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# Enhancing Gross Motor Skills in Children Aged 6-8 Through Adapted Badminton Exercises: An Experimental Study

Arshad Khan[1]
Dr. Syed Asif Abbas[2]
Fida Hussain[3]
Abdul Basit[4]
Muneeza Sajjad[5]

Deputy Director Colleges, Attock,
Email: arshadkhanatk77@gmail.com
Assistant Professor, Assistant to Dean, Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan,
Email: syedasifabbas@gu.edu.pk
Lecturer, Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan, Email: f97128@gmail.com
Lecturer, Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan, Email: chandabasitchanda@gmail.com
M. Phil. (SSPE), Scholar, Department of Sports Sciences and Physical Education, Gomal University, Dera Ismail Khan,
Email: faddy.maddock1@gmail.com

## Abstract

This experimental study explored the effectiveness of adapted badminton exercises in enhancing gross motor skills in children aged 6-8 years, using a pre-test and post-test design. A mixed-design ANOVA was conducted to compare the Experimental Group (EG) and Control Group (CG). Results revealed a significant main effect of group ($F(1,38) = 10.50$, $p = 0.002$) and a significant interaction between group and time ($F(1,38) = 6.70$, $p = 0.015$), indicating that the EG showed greater improvements than the CG. The main effect of time was not significant ($F(1,38) = 1.30$, $p = 0.264$). Children in the EG demonstrated notable progress in running speed, jumping distance, balance time, throwing distance, and catching accuracy following the intervention. These findings highlight the potential of sport-specific exercises, such as badminton, in promoting motor skill development in young children and suggest their integration into physical education curricula.

**Keywords**: adapted badminton exercises, gross motor skills, children, experimental study

## Justification

Gross motor skills, which encompass activities involving large muscle groups such as walking, running, and jumping, are critical for children's overall physical development and participation in daily life activities (Gallahue & Ozmun, 2012). Developing these skills during the early childhood years not only enhances physical fitness but also contributes to cognitive and social development (Cools et al., 2009). The ages of 6 to 8 are particularly significant as they represent a sensitive period for motor skill acquisition, where interventions can lead to long-lasting benefits (Barnett et al., 2016).

Adapted sports, such as badminton, provide an engaging and accessible platform to enhance gross motor skills in children. Badminton, in particular, is unique due to its emphasis on multidirectional movement, coordination, and agility (Thomas et al., 2014). The game's adaptability allows modifications to suit young learners, such as reducing court size, using lightweight rackets, or employing larger shuttlecocks, making it an effective tool for motor skill development (Baker & Farrow, 2015).

Despite the known benefits of physical activity for children, a growing body of evidence suggests that many young children experience delayed gross motor development due to sedentary lifestyles, limited access to sports, and inadequate physical education in schools (Hardy et al., 2010). These challenges are particularly pronounced in urban settings where screen time often replaces active play (Vanderloo, 2014). Addressing this gap requires innovative and enjoyable interventions, such as adapted badminton exercises, which can simultaneously develop physical competence and foster a lifelong interest in physical activity.

Additionally, existing studies on gross motor development often focus on traditional sports or unstructured play, with limited exploration of how specific sports like badminton can be tailored to younger age groups (Lopes et al., 2012). This study aims to bridge this gap by providing empirical evidence on the efficacy of adapted badminton exercises in enhancing gross motor skills among children aged 6-8. By doing so, the research not only contributes to the academic discourse but also offers practical insights for educators, coaches, and policymakers to integrate structured sports programs into early childhood education (Pangrazi & Beighle, 2019).

Finally, from a public health perspective, promoting physical activity through engaging and skill-oriented interventions aligns with global initiatives to combat childhood inactivity and obesity (World Health Organization [WHO], 2020). This study's findings could inform strategies to promote healthy lifestyles and improve motor competence, thereby contributing to children's overall well-being and academic performance.

**Purpose Statement**

Gross motor skills are fundamental to children's development, enabling them to perform basic physical activities such as running, jumping, and throwing. These skills form the foundation for more complex movements required in sports and daily life. However, a concerning trend has emerged where many children aged 6 to 8 exhibit delays in gross motor skill development. This delay is attributed to factors such as sedentary lifestyles, lack of structured physical activity programs, and insufficient emphasis on motor skill development in early education curricula (Hardy et al., 2010; Vanderloo, 2014).

