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ORIGINAL ARTICLE

Correlation between Core Strength with Dynamic Balance and Change of Direction Speed in Adolescent Skaters: A Cross-sectional Study

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Abstract

Background: Inline skating has become an increasingly popular form of physical exercise worldwide. Core strength and stability contribute to efficient energy transfer, body control, and balance maintenance during movement. Understanding the relationship between these variables is essential for designing training programs that enhance performance and support the physical development of young skaters. **Method:** A total of 52 Skaters participated in the study. Balance and Agility, core strength and endurance were assessed using the Y-Balance Test and Arrowhead Agility, and an isometric test, respectively. Data were analysed using Pearson correlation analysis to determine the relationships among the measured variables, with pvalue of < 0.05. **Result:** Core strength showed a moderate negative correlation with agility test scores on both sides, and the values are Right $r = -0.667$, Left: $r = -0.581$, $p<0.00001$. Also, Core strength showed a moderate positive correlation with Y Balance Test scores across all directions (Anterior, Posteromedial, Posterolateral) for both limbs, $r = 0.45–0.68$, $p<0.00001$. **Conclusion:** The findings emphasise that core strengthening should be an essential part of training programs to boost skating performance and movement efficiency.

INTRODUCTION

In recent years, inline skating has gained popularity as a recreational activity and a way to improve physical fitness[1]. Inline skating is a popular sport practised by millions globally, offering benefits such as improving cardiovascular health, enhanced postural control, and general fitness. Despite its benefits, it poses a significant risk of injuries, emphasising the need for proper training[2]. Research indicates that balance, speed, and agility are key components for excelling in various sports. The ability to sustain the centre of pressure on a support base with little body sway and maximum stability is known as balance. Agility is the capacity to change direction and speed rapidly. A child's development as an agile child takes a lengthy time. One of the most important performance criteria in many professional sports is speed, particularly forward linear speed[3].

The trunk facilitates energy transfer and coordination between lower and upper extremities. Optimal trunk muscular activation is necessary for proper movement and posture during sports. Trunk function refers to core stability, which involves coordination, strength, and endurance in trunk muscles[4].

Advanced skating techniques demand a higher degree of balance, which improves with practice and maturity[5]. Inline skating games can teach principles, increasing motivation during training sessions, especially among adolescents who value exercise and social contact[6]. Skating involves constant balance adjustments due to displacement conditions, requiring adjustments in gravity, space, and body extremities, with variations in speed at the start[7].

The three reaches of figure skaters were symmetrical overall, but when sexes were separated, skating speed and posterolateral reach were linked, suggesting that females may use the take-off leg more to generate power when gliding on the landing leg, which increases hip activation and take-off leg strength. Female singles skaters may be more susceptible to lower extremity injuries, according to composite results on the Y-balance test[8].

Agility involves both physical adjustments and decision-making processes. Athletes with strong agility skills often demonstrate better visual processing, spatial awareness, dynamic balance and rhythm. Forward linear speed, in particular, is critical in many sports and directly impacts skating performance. Speed training focuses on minimising the time taken to move between two points, and similar methods are often applied to enhance both sprinting and skating speed[5].

Change of Direction Speed (CODS) is influenced by various physical factors, including linear sprint speed, reactive strength, and the power of leg muscle. Core has also been suggested as a potential factor impacting CODS, but its exact role remains unclear. Core training appears to effectively enhance CODS in less skilled middle-adolescent athletes, but its benefits diminish in more skilled adult athletes. These findings suggest that core muscle strength plays an important role in CODS and that incorporating core training can be beneficial for improving this skill[9].

Enhancing performance is mostly dependent on core training. In addition to preventing injuries, it plays a crucial role in lower limb and trunk injury rehabilitation programs[10]. Lehman's definition of strength in athletes, which is the greatest force generated by a muscle group at a specific velocity, is different from our concept. There is scant research on the relationship between core stability exercises and improved sports performance[11]. The core muscles are in charge of transmitting stresses from the body's proximal to most distal regions and stabilising the spine[12].

According to research, athletes who include core strengthening exercises in their training routines report increases in strength, agility, and stability. Athletes can better regulate their body motions and respond swiftly to unforeseen circumstances by strengthening their bodies[13].

