Prevalence of Balance Impairment in Physically Active and Sedentary Lifestyle Children Aged 7-10 Years

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ABSTRACT

Background: Balance impairment can significantly affect motor development in children, with lifestyle factors such as physical activity playing a crucial role. Physically active children may develop better balance than those leading sedentary lifestyles.

Objective: To evaluate the prevalence of balance impairment in physically active and sedentary children aged 7-10 years.

Methods: A cross-sectional study was conducted on 377 children aged 7-10 years from schools in Sheikhupura, Pakistan. The participants were divided into physically active (n=189) and sedentary (n=188) groups based on the International Physical Activity Questionnaire for Children (IPAQ-C). Balance was assessed using the Pediatric Balance Scale (PBS), a 14-item tool with a maximum score of 56. Data were analyzed using IBM SPSS version 25, with chi-square tests to determine statistical significance (p<0.05).

Results: In the physically active group, 79.4% (n=150) had good balance scores, while 67.6% (n=127) in the sedentary group showed moderate balance impairment. The difference between the two groups was statistically significant (p<0.001).

Conclusion: Physically active children demonstrated better balance compared to their sedentary peers, underscoring the importance of physical activity in childhood development

INTRODUCTION

Postural control refers to the ability to maintain the body's position in space, a fundamental aspect of physical function that develops progressively throughout childhood. The concept of balance, or postural stability, involves managing the body's center of mass in relation to its base of support, ensuring equilibrium during both static and dynamic activities. Children acquire balance control through a developmental process. From the ages of 4 months to 2 years, visual cues primarily guide balance. Between the ages of 3 and 6 years, the integration of somatosensory inputs begins, and by the age of 7 to 10 years, children can efficiently resolve sensory conflicts and use the vestibular system as a primary balance reference (1). Balance itself can be categorized into several distinct forms: stable static balance, which refers to maintaining a stationary position; stable dynamic balance, which involves preserving balance during movement; proactive balance, which anticipates and adjusts to expected disruptions; and reactive balance, which compensates for unexpected challenges (2).

Despite children being generally active, there is growing concern that their physical fitness is declining due to urbanization, restricted access to recreational spaces, pollution, and evolving family structures. These changes have limited opportunities for children to engage in physical activities, and consequently, their balance and coordination may be compromised (3). Fundamental movement skills (FMS), which include locomotor, object-control, and stability skills, are essential for promoting physical activity in children. Locomotor skills, such as running and hopping, are necessary for basic mobility, while object-control skills, like throwing and catching, contribute to physical competence. Stability skills, including balancing, are crucial for overall motor development (4). Engaging in physical activity during childhood is known to confer numerous health benefits. It improves cardiovascular health, enhances bone mass, and contributes to long-term physical well-being. Furthermore, children who regularly engage in physical activity are more likely to maintain an active lifestyle into adulthood (5).

However, there has been a noticeable shift toward sedentary lifestyles among children, which is contributing to increasing rates of childhood obesity globally. Sedentary behaviors, characterized by excessive screen time, passive transportation, and reduced opportunities for physical activity, are becoming more common among children. These behaviors, coupled with poor dietary choices, have been linked to weight gain and associated health issues such as obesity (6). Obesity in children not only poses a risk to their overall health but also negatively impacts their balance and motor skills. Overweight children often experience issues such as abnormal pressure distribution on their feet, leading to postural defects and balance impairments (7). Research has shown that physically active

children tend to have better health-related quality of life outcomes compared to their less active peers, suggesting that promoting physical activity can have far-reaching benefits for both physical and mental health (8).

The increasing prevalence of sedentary lifestyles among children highlights the need for a deeper understanding of how these behaviors affect balance and postural control. Given the importance of physical activity for maintaining balance and preventing long-term health issues, this study aims to investigate the prevalence of balance impairment in children aged 7 to 10 years who lead either physically active or sedentary lifestyles. By assessing balance using the Pediatric Balance Scale, this research seeks to contribute valuable insights into the impact of lifestyle choices on children's postural stability, with the goal of informing future interventions and promoting healthier, more active lifestyles in this population (9).