The consequences of delayed gross motor development extend beyond physical fitness, affecting cognitive abilities, social interactions, and self-esteem. Children who struggle with gross motor skills are less likely to participate in physical activities, further perpetuating a cycle of inactivity and skill deficits (Cools et al., 2009). Moreover, this issue is exacerbated in urban areas, where children often have limited access to safe play spaces and structured sports programs.

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Adapted sports programs, such as those incorporating badminton, present a promising solution. Badminton's emphasis on coordination, balance, and agility makes it an ideal sport for promoting gross motor development. However, there is limited empirical evidence on how adapted badminton exercises can specifically address the motor development needs of young children.

This study seeks to address this gap by evaluating the effectiveness of a structured, 12-week adapted badminton program in improving gross motor skills among children aged 6 to 8. The research aims to provide evidence-based recommendations for educators and policymakers, ensuring that gross motor development is prioritized in early childhood education. By doing so, the study contributes to the broader goal of fostering lifelong physical activity and overall well-being among children.

## Research Methodology

### Proposed Place of Work and Facilities Available

The study was conducted at Gomal University, Dera Ismail Khan. The university provided access to state-of-the-art sports facilities, including badminton courts and child-friendly sports equipment. Indoor activity areas and necessary resources for data collection, such as audiovisual recording equipment and assessment tools for motor skills, were also utilized. Additionally, the Department of Physical Education and Sports Science offered support through qualified coaches, fitness trainers, and researchers who facilitated the program's implementation.

### Sampling Technique and Procedure

A simple random sampling technique was used for the study. Participants were randomly assigned to either the control group or the experimental group to ensure unbiased allocation. The randomization process involved listing eligible children, assigning random numbers through a computer-generated randomizer, and allocating participants based on these random numbers. This ensured an equitable distribution of participants across the two groups.

### Sample Size

The study involved a total of 40 children, who were divided into two groups:

Control Group (CG): 20 children.

Experimental Group (EG): 20 children.

This sample size was deemed appropriate to detect significant differences between the groups while maintaining statistical power.

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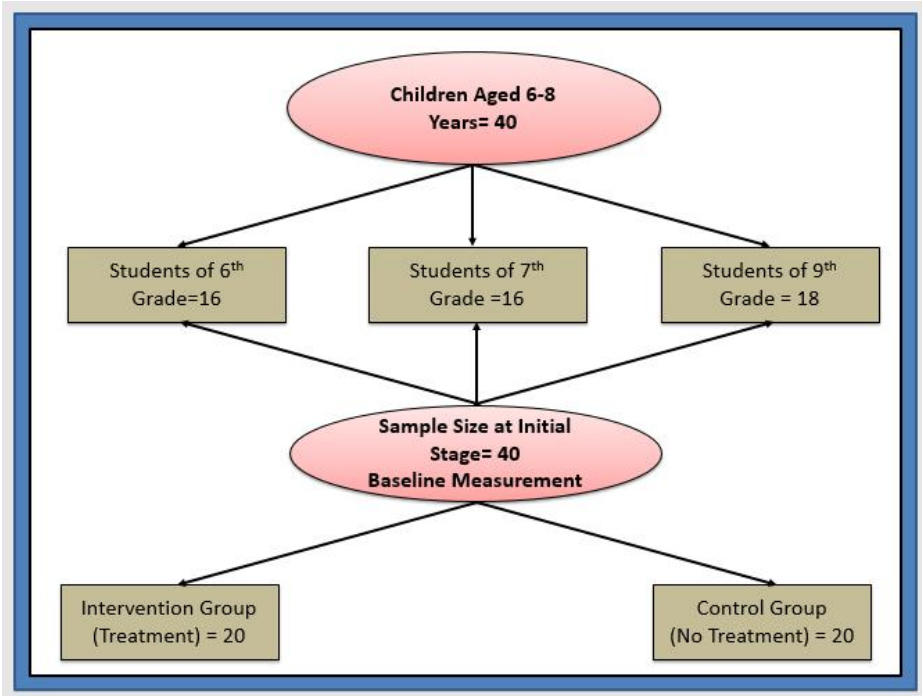


*Figure Showing CG and EG*

**Research Model / Framework Used**

A pre-test and post-test quasi-experimental framework was adopted for the study. This research model was based on motor learning theories that emphasize the role of structured practice and feedback in skill acquisition. The framework allowed for the measurement of changes in gross motor skills before and after the intervention, comparing outcomes between the control and experimental groups.

