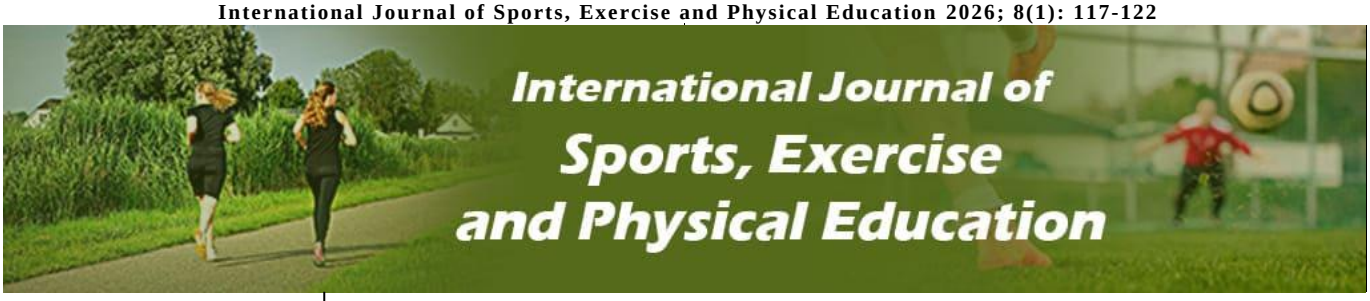

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Effect of a structured physical education programme on selected motor skill development among preschool children

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Abstract
This study aimed to identify the impact of a structured physical education (PE) program on gross motor skill development among preschool children in the Sabaragamuwa Province of Sri Lanka using a quantitative quasi-experimental design. A total of 220 preschool children participated in the study, with 200 assigned to an experimental group and 20 to a control group. The experimental group engaged in a structured Test of Gross Motor Development-2 (TGMD-2)-based PE program for six months, while the control group continued with routine preschool activities. Gross motor skills were assessed using the TGMD-2, focusing on locomotor skills, object control skills, and overall motor performance. Pre-test and post-test scores were analyzed using Mixed Analysis of Variance (Mixed ANOVA), with Time (pre vs. post) as the within-subjects factor and Group (experimental vs. control) as the between-subjects factor.

The experimental group demonstrated a marked improvement in locomotor skills, with mean locomotor total scores increasing from 13.63 (SD=6.49) at pre-test to 23.84 (SD=6.43) at post-test, representing a gain of 10.21 points. In contrast, the control group showed only a marginal increase from 8.70 (SD=5.42) to 9.45 (SD=4.74). Mixed ANOVA results revealed a significant main effect of Time for locomotor total ($F=28.24$, $p<.001$) and a significant Group × Time interaction ($F=21.04$, $p<.001$). Significant interaction effects were also observed for gallop ($F=4.59$, $P=.033$) and hop ($F=4.20$, $p=.042$). Object control skills, the experimental group's total score increased from 20.33 (SD=7.25) to 24.63 (SD=5.99), while the control group showed no change (22.65). A significant Time effect and Group × Time interaction were found for object control total ($F=4.37$, $P=.038$), although between-group differences were not significant. These findings provide strong empirical evidence that structured, developmentally appropriate PE programs significantly enhance preschool children's gross motor development, particularly locomotor skills, supporting their integration into early childhood education curricula.

Keywords: TGMD-2, preschool children, physical education, motor skills, locomotor, object control

1. Introduction
The importance of motor skill development during early childhood is a well-known part of physical, cognitive and socio emotional development of children (Goodway and Branta, 2003) [20]. Motor skills include the gross motor skills, i.e., running, jumping, balancing and hopping and fine motor skills, i.e. drawing, cutting and handling small objects. Preschool age, i.e. the age between three and five years, is an especially precarious developmental phase when it comes to learning the basic pattern of movement, which can be explained by intensive neuromuscular growth and brain development (Haywood and Getchell, 2020) [24]. The mastering basic movement skills at this window helps in maintaining physical fitness, reducing sedentary behavior and forming a base to the subsequent engagement in games and sports and organized physical activities. PE programs are effective ways of ensuring that children acquire motor skills in their early years. Play based PE activities that are developmentally appropriate are the ones that allow children to run, hop, gallop, or control objects by throwing, catching, kicking and refining the previously acquired skills in interesting settings (Brian *et al.*, 2017) [8]. Empirical findings on Western preschoolers suggest that those who are exposed to organized PE programs record significantly better gains in motor competence compared to children who do not use unstructured play.

