, and the jump height is recorded in centimeters using a Vertec device, which measures the maximum reach during the jump.

Physical Activity Questionnaire:

Distributed to parents to determine each child's level of physical activity. Participants were classified into three groups (high, moderate, low activity levels) based on the frequency and intensity of physical activity performed during the week.

b. Psychometric Properties of the Instruments

Validity:

Expert judgment validity was employed by presenting the tools to nine specialists in motor education. The agreement rates ranged between 81.61% and 95.91% for all proposed tests, indicating high content validity. This high level of expert agreement confirms that the tools adequately cover the constructs they are intended to measure.

Reliability:

Test-retest reliability was applied on a pilot sample of 30 students, with measurements taken twice, one week apart.

- The correlation coefficients between the two sets of measurements ranged from 0.83 to 0.89, indicating a high degree of reliability and consistency of the instruments used.

5.6 Statistical Processing

To examine the significance of differences between the three physical activity groups in terms of Body Mass Index (BMI) and motor performance indicators, a one-way Analysis of Variance (ANOVA) was employed. This method is suitable for comparing the means of more than two independent groups

6. Presentation and Analysis of Results

This section presents the study's findings based on the stated hypotheses. The analysis examines differences in BMI and motor performance (balance, speed, muscular strength) among children aged 9 to 11 according to their level of physical activity (high, moderate, low).

Prior to analysis, the assumptions of normality and homogeneity of variance were verified. Each hypothesis is addressed separately, with results shown in tables and briefly interpreted in light of relevant literature.

First hypothesis

“There are statistically significant differences in Body Mass Index (BMI) between children with different levels of physical activity.”

To test this hypothesis, BMI means and standard deviations were calculated across the three physical activity groups. The ANOVA results are presented below:

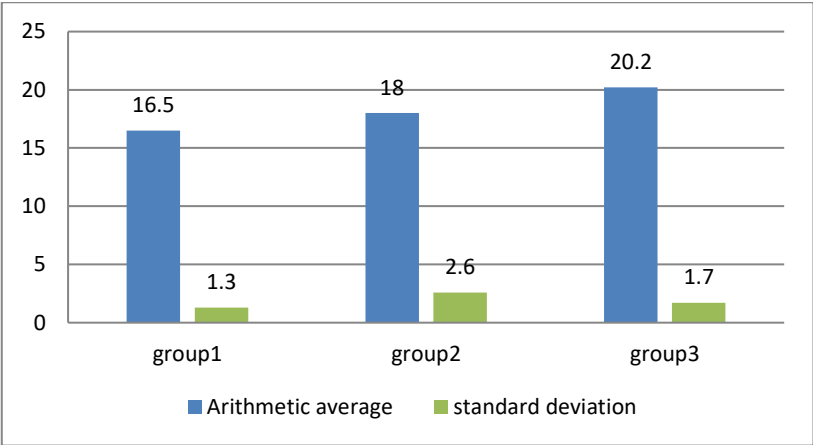
Table 7. Mean and Standard Deviation of BMI by Physical Activity Level

Physical Activity Level	Mean BMI	SD	F-value	p-value
High	16.5	1.3		
Moderate	18.0	2.6	40.01	0.000
Low	20.2	1.7		



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Fig 2. Mean and Standard Deviation of Body Mass Index (BMI) Across the Research Groups



Interpretation:

The results provide strong support for Hypothesis 1. The ANOVA revealed a statistically significant difference in BMI between the three physical activity groups ($F = 40.01$, $p < 0.001$). Children in the high activity group had significantly lower BMI scores ($M = 16.5$, $SD = 1.3$) compared to their peers in the moderate ($M = 18.0$, $SD = 2.6$) and low activity groups ($M = 20.2$, $SD = 1.7$). These differences are not only statistically significant but also meaningful in the context of child health promotion. This outcome is consistent with previous findings (e.g., Park et al., 2020; Monserrat-Mesquida et al., 2023), which demonstrate that increased physical activity is associated with better body composition in school-aged children.