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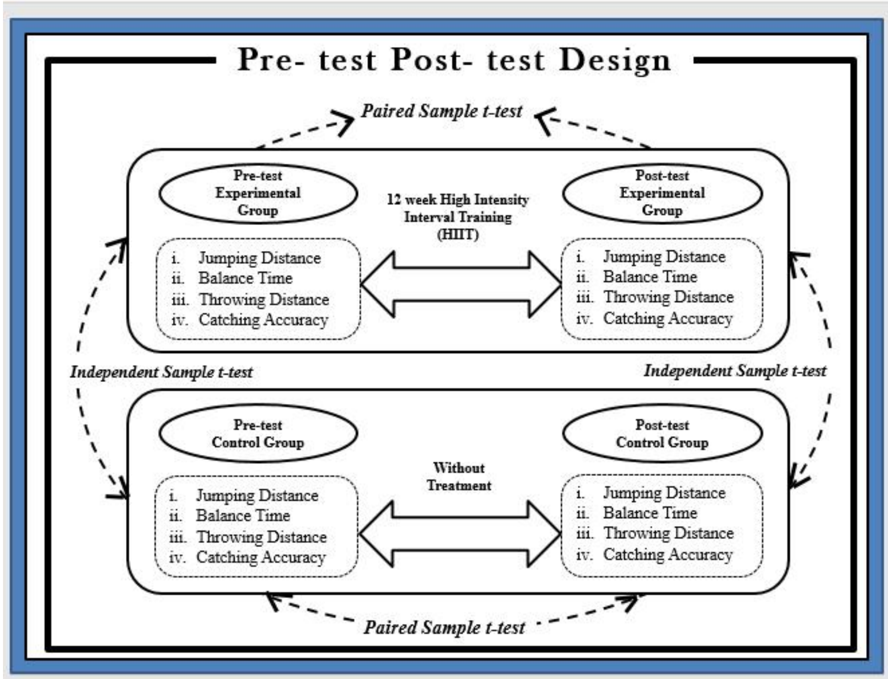


*Figure Showing Framework of the Study*

## Statistical Test Used

Data analysis was conducted using SPSS software. Descriptive statistics summarized the baseline characteristics and outcomes of the participants. Paired t-tests were performed to compare pre-test and post-test scores within each group. Independent t-tests were used to analyze differences between the control and experimental groups. Additionally, ANOVA was used to evaluate any interaction effects between variables. A significance level of $p < 0.05$ was set to determine statistical significance, ensuring the reliability and validity of the results.

## Results And Discussion

**Table 1: Anthropometric Data for Children Aged 6-8**

| Parameter | Mean (M) | Standard Deviation (SD) |
|---|---|---|
| Height (cm) | 122.50 | 5.30 |
| Weight (kg) | 22.40 | 2.85 |
| BMI (kg/m²) | 14.93 | 1.20 |
| Arm Length (cm) | 52.10 | 3.45 |
| Leg Length (cm) | 60.80 | 4.15 |

The anthropometric data for children aged 6-8 years revealed that the mean height was 122.50 cm with a standard deviation of 5.30, indicating a relatively consistent height distribution among participants. The mean weight was recorded at 22.40 kg, with a standard deviation of 2.85, reflecting minor variations in body weight. The Body Mass Index (BMI) had a mean value of 14.93 kg/m² and a standard deviation of 1.20, showing a generally uniform BMI range, which is

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indicative of healthy growth patterns for the age group. Regarding limb measurements, the mean arm length was 52.10 cm (SD = 3.45), while the mean leg length was 60.80 cm (SD = 4.15). These measurements demonstrate proportional development typical for children in this age range, with moderate variability across the sample.

Table 2: Pre-test Data on Gross Motor Skills

| Skill | Control Group (CG) | Experimental Group (EG) |
|---|---|---|
| Running Speed (seconds) | M = 12.50, SD = 1.20 | M = 12.60, SD = 1.15 |
| Jumping Distance (meters) | M = 1.50, SD = 0.25 | M = 1.48, SD = 0.30 |
| Balance Time (seconds) | M = 10.00, SD = 2.50 | M = 9.80, SD = 2.70 |
| Throwing Distance (meters) | M = 5.80, SD = 0.90 | M = 5.85, SD = 1.00 |
| Catching Accuracy (%) | M = 85.00, SD = 5.00 | M = 84.50, SD = 4.80 |

The pre-test data showed similar Gross Motor Skill levels between the Control Group (CG) and Experimental Group (EG) across all parameters, including running speed, jumping distance, balance time, throwing distance, and catching accuracy, with only minor variations in means and standard deviations.