(Logan *et al*., 2012) [30]. Such benefits are not just physical, but also improve coordination, spatial skills and fine motor dexterity and thus lead to academic preparedness and social inclusion (Goodway & Branta, 2003) [20]. In Sri Lanka, preschool education has been based on cognitive and language development, where structured physical activity has not been given much attention. The only physical movement is either informal play or unstructured recess. Despite the recent policy statements by the National Education Commission in which the significance of holistic child development has been emphasized and the introduction of the standardized motor skills assessment tools like the Test of Gross Motor Development Second Edition (TGMD-2) is recommended as an essential part of the preschool curriculum, the introduction of structured PE programs is limited (National Education Commission in Sri Lanka, 2020).

1.1 Research Gap and Contextual Challenges

There are limited empirical studies on the effectiveness of structured PE programs on motor development in preschools in Sri Lanka. Most of the surviving evidence is made in the West where educational institutions, cultural practices and teacher training differ greatly to those in the Sri Lankan preschool educational background. Sri Lankan preschools exhibit vast differences in resources available, teacher qualification and access to safe playing grounds, especially between the rural and urban preschools (Logan *et al*., 2012) [30]. The cultural norms and expectations of play and physical activity among young girls, can also affect the participation and development of motor skills. These situational considerations highlight the necessity of locally based studies to identify whether structured PE interventions could be effectively used to improve motor competence in Sri Lankan preschoolers.

1.2 Objectives

The primary aim of the research was to test how a structured physical education program affects the growth of motor skills in preschool children in the Sabaragamuwa Province of Sri Lanka. The motor skill development was measured by TGMD-2 which targeted locomotor (e.g., running, hopping, galloping) and object-control (e.g., throwing, catching, kicking) skills.

Secondary objectives included,

- To determine the effect of a structured physical education (PE) program on the locomotor skill development of preschool children.
- To examine the effect of the structured PE program on object control skill development among preschool children.
- To compare overall gross motor development between children participating in a structured PE program and those engaged in routine preschool activities.

By integrating quantitative assessments is enhancing early childhood PE programs and supporting holistic motor development in Sri Lankan preschool contexts.

2. Methods

2.1 Research Design and Approach

The research design used in this study was a quasi-experimental pretest-posttest with intervention and control groups, which aimed at assessing the effects of a structured preschool physical education (PE) program on the development of fundamental motor skills in preschool-aged children in the Sabaragamuwa Province in Sri Lanka. The design allowed comparing children who received the structured PE intervention with those who did not receive the programs in preschools and the design incorporated changes over time (Creswell, 2014, Saunders, Lewis) [13]. The quantitative one was taken as the leading one, which was to objectively assess the alteration in the motor competence of children with the help of standardized tests and the qualitative one offered the information about the perceptions, difficulties and suggestions, related to PE integration, which guaranteed the level of statistical rigor and also provided the level of contextual richness. Locomotor and object control skills were measured with the help of the Test of Gross Motor Development (TGMD 2).

2.2 Population and Sampling

The population of the study was preschool aged children (3-5 years) attending licensed preschools in the Sabaragamuwa Province and had different socioeconomic and cultural backgrounds. The ultimate sample of the children included 220 participants which included 200 in the intervention and 20 control groups.