Skating is a dynamic sport that requires optimal core strength, postural control, dynamic balance, and rapid CODS for effective performance and injury prevention. Although previous studies have examined the individual roles of core strength, balance, and agility, limited evidence exists regarding their interrelationship in adolescent skaters. This study aims to evaluate the correlation between core strength, dynamic balance using the Y-Balance Test, and CODS using the Arrowhead Agility Test. The findings may provide valuable insights for physiotherapists, coaches, and strength and conditioning professionals in developing evidence-based training strategies to optimise performance and reduce the risk of sports-related injuries.

MATERIALS AND METHODS

This study was conducted at the Garkheda Divisional Sports Complex and Shiv Chhatrapati College, Chhatrapati Sambhajinagar, Maharashtra, India, focusing on adolescent inline skaters. The research adopted a convenience sampling method and employed an observational cross-sectional study design. A total of 58 adolescent inline skaters aged 15-19 years participated in the study over a duration of six months. The study utilised essential materials, including a stopwatch, markers, inch tape, couch/mat, micropore tape, and cones for the assessment procedures. Ethical clearance was obtained from the Institutional Ethics Committee of MGM-ECRHS RHS, Department of Pharmacology, Chhatrapati Sambhajinagar. CTRI registration was not required as the study was observational in nature. The inclusion criteria comprised adolescent inline skaters aged 15–19 years with a BMI between 18.5 and 24.9 kg/m^2 who practised skating at least three times per week. Participants were excluded if they had a history of recent lower limb surgery or any orthopaedic condition, musculoskeletal disorder, neurological deficit, or congenital deformity affecting lower limb function or core strength. Additionally, skaters actively participating in other outdoor sports such as football, athletics, badminton, or soccer were excluded.

PROCEDURE

Participants were selected based on inclusion and exclusion criteria; the procedure was explained to the participants. Informed consent was obtained from them. Then we measured the core strength by using different outcome measures. Along with the Arrowhead Agility Test and Y balance test.

Dynamic Abdominal Endurance test: The athletes were positioned in the supine lying with hips at 45 degrees and knees at 90 degrees and hands at the side. A line was drawn 8 centimetres and 12 centimeters distal to the fingers. The athlete tucks his/her chin and curls the trunk to touch the lines with the fingers and repeats as many curls as possible using a cadence of 25 repetitions per minute. The number of repetitions possible before holding breath, altered mechanics or fatigue occurs was recorded as the score.

Isometric Abdominal test: The athletes are in a supine lying position with hips at 45 degrees and knees at 90 degrees and hands at the side or behind the head or neck. The athlete has to tuck his/her chin and scapula off the couch. This position is held as long as the athlete is able to do.

Dynamic horizontal side support: The athlete was positioned in a side-lying position, resting the upper body on his/her elbow and flexing the knee to 90 degrees. The athletes had to lift the pelvis off the couch and straighten the spine. The athletes repeated this movement as many times as possible.

Isometric horizontal side support: The athletes were positioned in the side-lying position and rested the upper body on his/her elbow and then flexed the knee to 90 degrees. The athletes lifted the pelvis off the couch and straightened the spine. The athletes held this position as long as he/she was able to.

Isometric extensor test: The athletes were positioned in a prone lying position with hands on the side of the couch. Moving his/her hands to the back and finally moved their hands behind the head to increase the difficulty. The athletes lifted the body off the couch and held off as long as he/she was able to do. That was recorded[14].

Arrowhead agility test: The athletes were asked to sprint across the markers and come back to the starting position. We recorded the time as the participant starts and ends the test. 4 trials were done with 3 min rest in between. The best of 2 trials for each side was taken for analysis[15].

Y balance test: This test protocol involved three directions (posterolateral, posteromedial, anterior) forming a Y pattern instead of eight. Athletes underwent a demonstration, and four familiarisation trials per limb in each direction were performed. During the test, three recorded trials focused on stability, with hands on hips and barefoot athletes placing their great toe at the point 0. Assessment parameters included the mean of three trials for each direction and limb, a composite score calculation, and qualitative movement analysis.

Reach Distance = (Average reach distance for a direction / Limb length) x 100%[16].