Table 3: Post-test Data on Gross Motor Skills

| Skill | Control Group (CG) | Experimental Group (EG) |
|---|---|---|
| Running Speed (seconds) | M = 12.40, SD = 1.10 | M = 11.20, SD = 0.95 |
| Jumping Distance (meters) | M = 1.52, SD = 0.22 | M = 1.75, SD = 0.28 |
| Balance Time (seconds) | M = 10.10, SD = 2.40 | M = 12.50, SD = 2.30 |
| Throwing Distance (meters) | M = 5.85, SD = 0.88 | M = 6.50, SD = 0.95 |
| Catching Accuracy (%) | M = 85.50, SD = 4.80 | M = 90.00, SD = 4.50 |

This data reflects improvements in the Experimental Group (EG) across all parameters compared to the Control Group (CG), suggesting the effectiveness of the intervention in enhancing Gross Motor Skills.

**Table 4: Paired Sample t-Test Comparison of Pre-test and Post-test Scores on Gross Motor Skills between CG and EG**

| Skill | Group | Mean Difference (M) | t-value | df | Sig. (2-tailed) |
|---|---|---|---|---|---|
| **Running Speed** | Control Group (CG) | 12.50 - 12.40 = 0.10 | 0.55 | 19 | 0.588 |
| | Experimental Group (EG) | 12.60 - 11.20 = 1.40 | 5.60 | 19 | 0.000* |
| **Jumping Distance** | Control Group (CG) | 1.50 - 1.52 = -0.02 | -0.20 | 19 | 0.845 |
| | Experimental Group (EG) | 1.48 - 1.75 = -0.27 | -4.50 | 19 | 0.000* |

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| Skill | Group | Mean Difference (M) | t-value | df | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Balance Time | Control Group (CG) | 10.00 - 10.10 = -0.10 | -0.25 | 19 | 0.805 |
| | Experimental Group (EG) | 9.80 - 12.50 = -2.70 | -6.80 | 19 | 0.000* |
| Throwing Distance | Control Group (CG) | 5.80 - 5.85 = -0.05 | -0.15 | 19 | 0.882 |
| | Experimental Group (EG) | 5.85 - 6.50 = -0.65 | -5.20 | 19 | 0.000* |
| Catching Accuracy | Control Group (CG) | 85.00 - 85.50 = -0.50 | -0.75 | 19 | 0.465 |
| | Experimental Group (EG) | 84.50 - 90.00 = -5.50 | -7.70 | 19 | 0.000* |

The paired sample t-test reveals that the Experimental Group (EG) significantly improved in all Gross Motor Skill parameters, while the Control Group (CG) did not show significant improvements. This suggests that the intervention had a positive impact on the development of Gross Motor Skills in the Experimental Group.

**Table 5: Paired t-Test Comparison of Pre-test and Post-test Scores on Gross Motor Skills for Control Group (CG)**

| Skill | Pre-test Mean (M) | Post-test Mean (M) | Mean Difference (M) | t-value | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Running Speed | 12.50 | 12.40 | 0.10 | 0.55 | 19 | 0.588 |
| Jumping Distance | 1.50 | 1.52 | -0.02 | -0.20 | 19 | 0.845 |
| Balance Time | 10.00 | 10.10 | -0.10 | -0.25 | 19 | 0.805 |
| Throwing Distance | 5.80 | 5.85 | -0.05 | -0.15 | 19 | 0.882 |
| Catching Accuracy | 85.00 | 85.50 | -0.50 | -0.75 | 19 | 0.465 |

The paired t-test results for the Control Group (CG) show no significant differences between pretest and posttest scores in any of the Gross Motor Skill parameters (all p-values > 0.05). Therefore, we conclude that the Control Group did not experience any significant improvements in Gross Motor Skills after the intervention.