2.3 Instruments

The independent variable was attendance at structured preschool PE programs which were coded present or absent. Motor skill competence was the dependent variable, which was operationalized in terms of TGMD-2 locomotor, object-control and total scores. In between variables were teacher self-efficacy (adapted Teachers Sense of Self-efficacy scale) and parental support (Parental Support Scale). The moderating variables included child age, gender and socio-economic status. Structured observations such as the frequency of sessions, the adherence to the curriculum, the availability of equipment and teacher-student ratios were used to measure program fidelity.

2.4 Data Collection Procedures

The data collection process involved several stages, which included

- Children in the intervention group will demonstrate significantly higher post-test TGMD-2 scores compared to those in the control group.
- Higher levels of program fidelity will be positively associated with improvements in children's motor competence.

2.5 Ethical Considerations

Institutional ethics committee gave approval to ethics. It was voluntary with the written informed consent of the adult and parent/guardian participation; assent of the children was taken through age-related explanations. The identification was kept secret by coded identifiers and data security. All physical examinations, such as non-slip flooring and adult monitoring, were practiced in terms of safety.

2.6 Hypotheses

Hypothesis 1: Effect on Locomotor Skills

- **Null Hypothesis:** There is no significant difference in locomotor skill development between preschool children who participate in a structured physical

education program and those who engage in routine preschool activities.

- **Alternative Hypothesis:** Preschool children who participate in a structured physical education program show significantly greater improvement in locomotor skills than those who engage in routine preschool activities.

Hypothesis 2: Effect on Object Control Skills

- **Null Hypothesis:** There is no significant difference in object control skill development between preschool children who participate in a structured physical education program and those who engage in routine preschool activities.
- **Alternative Hypothesis:** Preschool children who participate in a structured physical education program show significantly greater improvement in object control skills than those who engage in routine preschool activities.

Hypothesis 3: Overall Gross Motor Development

- **Null Hypothesis:** There is no significant difference in overall gross motor development between preschool children exposed to a structured physical education program and those exposed to regular preschool activities.
- **Alternative Hypothesis:** Preschool children exposed to a structured physical education program demonstrate significantly higher overall gross motor development compared to those engaged in regular preschool activities.

2.7 Data Analysis Techniques

The descriptive statistics were used in summarizing participant characteristics and motor scores. The inferential analyses have used a Mixed ANOVA to evaluate the differences between within-subject (pre- vs. post-test) and between-group (intervention vs. control) differences. The SPSS v25 was used to analyze quantitative data.

3. Results

3.1 Quantitative Findings

3.1.1 Locomotor Skills Development

The PE program was conducted in a structured manner, which generated some apparent positive changes in locomotor skills in the members of an experimental group of preschool children. There was gradual improvement in running, galloping, hopping, leaping, horizontal jumping and sliding during the pre-test and post-test. On the other hand, the control group had a slight change after a period. Aggregate locomotor ability, measured as the sum of locomotor score, increased significantly in the experimental group, hence supporting the effectiveness of the organized PE activities in promoting simple and complex locomotor skills. Estimated marginal means line charts depict that the trend of the experimental group is steadily increasing whereas the control group has a zero trend. These data suggest that facilitated physical exercises in preschools can significantly facilitate motor competence among the early childhood.

The line graph of the estimated marginal means shows the Group x Time interaction of locomotor skills. Group 1 refers to the experimental group, whereas Group 2 refers to the control group in the chart.