Second hypothesis

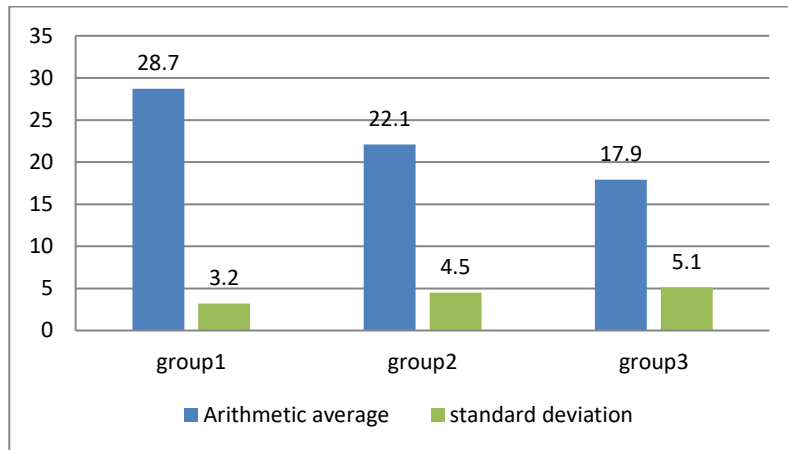
“There are statistically significant differences in motor performance (balance, speed, and muscular strength) between children with different levels of physical activity.”

a. Balance Performance

Table 8. Balance Test Results (seconds) by Physical Activity Level

Physical Activity Level	Mean (sec)	SD	F-value	p-value
High	28.7	3.2		
Moderate	22.1	4.5	41.30	0.000
Low	17.9	5.1		

Fig 3. Mean and Standard Deviation of Balance Test Across the Research Groups



Interpretation:

The results support the second hypothesis regarding balance performance. ANOVA revealed significant differences among the three physical activity groups ($F = 41.30$, $p < 0.001$), with children in the high activity group showing better balance ($M = 28.7$ sec) than those in the moderate ($M = 22.1$ sec) and low activity groups ($M = 17.9$ sec). These findings indicate that higher physical activity is linked to improved postural control in children. This is in line with previous studies (e.g., Golle et al., 2015), which highlight the role of regular movement in developing balance and motor coordination during childhood

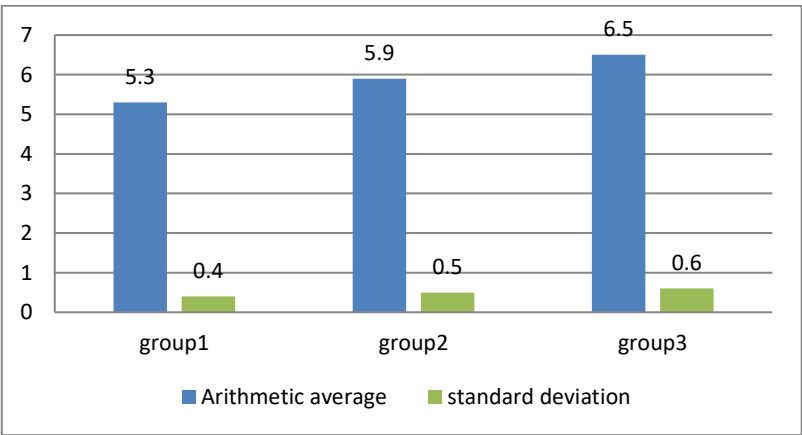


b. Speed Performance

Table 9. 30m Sprint Test Results (seconds) by Physical Activity Level

Physical Activity Level	Mean (sec)	SD	F-value	p-value
High	5.3	0.4		
Moderate	5.9	0.5	48.05	0.000
Low	6.5	0.6		

Fig 4. Mean and Standard Deviation of Sprint Test Across the Research Groups



Interpretation:

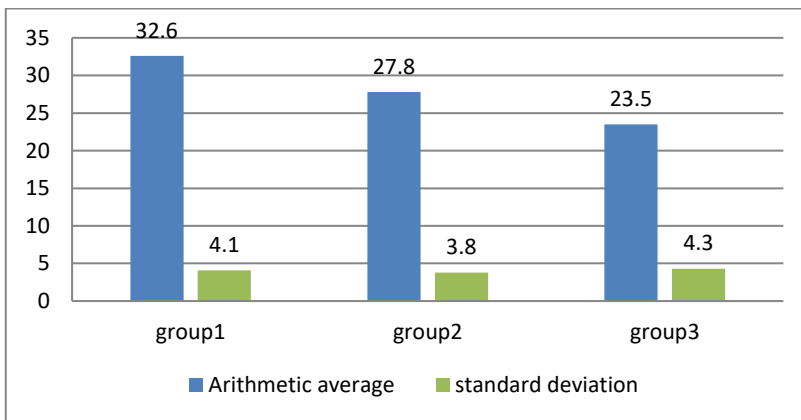
The results confirm the second hypothesis related to speed performance. ANOVA showed a statistically significant difference between the three groups ($F = 48.05$, $p < 0.001$), with children in the high activity group achieving faster 30m sprint times ($M = 5.3$ sec) than their moderately active ($M = 5.9$ sec) and less active peers ($M = 6.5$ sec). These results underline the beneficial effect of regular physical activity on neuromuscular coordination and acceleration, supporting findings by Pinho et al. (2024) regarding the role of physical activity in enhancing sprint and explosive performance in children.

c. Muscular Strength Performance

Table 10. Vertical Jump Results (cm) by Physical Activity Level

Physical Activity Level	Mean (cm)	SD	F-value	p-value
High	32.6	4.1		
Moderate	27.8	3.8	35.82	0.000
Low	23.5	4.3		

Fig 5. Mean and Standard Deviation of V. Jump Across the Research Groups



Interpretation:

The results confirm the second hypothesis on muscular strength, as ANOVA revealed a significant difference in vertical jump performance among the groups ($F = 35.82$, $p < 0.001$). Children with high physical activity showed greater lower-body explosive strength ($M = 32.6$ cm) than their moderately active ($M = 27.8$ cm) and less active peers ($M = 23.5$ cm). These findings highlight the positive influence of regular physical activity on muscular power and neuromuscular efficiency, in line with Pinho et al. (2024)



7. Discussion of Results

The findings of this study provide robust evidence of the influence of physical activity level on both body composition and motor performance in children aged 9 to 11. Statistically significant differences were observed between high, moderate, and low activity groups across all measured variables: Body Mass Index (BMI), balance, speed, and muscular strength. These results confirm the study's hypotheses and highlight the crucial role of regular physical activity during a sensitive period of motor and functional development in childhood.

a. Body Mass Index (BMI)

Children with higher levels of physical activity recorded significantly lower BMI values ($M = 16.5 \text{ kg/m}^2$) compared to their less active peers ($M = 20.2 \text{ kg/m}^2$), with strong statistical significance ($F = 40.01, p < 0.001$). This finding aligns with earlier research, including Wang et al. (2006), who identified a clear link between sedentary behavior and childhood obesity, and Suleiman (2022), who emphasized the protective effect of regular physical activity in controlling fat accumulation and promoting healthy body composition.

The physiological mechanisms underpinning this relationship may involve increased energy expenditure, improved metabolic function, hormonal regulation (e.g., insulin sensitivity), and decreased sedentary time. Active children also tend to develop healthier overall habits, such as adequate sleep, active play, and reduced screen exposure, which indirectly support a healthy BMI.

From a public health standpoint, these findings reaffirm the importance of integrating physical activity into children's daily routines, particularly through formal physical education programs in schools and movement-promoting activities at home. Early intervention can be especially effective in preventing excess weight gain and encouraging lifelong engagement in healthy behaviors.

b. Motor Performance (Balance, Speed, Explosive Strength)

Significant differences in motor performance were also observed, with children in the high-activity group consistently outperforming their peers across all tested indicators:

- **Balance:** Children in the high-activity group demonstrated superior performance on the static balance test ($M = 28.7 \text{ sec}$) compared to the low-activity group ($M = 17.9 \text{ sec}$). This suggests that frequent movement

stimulates neuromuscular coordination and sensory integration—key elements in developing postural control. These results are consistent with Golle et al. (2015) and Ortega et al. (2008), who identified balance and coordination as sensitive to variations in physical activity levels.