Outcome Measures

This are our outcome measures used for Core Strength: Dynamic extensor endurance test, Isometric abdominal test, Isometric extensor test, Dynamic horizontal side support. Isometric horizontal side support[14]. The dynamic y balance test has intra-rater reliability ranging from 0.85-0.91[16]. Arrowhead agility test have ICC ranging from 0.80 to 0.83[15].

Data Analysis

Data obtained was entered by MS Excel Windows 11, then transferred to the new SPSS (Statistical Package for the Social Sciences) software version for advanced analysis. The collected data were tabulated by taking demographic variables such as age, gender, height, weight, *etc*.

Along with that, mean, SD, SE means, percentage, analysis of variances, *etc*. were used between groups to be tested.

The Data were interpreted using both descriptive and inferential statistical techniques. While Spearman's correlation test was utilised to ascertain correlations between core strength, agility and dynamic balance variables, descriptive statistics included mean and standard deviation to summarise participant characteristics and performance measurements.

RESULTS

Data were entered in Microsoft Excel. After data cleaning, data were imported into the Statistical Package for the Social Sciences version 25 and analysed using the same. Data were analysed for descriptive and inferential statistics. Data were presented in tabular and graphical formats. Graphs were plotted in Excel. The data were analysed for 58 participants.

Table 1. Credentials of the participants

Variables	Mean	Standard deviation
Age	16.68	1.59
BMI	21.93	1.72
Dominance	**Frequency**	**Percentage**
Right	45	78
Left	13	22

Interference: The participants of the study were adolescent skaters with a mean age of 16.68 ± 1.59 years, indicating that the study sample represented mid- to late-adolescent individuals with a relatively homogeneous age distribution. The mean Body Mass Index (BMI) of the participants was 21.93 ± 1.72 kg/m^2, which falls within the normal BMI range for adolescents. Out of 58 participants, 45 (78%) were right-dominant, and 13 (22%) were left- dominant.

Table 2. Correlation of core strength with agility

Variables	Spearman's correlation	pvalue	Interpretation
Core strength * mean of agility test right	-0.667	<0.00001	Moderate negative correlation
Core strength * mean of agility test left	-0.593	<0.00001	Moderate negative correlation

Interference: Core strength showed a moderate negative correlation with agility test scores on both sides: Right: r = - 0.667, Left: r = -0.581, p<0.00001. Since agility test time is measured in seconds (lower time = better performance), a negative correlation indicates that greater core strength was associated with better agility.

Table 3. Correlation of core strength with Y balance test

Variables	Spearman's correlation	pvalue	Interpretation
Core strength *anterior side Y balance test right	0.526	<0.00001	Moderate positive correlation
Core strength *anterior side Y balance test left	0.452	<0.00001	Moderate positive correlation
Core strength *posteromedial side Y balance test right	0.683	<0.00001	Moderate positive correlation
Core strength*posteromedial side Y balance test left	0.615	<0.00001	Moderate positive correlation
Core strength*posterolateral side Y balance test right	0.636	<0.00001	Moderate positive correlation
Core strength*posterolateral side Y balance test left	0.541	<0.00001	Moderate positive correlation

Core strength showed a moderate positive correlation with Y Balance Test scores across all directions (Anterior, Posteromedial, Posterolateral) for both limbs, where r values ranged from r = 0.45–0.68, p<0.00001. A positive correlation here means that better core strength was linked with greater reach distances, indicating improved dynamic postural control and stability.

DISCUSSION

The goal of the current study was to ascertain the relationship between teenage skaters' CODS, dynamic balance, and core strength. There were 58 participants in all, representing mid-to late-adolescent athletes who were actively skating, ages 15 to 19. The results showed that core strength and agility time had a moderately negative association (r = −0.667 and −0.593, p<0.00001) and dynamic balance had a moderately positive correlation (r = 0.45–0.68, p<0.00001). This suggests that individuals with stronger cores exhibited better balance control and quicker agility performance. These connections imply that postural stability, effective force transmission, and movement control-all essential for successful skate performance—are greatly influenced by core muscle endurance.