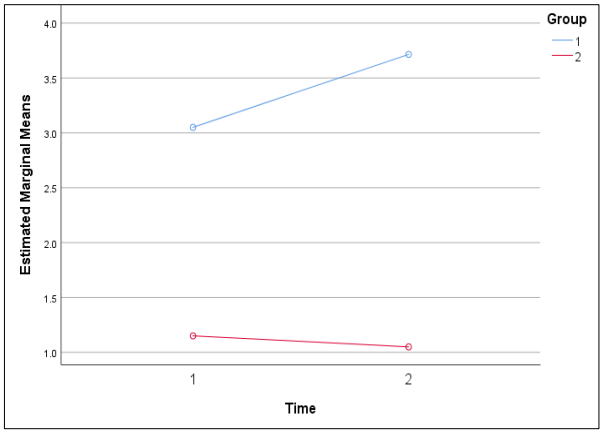

Fig 1: Run Line Chart

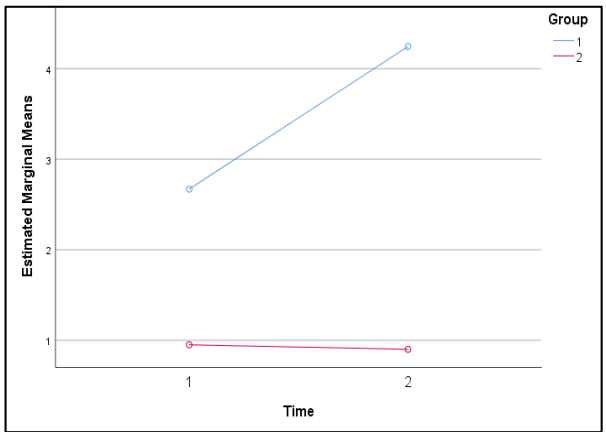

Fig 2: Gallop Line Chart

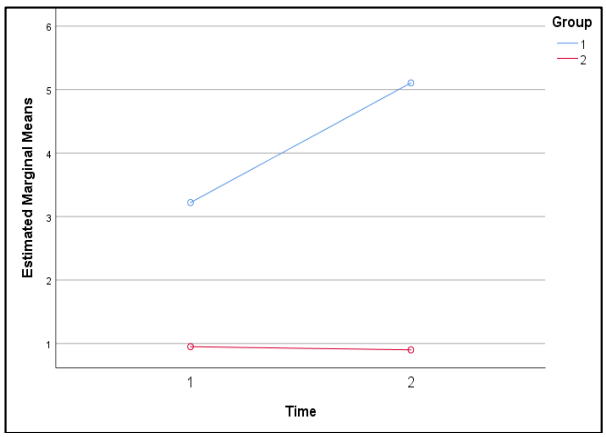

Fig 3: Hop Line Chart

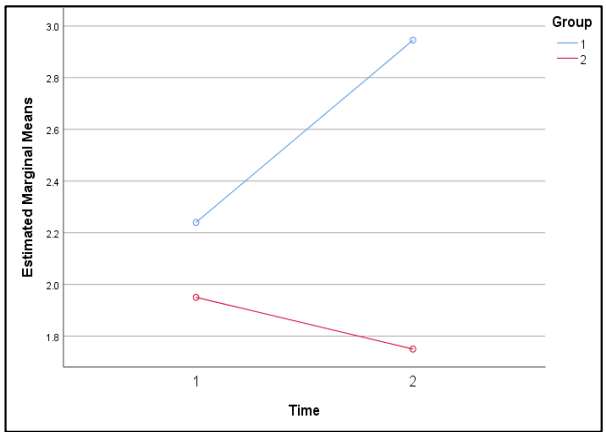

Fig 4: Leap Line Chart

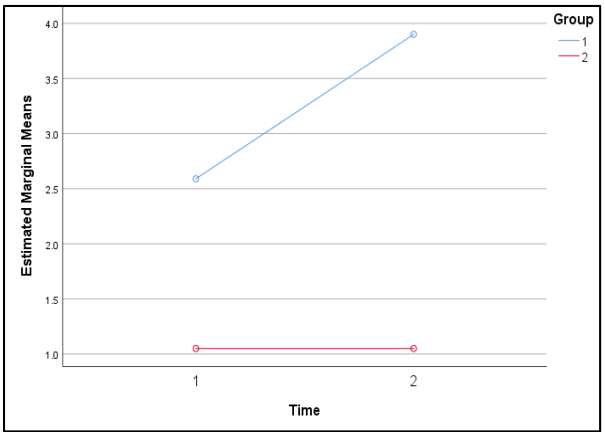

Fig 5: Horizontal Jump Line Chart

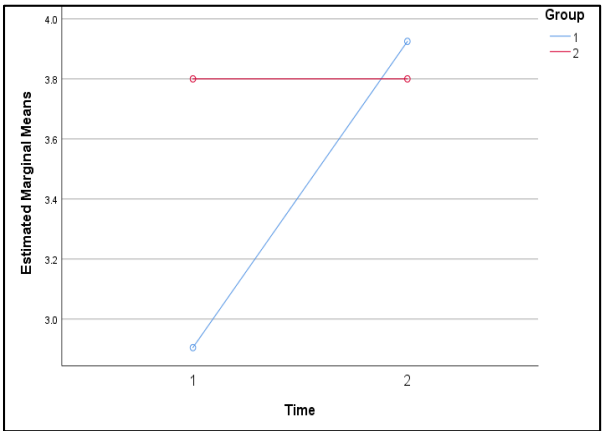

Fig 6: Slide Line Chart

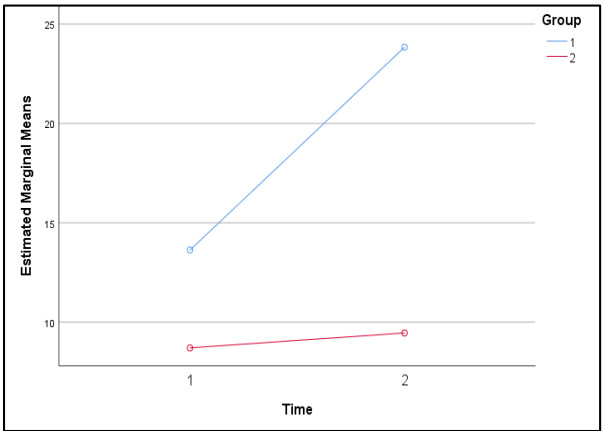

Fig 7: Locomotor Total Line Chart

3.1.2 Object Control Skills Development

Object control skills that were also augmented in the experimental group, included striking, dribbling, catching, kicking, overhand throwing and underhand rolling. Even though the change in individual skill was relative, as compared to the locomotor improvement, the total object control score improved during the intervention period. The control group showed a slight change, and this indicates that unstructured preschool activities cannot be used to encourage object control development. Group-by-time interaction line charts show progressive changes in total object control within the experimental group and thus indicate that the necessary intervention may require more time or more intensive intervention to induce significant changes. The findings suggest that structured PE promotes gradual advancement in the object control, which supplements the general motor ability improvements. Finally, PE program had a strong influence on the locomotor skills and moderate influence on the object control skills, the experimental group significantly exceeded the control group in terms of locomotor competence, but object control was improved at a slower rate. On aggregate, the quantitative data supports the idea that the involvement in a structured PE program improves motor competence, the greatest effects of which are reflected in gross locomotor movements.

The estimated marginal means line chart can demonstrate the Group x Time Interaction of Object Control Skill. Group 1 in the chart refers to the experimental group and Group 2 refers to the control group.