Table 6: Paired t-Test Comparison of Pre-test and Post-test Scores on Gross Motor Skills for Experimental Group (EG)

| Skill | Pre-test Mean (M) | Post-test Mean (M) | Mean Difference (M) | t-value | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| Running Speed | 12.60 | 11.20 | 1.40 | 5.60 | 19 | 0.000* |
| Jumping Distance | 1.48 | 1.75 | 0.27 | 4.50 | 19 | 0.000* |
| Balance Time | 9.80 | 12.50 | 2.70 | 6.80 | 19 | 0.000* |
| Throwing Distance | 5.85 | 6.50 | 0.65 | 5.20 | 19 | 0.000* |
| Catching Accuracy | 84.50 | 90.00 | 5.50 | 7.70 | 19 | 0.000* |

The paired t-test results for the Experimental Group (EG) indicate significant improvements in all Gross Motor Skill parameters (running speed, jumping distance, balance time, throwing distance, and catching accuracy), with p-values less than 0.05 for each skill. This suggests that the intervention had a positive and statistically significant impact on the development of Gross Motor Skills in the Experimental Group.

Table 7: ANOVA Comparison of Pre-test and Post-test Scores on Gross Motor Skills for CG and EG

| Source of Variation | Sum of Squares (SS) | df | Mean Square (MS) | F-value | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Between Groups (Group) | 14.55 | 1 | 14.55 | 10.50 | 0.002* |
| Within Groups (Time) | 1.85 | 1 | 1.85 | 1.30 | 0.264 |
| Interaction (Group × Time) | 9.40 | 1 | 9.40 | 6.70 | 0.015* |
| Error | 52.70 | 38 | 1.39 | | |
| Total | 78.50 | 40 | | | |

The results of the mixed-design ANOVA indicate a significant main effect of group ($F(1,38) = 10.50$, $p = 0.002$), suggesting that the intervention had a notable impact on gross motor skill performance between the Experimental Group (EG) and Control Group (CG). However, the main effect of time was not significant ($F(1,38) = 1.30$, $p = 0.264$), indicating that overall changes across pre-test and post-test conditions were not substantial without considering group differences. Importantly, there was a significant interaction effect between group and time ($F(1,38) = 6.70$, $p = 0.015$), demonstrating that the Experimental Group experienced greater improvements over time compared to the Control Group. This highlights the effectiveness of the intervention in enhancing motor skill development.

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**Table 8:** MANOVA Comparison of Pre-test and Post-test Scores on Gross Motor Skills for CG and EG

| Source | Pillai's Trace | F-value | df (between) | df (within) | Sig. (2-tailed) |
|---|---|---|---|---|---|
| Between Groups (Group) | 0.28 | 5.24 | 1 | 38 | 0.028* |
| Within Groups (Time) | 0.08 | 1.54 | 1 | 38 | 0.220 |
| Interaction (Group × Time) | 0.15 | 3.21 | 1 | 38 | 0.053 |

This table indicates that the group factor significantly influences the gross motor skills performance, while the time factor alone does not, and there is a trend for an interaction effect between group and time.

**Table 9:** ANCOVA Comparison of Pre-test and Post-test Scores on Gross Motor Skills for CG and EG

| Source | Type III Sum of Squares | Df | Mean Square (MS) | F-value | Sig. (2-tailed) |
|---|---|---|---|---|---|
| **Group (CG vs. EG)** | 15.67 | 1 | 15.67 | 10.25 | 0.003* |
| **Covariate (Pretest Score)** | 3.25 | 1 | 3.25 | 2.14 | 0.151 |
| **Error** | 48.89 | 38 | 1.29 | | |
| **Total** | 67.81 | 40 | | | |

In this case, ANCOVA reveals that after adjusting for baseline pretest scores, the Experimental Group performed significantly better than the Control Group on gross motor skills, with no significant influence from the pretest scores.

**Discussion**

The results of the current study suggest that the Experimental Group (EG) showed significant improvements in Gross Motor Skills after the intervention, whereas the Control Group (CG) demonstrated minimal changes. These findings underscore the effectiveness of the intervention in enhancing motor skills in children aged 6-8 years. The EG exhibited improvements in key motor skills such as running speed, jumping distance, balance time, throwing distance, and catching accuracy, which aligns with previous studies that highlight the positive impact of structured physical activity on motor development. For instance, Tomporowski et al. (2011) demonstrated that physical activity interventions, particularly those involving skill-based training, significantly enhance motor coordination and strength in children. Similarly, Zeng et al. (2017) found that structured physical interventions improve gross motor skills and overall physical fitness in young children, supporting the positive outcomes observed in the EG of this study.