MATERIAL AND METHODS

This cross-sectional study was conducted to assess balance impairment in children aged 7-10 years, comparing those with physically active lifestyles to those with sedentary lifestyles. Data were collected from British International High School and The Height School System in Sheikhupura, Pakistan, between December 2023 and May 2024. The study employed non-probability convenient sampling, targeting a total sample size of 377 children, which was calculated using the Raosoft sample size calculator (26). The participants were divided into two groups: 189 children were classified as physically active, and 188 children were identified as leading sedentary lifestyles.

The inclusion criteria for the study involved children aged 7-10 years, both boys and girls, who either actively engaged in organized or non-organized physical activities such as sports, exercises, household chores, and active travel, or exhibited sedentary behaviors characterized by over two hours of screen time per day, including watching television and playing video games (21, 22). Exclusion criteria included children younger than 7 years or older than 10 years, those unwilling to participate, and children with a history of physical trauma, such as road traffic accidents, burns, or bicycle accidents. Furthermore, children with orthopedic disorders (e.g., flat feet, bow legs, or knock knees), psychological issues (e.g., anxiety, depression, mood disorders, or post-traumatic stress disorders), neurological conditions (e.g., brain injury, cerebral palsy, autism, or epilepsy), or systemic illnesses (e.g., asthma, cardiovascular diseases, or diabetes) were excluded from the study (23, 24, 25).

Data collection involved distributing questionnaires to the parents of the participants to classify the children based on their lifestyle habits. The International Physical Activity Questionnaire for Children (IPAQ-C) was used to differentiate between physically active and sedentary children. For the assessment of balance, the Pediatric Balance Scale (PBS), which is a modified version of the Berg Balance Scale, was employed. The PBS comprises 14 items, each scored on a scale from 0 to 4, with a maximum possible score of 56. Scores were assigned based on each child's performance on tasks such as standing on one leg, maintaining balance while reaching forward, and maintaining stability during various movements. Each child's total score was calculated, and the severity of balance impairment was classified as follows: good balance (scores of 51-56), mild impairment (45-50), moderate impairment (35-44), and severe impairment (below 35).

The study adhered to ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from the parents or guardians of all participants, ensuring that they understood the purpose of the study and the procedures involved. Confidentiality and anonymity of the participants were maintained throughout the study, and all data were stored securely.

Data analysis was performed using IBM SPSS Statistics version 25. Descriptive statistics, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables, were calculated. Comparative analyses were conducted to assess differences in balance scores between the physically active and sedentary groups, with results presented in the form of tables and graphs for clear interpretation. Balance impairment categories were analyzed to identify trends and patterns across age and gender in both groups.

RESULTS

The results of the study, including statistical significance, were analyzed using IBM SPSS version 25. In addition to descriptive statistics, chi-square tests were performed to assess the association between physical activity levels and balance impairment, with p-values determining the statistical significance of the differences between the physically active and sedentary groups. A p-value of less than 0.05 was considered statistically significant.

In the physically active group, 150 children (79.4%) scored between 51 and 56, indicating good balance, while only 4 children (2.1%) in the sedentary group achieved this score.

Table 1: Balance Scores for Physically Active Group

Impairment Level	Frequency	Percentage (%)	Cumulative Percentage (%)
Severely Affected	9	4.8	4.8
Moderately Affected	10	5.3	10.1
Mildly Affected	20	10.6	20.6
Good Balance	150	79.4	100.0
Total	189	100.0	100.0

Table 2: Balance Scores for Sedentary Lifestyle Group

Impairment Level	Frequency	Percentage (%)	Cumulative Percentage (%)
Severely Affected	35	18.6	18.6
Moderately Affected	127	67.6	86.2
Mildly Affected	22	11.7	97.9
Good Balance	4	2.1	100.0
Total	188	100.0	100.0

The chi-square analysis revealed a significant difference between the two groups in terms of the proportion of children with good balance ($\chi^2 = 160.2$, $p < 0.001$), indicating that physically active children are significantly more likely to have good balance compared to their sedentary peers.

In the analysis of severe balance impairment, 35 children (18.6%) in the sedentary group were classified as severely affected, compared to only 9 children (4.8%) in the physically active group. The difference in severe balance impairment between the two groups was statistically significant ($\chi^2 = 25.5$, $p < 0.001$). Similarly, for moderate impairment, 127 children (67.6%) in the sedentary group had scores indicating moderate impairment, whereas only 10 children (5.3%) in the physically active group showed moderate impairment. This difference was also statistically significant ($\chi^2 = 150.3$, $p < 0.001$).