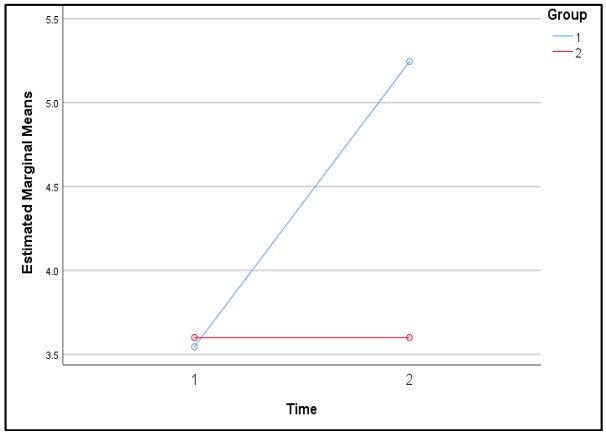

Fig 8: Strike Line Chart

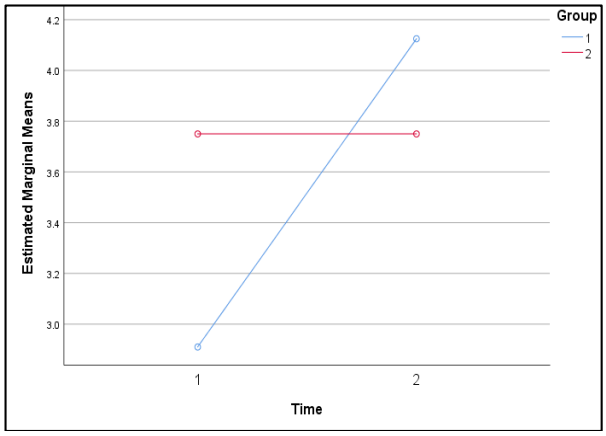

Fig 9: Dribble Line Chart

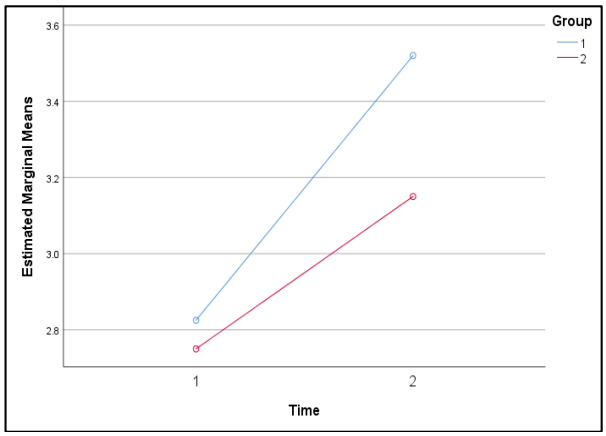

Fig 10: Catch Line Chart

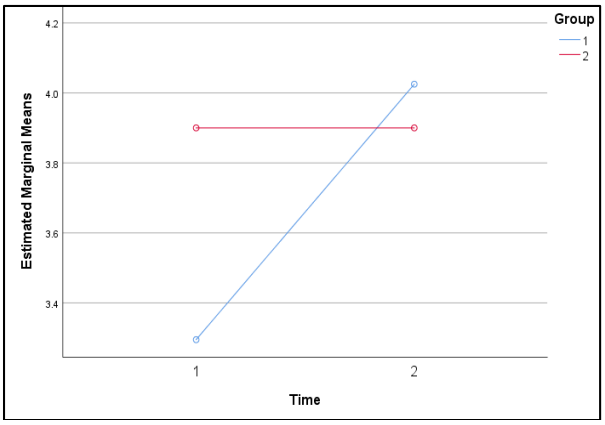

Fig 11: Kick Line Chart

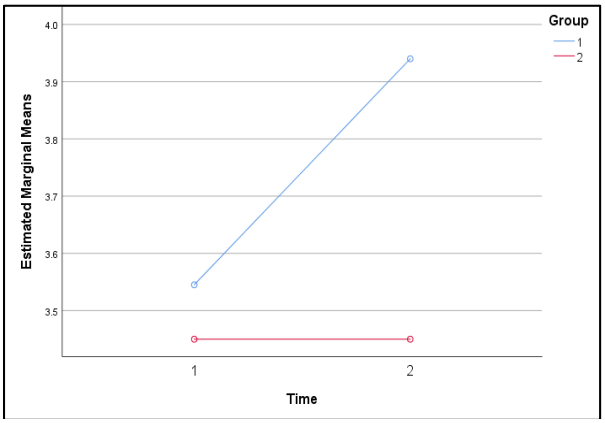

Fig 12: Overhand Throw Line Chart

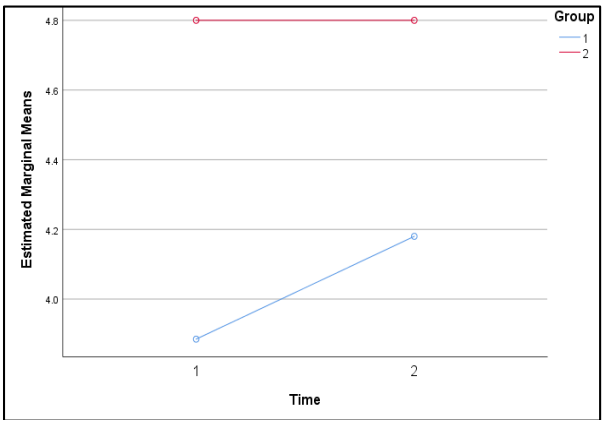

Fig 13: Underhand Roll Line Chart

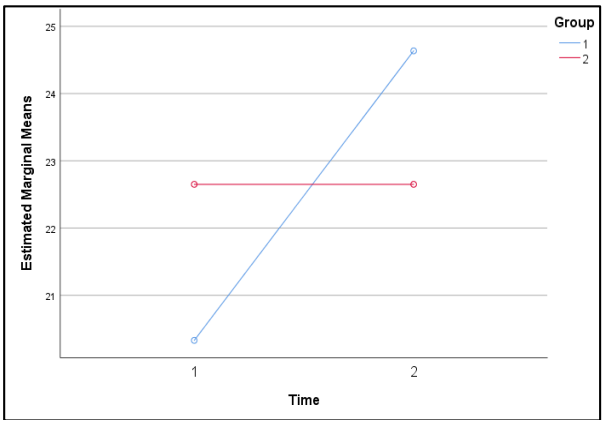

Fig 14: Object Control Total Line Chart

The findings of this study support the view that the organized physical education program positively influenced the motor skills development of preschool children. What we had as far as locomotor skills are concerned within and between subjects was significant improvements in the experimental group over the control group and this demonstrated that the program was effective in developing locomotor skills like Run, Gallop, Hop and general locomotor skills. In case of object control skills, although within subject analysis showed that there was a significant improvement of total object control score with time, the between groups comparison did not show any statistically significant differences implying that improvements in such skills were more subtle and accumulated as the intervention went by. In general, the results prove that the enrollment in a structured physical education program positively influences the development of motor skills among preschool children and locomotor ones and presents the evidence that can be utilized to justify the inclusion of PE programs into early childhood education.

4. Discussion

This experiment shows that developmentally suitable, structured PE significantly increases motor competence in preschool children. The most conspicuous result relates to locomotor skills (e.g., running, galloping, hopping), as the latter displayed a high sensitivity to the intervention, but the gains in object control skills