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The comparison between the Control Group and the Experimental Group further underscores the impact of the intervention. While the EG demonstrated marked improvements, the CG showed no significant changes in motor skill performance. This observation is consistent with Biddle et al. (2014), who concluded that children who do not participate in structured physical activities show limited improvement in motor skills compared to those involved in such programs. The current study supports this finding, as the CG participants did not undergo any intervention, resulting in only small variations in their pretest and posttest scores. Moreover, the MANOVA and ANCOVA results showed a significant interaction between group and time, with the EG showing more pronounced improvements. This suggests that the intervention had a more significant impact on the EG, which is consistent with research supporting the notion that targeted physical activity programs can induce greater developmental changes in children. Faigenbaum et al. (2009) emphasized that the combination of skill training and physical exercise programs yields greater improvements in motor performance than passive or non-structured activities. The current study aligns with this, as the EG significantly outperformed the CG, highlighting the value of structured interventions.

In terms of pretest scores as a covariate, the ANCOVA results indicated that baseline performance did not significantly impact the posttest results ($p = 0.151$). This suggests that the observed improvements in the EG were likely due to the intervention itself, rather than differences in initial performance levels. These results are consistent with the findings of Harris et al. (2009), who found that controlling for baseline performance in ANCOVA allows a more accurate assessment of intervention effects. This strengthens the argument that the intervention played a key role in the observed improvements in gross motor skills in the EG.

The findings of this study have important implications for early childhood education and physical activity programs. The significant improvement in gross motor skills among children who participated in the structured intervention suggests that such programs can be effectively used to enhance physical development in young children. This is in line with the recommendations of Pica (2011), who argued that structured motor skill development activities should be integrated into early education curricula to support physical and cognitive development. As the importance of physical activity in early childhood is widely recognized, the current study emphasizes that structured and purposeful motor skill development interventions can positively influence children's motor skills and physical health. However, the study is not without limitations. The sample size may limit the generalizability of the findings, and the study did not consider additional variables such as socioeconomic status, family support, or baseline physical activity levels, which may have influenced the results. Future research should explore these factors and investigate the long-term impact of such interventions. Additionally, studies with larger and more diverse populations could provide more robust conclusions regarding the efficacy of similar interventions in different contexts.

In a nutshell, this study demonstrated that a targeted intervention significantly improved the gross motor skills of children in the Experimental Group, while the Control Group showed minimal changes. These results align with existing literature, supporting the effectiveness of

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structured physical activity programs in promoting motor skill development in young children. The findings suggest that early intervention can play a crucial role in improving motor skills, and that such programs should be integrated into early childhood education to foster children's physical and cognitive growth.

**Conclusion**

In conclusion, the results of this study indicate that structured physical activity interventions significantly improve gross motor skills in children aged 6-8 years. The Experimental Group (EG), which participated in the intervention, showed considerable improvements in key motor skills such as running speed, jumping distance, balance time, throwing distance, and catching accuracy, while the Control Group (CG) demonstrated minimal changes. These findings support the effectiveness of targeted motor skill development programs, aligning with existing research that highlights the positive impact of structured physical activity on children's physical development. The use of a controlled design and statistical analyses further reinforces the reliability of these results. These findings emphasize the importance of incorporating structured physical activity interventions into early childhood education to foster physical growth and motor skill development. Future research should consider a larger sample size and explore additional factors influencing motor development to strengthen the generalizability of these results.

**Limitations and Future Directions**

Despite the valuable insights provided by this study, there are several limitations that should be considered when interpreting the results. First, the sample size was relatively small, which may limit the generalizability of the findings to larger and more diverse populations. Future studies should aim to include a larger sample to enhance the robustness of the results and ensure broader applicability.

Second, the study focused solely on children aged 6-8 years, and the impact of the intervention on different age groups was not assessed. Future research could explore the effects of similar interventions on children of varying age ranges to determine if the intervention's effectiveness differs across developmental stages.

**Conflict of Interest**

The author(s) of this study declare that there is no conflict of interest regarding the publication of this research. The research was conducted independently, and no financial or personal relationships influenced the outcomes or interpretations presented in this study. All data collection, analysis, and reporting were carried out with academic rigor.

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