- **Speed:** In the 30-meter sprint test, more active children achieved faster times ($M = 5.3$ sec) than their less active counterparts ($M = 6.5$ sec). This finding supports earlier work by Pinho et al. (2024), who demonstrated the benefits of structured training on speed and agility. It also corresponds with findings by Al-Otaibi & Al-Qahtani (2024), who highlighted the influence of movement frequency and intensity on locomotor performance.
- **Explosive Strength:** The vertical jump test revealed marked differences in lower-limb power, with the high-activity group achieving a mean of 32.6 cm compared to 23.5 cm in the low-activity group. This outcome reflects the role of physical activity in stimulating muscle recruitment, neuromotor adaptation, and power development—key characteristics of explosive strength. Similar associations were reported by Ortega et al. (2008).

Collectively, these results reinforce the concept of **motor competence as a mediator** in the relationship between physical activity and health. Children who move more develop stronger motor abilities, which in turn foster self-confidence, motivation, and a sustained commitment to physical engagement. Moreover, higher motor competence has been linked in prior research to better academic performance, psychosocial adjustment, and long-term participation in sports and recreation.

c. General Implications

The implications of this study extend beyond the individual level. They call for coordinated action by schools, families, and policymakers to create enabling environments that support movement and discourage sedentary behaviors. Educational institutions might consider implementing structured motor skills assessments and personalized physical activity programs, especially for children exhibiting early signs of motor delay or weight gain.

At the household level, families should be encouraged to cultivate active daily routines by limiting screen time and promoting outdoor play. These efforts are particularly urgent in the context of increasing urbanization and digitalization, which have significantly reduced spontaneous physical activity in childhood.

In addition to physical health, promoting motor activity contributes to



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children's emotional regulation, attention span, and academic readiness. Studies show that physically active children often exhibit better classroom behavior, reduced anxiety, and improved social interaction—factors that are essential for holistic child development.

In summary, fostering motor activity in late childhood is not only a strategy to enhance physical fitness, but also a long-term investment in children's health, self-esteem, and social development

8. Conclusion

This study underscores the critical importance of promoting physically active lifestyles from an early age, given their direct influence on body composition (as measured by BMI) and motor performance (balance, speed, strength). It also highlights the value of early screening for motor delays and excessive weight gain, in order to provide timely intervention and support.

The findings advocate for the integration of physical activity into educational, health, and family policy frameworks. Strengthening school-based physical education, developing inclusive sports initiatives, and raising parental awareness are key strategies for reducing sedentary behavior and preventing childhood obesity. Ultimately, supporting children's movement is essential for ensuring well-rounded, healthy, and capable future generations.

9. Recommendations and Suggestions

9.1. Recommendations

In light of the study's findings confirming the significant impact of physical activity on both BMI and motor performance in children, the following concise recommendations are proposed:

a. Educational and Health Recommendations

1. Encourage daily physical activity in schools by increasing physical education sessions and integrating spontaneous play throughout the school day.
2. Raise awareness among children, parents, and educators about the importance of active lifestyles and the risks of inactivity and obesity.
3. Apply interactive and inclusive teaching strategies in physical education to account for individual differences and motivate participation.
4. Establish routine school-based monitoring of BMI and motor performance

to guide early interventions.

5. Strengthen home–school collaboration to promote consistent physical activity habits, especially in the face of increased screen use.

b. Institutional Recommendations

1. Adjust school schedules to include regular physical activity.
2. Ensure all schools, including rural ones, are equipped with appropriate sports facilities and materials.
3. Launch nationwide awareness campaigns on the physical and psychological benefits of activity in childhood, in collaboration with health and media sectors.

c. For Physical Education Teachers

1. Diversify physical activities to suit developmental differences.
2. Provide extra support and tailored programs for children with weak motor skills.
3. Create inclusive, motivating environments that build self-confidence.
4. Collaborate with teachers, counselors, and health staff to support students with special needs

9.2. Suggestions for Future Research

To further deepen understanding in this field, future studies may explore the following:

1. Track the longitudinal relationship between physical activity, sedentary behavior, and BMI progression from early childhood to adolescence.
2. Investigate the psychological and social determinants of physical activity in children, including self-efficacy, family dynamics, peer influence, and school culture.
3. Compare the effects of different types of physical activity (e.g., aerobic vs. anaerobic) on specific motor skill development such as speed, balance, and muscular strength.
4. Examine the relationship between screen time (e.g., smartphones, tablets) and children's physical fitness, activity levels, and motor development.
5. Compare motor performance and physical activity levels between children in urban and rural settings, with attention to the availability and quality of recreational and movement spaces.

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