were comparatively less. These results give empirical evidence to the assumption that carefully planned PE programs can hasten the learning of motor skills in the early childhood phase of development, a phenomenon that can be explained in terms of theoretical models that motor development occurs as a result of the interplay of task, environmental and organism constraints. Self-efficacy of teachers and parental involvement came out as the key factors in child motor development. Efficient teachers had made better use of the instructions and the reinforcement of the skills by the parents in the home set up hence explaining the effects of home-school interactions on performance. The lack of gender differences and the equal gains at all socioeconomic stratums indicate that the PE programs in the form of structured activities can be inclusive and fair with a proper design. These results are in line with the findings of earlier studies that show that early and well-organized interventions in motor skills may have long-term effects and that supervision by an adult is an essential factor in skill acquisition. The research paper expands the current literature by providing empirical data in a South Asian setting, which proves that structured PE interventions can yield similar results as those obtained in the Western environment. It further brings out that a moderate increase in object control might require sustained or repeated exposure and this is where persistence in practicing the skills that help build the skills is important.

5. Conclusions

The research establishes that PE programs are significant in enhancing the motor competence of preschool children with the highest effects recorded in locomotor skills. The teacher self-efficacy and parent involvement improve program effectiveness and thus the incorporation of adult engagement strategies in the early childhood interventions.

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