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EDGE OF BALANCE: A COMPARATIVE INVESTIGATION INTO DYNAMIC EQUILIBRIUM AMONG INLINE SKATERS AND FOOTBALLERS

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ABSTRACT

Balance is crucial for success in sports. Developing this ability early is key to mastering skills and maximising performance. This study investigates the balance specificity to analyse the importance of promoting children to games involving changes in the centre of gravity in early childhood. Fifty participants, Inline skaters (n=25) and footballers (n=25), are selected randomly, and their lower limb length is measured from the anterior superior iliac spine to the most distal part of the medial malleolus using tape. Further dynamic balance test (YBT) is performed 3 times with dominant and non-dominant feet in the anterior, posteromedial, and posterior lateral areas, which are measured from the central starting point and readings are measured. YBT test score is then calculated using the standard equations, and composite reach distance (%) is obtained. The findings show a significant change in dynamic balance among inline skaters and footballers. A poor result in the YBT test is due to the lack of dynamic balance. Inline skaters have more dynamic balance than footballers at an early age. Thus, this test should be further investigated on games involving variations in their centre of mass with other games.

KEYWORDS: *YBT, Centre of Gravity, Performance, Football, Skating*

INTRODUCTION

Childhood is a critical period for physical development, and engaging in physical activities and games plays a vital role in shaping a child's overall well-being. Among the various aspects of physical development, dynamic balance is maintaining stability. At the same time, in motion stands out as a foundational skill that influences motor, cognitive, and emotional growth (Shumway-Cook & Woollacott, 1998). As children transition from crawling to walking, they explore their environment, developing the balance necessary to stand upright, take their first steps, and eventually engage in more complex movements such as running, jumping, and climbing (Clark & Metcalfe, 2002). These activities enhance physical health and lay the groundwork for refining gross motor skills, which are essential for navigating the challenges of daily life and sports (Gallahue & Ozmun, 2006).

Beyond its role in motor development, balance significantly impacts cognitive and perceptual abilities. Activities that challenge balance, such as walking on uneven surfaces or balancing on one foot, stimulate the vestibular system, which is responsible for spatial orientation and equilibrium (Horak, 2006; Peterka, 2002). These experiences enhance proprioception, spatial awareness, and cognitive functions such as attention, concentration, and problem-solving (Jefferson et al., 2013; Diamond, 2000). Furthermore, mastering balance fosters emotional resilience and self-confidence as children learn to persevere through challenges and setbacks, developing a sense of independence and determination (Piek et al., 2006). Cooperative games and outdoor play that promote balance also provide opportunities for social interaction, collaboration, and the development of interpersonal skills, which are critical for emotional intelligence and social competence (Barnett et al., 2009). The importance of balance in early childhood cannot be overstated, as it shapes every aspect of a child's growth and development. By engaging in activities that challenge their balance, children build a strong foundation for lifelong health, learning, and success (Haga, 2008). This study focuses on the role of dynamic balance in two distinct sports: inline skating and football. These sports demand unique forms of balance control, with inline skating requiring precise, fluid movements and football emphasising explosive agility and rapid directional changes (Fong et al., 2013; Stølen et al., 2005). Understanding how these activities influence dynamic balance can provide valuable insights into optimising physical development and performance in children.

This study employs the Y-Balance Test (YBT), a widely recognised sports science and rehabilitation tool to assess dynamic balance. The YBT evaluates dynamic stability and

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neuromuscular control by measuring reach distances in three directions (anterior, posteromedial, and posterolateral), revealing asymmetries and compensatory strategies that may influence injury risk and athletic performance (Plisky et al., 2006; Butler et al., 2013). This research aims to uncover sport-specific adaptations and potentially transferable skills between the two disciplines by comparing the dynamic balance of young inline skaters and football players. Such insights can inform targeted training interventions, cross-training programs, and injury prevention strategies tailored to the unique needs of each sport (Sheppard & Young, 2006; Bompa & Buzzichelli, 2019).

Ultimately, this study seeks to contribute to the growing body of knowledge on dynamic balance in sports, focusing on the nuanced interplay between inline skating and football. By unravelling the intricacies of balance control within these disciplines, it aims to empower athletes, coaches, and sports scientists with evidence-based strategies to enhance performance, reduce injury risks, and foster a culture of resilience in the athletic community. Through this exploration, the research underscores the importance of developing balance skills from an early age, highlighting their role in promoting lifelong physical, cognitive, and emotional well-being.

METHODS

Subjects

50 participants aged 8–10 years were selected from Pondicherry, India, for this study. The sample consisted of 25 inline skaters and 25 football players. Football players were recruited from Gunners FC, a private football club, while inline skaters were selected from two skating academies: Michael's Skating Academy (n = 13) and Thomas Skating Academy (n = 12). All participants were active members of their respective teams and had at least one year of training experience in their sport. Participants were excluded if they had any recent injuries, musculoskeletal pain, or pre-existing conditions (e.g., neurological disorders, lower extremity injuries, or back pain) that could affect their balance ability. Exclusion criteria were determined in consultation with the teams' head athletic trainers.