Further analysis by gender showed that males in the physically active group were more likely to score within the good balance range compared to females, although this difference was not statistically significant ($p = 0.08$). Age-based analysis revealed that older children (aged 9-10 years) in the physically active group had higher scores on the Pediatric Balance Scale, indicating better balance, while children in the sedentary group, regardless of age, tended to have more severe impairments. However, the age differences within each group were not statistically significant ($p = 0.12$).

The p-values confirmed significant differences in balance impairment between physically active and sedentary children. The findings clearly demonstrate that physically active children have significantly better balance than those with a sedentary lifestyle. The analysis highlights the importance of encouraging physical activity to improve balance and reduce the risk of balance impairments in children.

DISCUSSION

This study aimed to investigate the prevalence of balance impairment in physically active and sedentary lifestyle children aged 7-10 years, revealing significant differences in balance performance between the two groups. The findings clearly indicated that children who engaged in regular physical activities, whether structured or informal, exhibited better balance compared to their sedentary peers. This aligns with previous research that has consistently demonstrated the positive effects of physical activity on balance and motor skills in children. Physical activity has been shown to improve postural stability, strengthen musculoskeletal structures, and enhance neuromuscular coordination, which are essential components of balance (1, 7).

The results of the present study were consistent with the findings of Azevedo et al., who highlighted that physically active children demonstrate superior balance and postural control compared to sedentary individuals (3). Similarly, Cohen et al. emphasized the role of fundamental movement skills, which include balance, in promoting physical activity among children, supporting the notion that regular engagement in physical tasks can significantly enhance balance (6). The current study found that 79.4% of physically active children achieved good balance scores, whereas only 2.1% of children in the sedentary group attained similar results. This large discrepancy underscores the negative impact of a sedentary lifestyle, characterized by increased screen time and reduced physical activity, on children's balance and overall motor skills (9).

The study also shed light on the risks associated with sedentary behavior, including the development of balance impairments and related health issues. Children in the sedentary group exhibited a high prevalence of moderate to severe balance impairments, with 67.6% showing moderate impairment and 18.6% demonstrating severe impairment. These findings align with previous research by Szczepanowska-Wolowiec et al., which demonstrated that obesity and sedentary behavior are linked to altered foot structure, abnormal pressure distribution, and postural defects, all of which negatively affect balance (10). Furthermore, Fang et al. established a direct relationship between physical inactivity and decreased physical fitness, which further exacerbates balance deficits (5).

The study's strengths include its robust sample size, which provided sufficient statistical power to detect significant differences between the two groups. Additionally, the use of the Pediatric Balance Scale, a validated and widely used tool for assessing balance in children, ensured accurate and reliable measurement of balance impairment. However, several limitations should be acknowledged. First, the study focused solely on children aged 7-10 years, limiting the generalizability of the findings to other age groups. Future research should consider a broader age range to examine how balance impairment evolves over time. Second, the study relied on non-probability convenient sampling, which may introduce selection bias, as the children included in the study may not be fully representative of the general population. Third, the cross-sectional nature of the study precludes the ability to establish causality between physical activity levels and balance impairment. Longitudinal studies are recommended to explore the long-term effects of physical activity on balance development.

Despite these limitations, the findings of this study provide valuable insights into the importance of promoting physical activity among children. Regular physical activity has been

shown to not only improve balance but also contribute to better cardiovascular health, bone density, and overall physical well-being (7). This study supports the need for interventions targeting sedentary behavior in children, such as reducing screen time and creating opportunities for physical activity within schools and communities. Educational programs aimed at increasing parental awareness of the risks associated with sedentary lifestyles and the benefits of physical activity should also be prioritized (8).

CONCLUSION

In conclusion, this study demonstrated a clear association between physical activity and improved balance in children aged 7-10 years. Children who regularly participated in physical activities had significantly better balance scores compared to their sedentary peers. Addressing sedentary behavior and encouraging physical activity are crucial for improving children's balance and preventing long-term health consequences associated with physical inactivity (9). Future research should continue to explore the impact of various lifestyle factors on balance development and investigate effective strategies to promote active lifestyles in children.

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