Selection of Variables

The primary variable for this study was dynamic balance, selected based on its relevance to the study's objectives, feasibility of measurement, and consultation with experts in the field. Dynamic balance was chosen due to its critical role in athletic performance and applicability to inline skating and football.

Research Design

An independent randomised research design was employed for this study. Participants were divided into two groups: inline skaters and football players. The Y-Balance Test (YBT) was used to assess dynamic balance, and the collected data were analysed statistically to identify any significant differences between the two groups.

Instrumentation

The Y-Balance Test (YBT) was selected as the primary tool for measuring dynamic balance. The YBT is a reliable and validated assessment that simplifies the Star Excursion Balance Test (SEBT) while maintaining its effectiveness in evaluating dynamic stability and neuromuscular control. The test measures reach distances in anterior, posteromedial, and posterolateral directions.

Testing Procedure

Warm-Up

Participants were instructed to perform a thorough warm-up before testing. The warm-up included activities that corresponded to the biomechanical and physiological demands of the YBT. A recovery period of 3–5 minutes was provided after the warm-up to ensure participants were adequately prepared for the test.

Test Protocol

1. Preparation: Participants were required to wear lightweight clothing and remove their footwear. They stood on the centre platform of the YBT kit, behind the red line, with their hands placed firmly on their hips.
2. Test Order: The test was conducted in the following order for each foot:
   - Right Anterior
   - Left Anterior
   - Right Posteromedial
   - Left Posteromedial
   - Right Posterolateral
   - Left Posterolateral
3. Execution: Participants were instructed to push the reach indicator as far as possible with one foot while maintaining balance on the other foot. Each reach direction was performed three times, and the reach distance was recorded to the nearest 0.5 cm.
4. Failed Attempts: A reach attempt was considered invalid if:
   - The participant lost balance and touched their foot down before returning to the starting position.
   - The participant used the reach indicator for support (e.g., placing their foot on top of it).
   - The participant flicked or kicked the reach indicator instead of pushing it smoothly.
5. Scoring: The composite score for each participant was calculated by averaging the reach distances across all three directions and both feet. This score provided a comprehensive measure of dynamic balance

Analysis of data and results of the study

To facilitate the study, 50 subjects were selected. Twenty-five players were selected from inline skaters and 25 from football from Pondicherry and subjected to an independent t-test. The level of significance was fixed at 0.05.

The mean, standard deviation, standard error of the mean, mean difference, and 't' ratio were calculated.

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Table 1

	N	Mean	SD	Sig (2- tailed)
Left				
	25	81.4704	9.17759	0.048
	25	76.6090	7.74039	0.049
Right				
	25	80.5028	7.83262	0.047
	25	75.9125	8.09474	0.047

Significance level fixed at 0.05

The results presented in Table 1 indicate statistically significant differences in dynamic balance between left-sided skaters and left-sided footballers, as well as between right-sided skaters and right-sided footballers, at a significance level of 0.05.

For the left-sided participants, skaters demonstrated a higher mean dynamic balance score (M = 81.4704, SD = 9.17759) compared to footballers (M = 76.6090, SD = 7.74039), with a statistically significant difference (p = 0.048). Similarly, for the right-sided participants, skaters also exhibited a higher mean dynamic balance score (M = 80.5028, SD = 7.83262) compared to footballers (M = 75.9125, SD = 8.09474), with a statistically significant difference (p = 0.047).

Table 2

N	Mean	SD	t	Sig (2-tailed)
25	161.9728	15.98582	2.197	0.033
25	152.5212	14.39633	2.197	0.033

Significance level fixed at 0.05

The results in Table 2 compare the overall dynamic balance performance between skaters and footballers, combining data from both left and right sides. The analysis reveals a statistically significant difference in the total mean dynamic balance scores between the two groups at a significance level of 0.05.

Skaters exhibited a higher total mean dynamic balance score (M = 161.9728, SD = 15.98582) compared to footballers (M = 152.5212, SD = 14.39633). The independent samples t-test yielded a t-value of 2.197, with a statistically significant p-value of 0.033. This indicates that the observed difference in dynamic balance between skaters and footballers is unlikely to be due to random chance

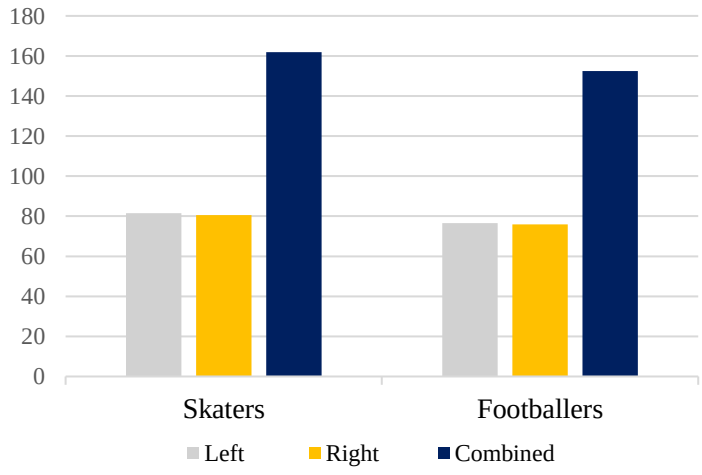


Figure. 1

DISCUSSION

In skating, the Centre of Gravity (COG) concept plays a crucial role in understanding and optimising performance. The COG is a key factor in maintaining stability and achieving graceful movements. Skaters actively manipulate their COG to control balance and create effortless gliding. During jumps, spins, and intricate routines, precise adjustments of the centre of mass are essential for achieving desired positions and controlling rotational movements. For instance, figure skaters often lower their COG to increase stability during spins and raise it for jumps, showcasing the dynamic nature of this fundamental concept (Hubbard, 2009). Skaters leverage the small base of support the wheels provide, allowing for intricate footwork and quick changes in direction. The interaction between the skater's body position, wheel placement, and the constantly shifting centre of mass contributes to the unique and captivating movements observed in figure skating (King, 2005). Understanding and mastering the manipulation of the COG is a

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continuous process for skaters. Coordinating body movements, limb positions, and wheel interactions with the ever-changing COG are essential skills that contribute to the elegance and precision characteristic of elite skating performances (Lockwood, 2010).

Dynamic balance is equally crucial for footballers, as it helps them maintain stability and control while in motion. Football requires rapid changes in direction, quick turns, and various movements, making dynamic balance essential for performance and injury prevention (Gamble, 2013). Improving core strength, agility drills, and specific balance exercises can significantly enhance a footballer's ability to maintain stability during dynamic movements on the field (Jeffreys, 2010). In football, dynamic balance enables players to stay on their feet when faced with challenges like tackles or sudden changes in the game's pace. It also plays a critical role in ball control, dribbling, and executing precise movements (Bangsbo, 1994). Footballers often engage in training routines that focus on improving agility, coordination, and overall body control to enhance their dynamic balance, contributing to their effectiveness on the field (Reilly & Williams, 2003).

The development of dynamic balance can vary among individuals, and factors such as genetics, early exposure to specific activities, and training play a significant role (Malina et al., 2004). Skaters may exhibit early dynamic balance proficiency due to the nature of their sport, which emphasises gliding, turning, and maintaining stability on a moving surface (King, 2005). In contrast, footballers typically develop dynamic balance in response to the demands of their sport, which involves constant changes in direction, quick accelerations, and decelerations (Bangsbo, 1994). Both skaters and footballers can benefit from age-appropriate training that targets dynamic balance to enhance their respective skills (Gallahue & Ozmun, 2006).

This study found a significant difference ($p = 0.033$) in the total dynamic balance between footballers and skaters in early childhood. This suggests that involving children in activities challenging their centre of gravity helps them attain dynamic balance more effectively. Such activities enable children to adapt to sudden changes in their centre of gravity, allowing them to achieve stable equilibrium faster in unbalanced states. Skaters may demonstrate superior dynamic balance to footballers due to their movement strategies, which involve transitioning from a stable to an unstable state and continuously adjusting their centre of gravity throughout their movement patterns (Hubbard, 2009). In contrast, footballers primarily focus on maintaining balance during rapid directional changes and accelerations, which may not require the same level of continuous COG adjustment as skating (Jeffreys, 2010).

CONCLUSION

This study highlights the critical role of dynamic balance in enhancing athletic performance and reducing injury risk for both footballers and skaters. An analysis of factors such as proprioception, muscle strength, and neuromuscular control shows that maintaining optimal dynamic balance is essential for maximising potential in these sports. While advancements in training techniques and technology have provided innovative tools for improving balance, further research is needed to develop sport-specific training protocols tailored to the unique demands of football and skating.

Footballers rely on dynamic balance for agility, quick directional changes, and spatial awareness, whereas skaters require finely tuned balance for intricate manoeuvres and stability on varying surfaces. By incorporating sport-specific balance training into their regimens, athletes can enhance their physical capabilities and technical skills, decision-making, and overall performance.

In conclusion, dynamic balance is a cornerstone of athletic success. Prioritising balance training and adopting sport-specific methodologies can help athletes unlock their full potential, minimise injury risks, and achieve long-term success in their respective sports. This holistic approach to athlete development underscores the importance of integrating dynamic balance training into comprehensive training programs.

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