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The current study's findings are in line with earlier studies emphasising the role of the core in improving athletic abilities. According to Hornikova and Zemkova[9], CODS is strongly influenced by core muscle strength, highlighting the superior performance of athletes with stronger cores in multidirectional movement activities. The present study's conclusion that a well-conditioned core promotes balance during sport- specific movements is supported by Bhardwaj *et al.*[7], who discovered a favourable association between core stability and dynamic balance among teenage female roller skaters. According to Granacher *et al.* and Prieske *et al.*[17], core stability training improves adolescent athletes' coordination and postural control. The rectus abdominis, obliques, erector spinae, and quadratus lumborum are among the core muscles that work together to maintain trunk alignment and control during dynamic activities like skating. This stabilising function is responsible for the improved balance seen in this study.

Higher core endurance may enable quicker direction changes, as indicated by the negative connection between agility test duration and core strength. This result corroborates research by Sato and Mokha[18] and Nesser *et al.*, who found that trunk stability improves lower-limb mechanics and kinetic efficiency, enabling faster transitions during high-speed movements. Strong cores reduce energy leaks and speed up reaction times by providing a robust foundation for the production and transfer of forces between the upper and lower extremities. Additionally, skating necessitates constant body position adjustments, including accurate centre of gravity management and effective stabilising muscle engagement, especially during accelerations, decelerations, and turns[2].

The body's capacity to maintain balance and perform strong, well-coordinated motions is closely correlated with the strength of the core, which serves as the key link in the kinetic chain. Reduced agility, compensatory movement patterns, and an elevated risk of injury might result from weak core muscles. According to Hibbs *et al.*[19], core strength enhances balance and agility by improving proprioception and postural control. The study's virtually symmetrical Y-Balance scores also point to individuals' balanced neuromuscular coordination, which reduces asymmetries that may put athletes at risk for overuse problems. Willardson[20] asserts that preserving core-limb symmetry is crucial for maximising performance effectiveness and preventing injuries.

Thus, the current study's findings highlight the necessity of including core-strengthening activities in adolescent skaters' regular training regimens, such as planks, bridges, side holds, and dynamic balance drills. In the end, these workouts can result in better performance and a lower risk of injury by increasing trunk endurance, improving balance, and enabling quicker, more controlled changes of direction.

CONCLUSION

The study concludes that core strength has a significant influence on agility and dynamic balance among teenage skaters. A stronger core is associated with quicker agility test performance and better stability in all directions of the Y-Balance Test, indicating improved postural control and movement efficiency. Participants showed physical uniformity, suggesting that variations in performance were primarily linked to core strength differences. These findings emphasise the importance of incorporating core-strengthening exercises into training programs for young skaters. Enhancing core stability not only boosts agility and balance but also contributes to better overall coordination and skating performance

Limitations

i. *Sample size*: With only 58 participants, the study's conclusions cannot be applied to the larger adolescent skate community.
ii. *Cross-sectional design*: The study evaluated correlations only; it was unable to determine causal links between agility, balance, and core strength.
iii. *Sampling technique*: Because participants were selected from a small number of training facilities, convenience sampling might have induced selection bias.
iv. *Gender analysis*: It's possible that sex-related differences were obscured since the data for male and female participants were not examined independently.
v. *Scope of measurement*: No sophisticated biomechanical or electromyographic studies were used; only field-based tests (Y-Balance Test and Arrowhead Agility Test) were utilised.
vi. *No intervention or follow-up*: Neither a training course nor a longitudinal evaluation to gauge changes over time were part of the study.

Future Scope of the Study

i. To investigate how structured core-strength training affects skaters' balance, agility, and injury prevention, future studies should use longitudinal or interventional designs.

ii. Results will be more broadly applicable if the sample size is increased and participants from a variety of age groups, skill levels, and athletic backgrounds are included.
iii. To investigate any physiological or performance-based variations in core strength and balance, gender- specific research is advised.
iv. More accurate information on core activation patterns can be obtained by incorporating biomechanical methods like electromyography (EMG), 3D motion analysis, and force plate evaluations.
v. To learn more about performance dynamics, it is possible to examine how tiredness, proprioception, and reaction time affect agility and balance.

REFERENCES

1. Hoffman MD, Jones GM, Bota B, Mandli M, Clifford PS. In-line skating: Physiological responses and comparison with roller skiing. Int J Sports Med. 1992; 13(02):137-144. https://doi.org/10.1055/s-2007-1021245 PMid:1555903
2. Radman I, Ruzic L, Padovan V, Cigrovski V, Podnar H. Reliability and validity of the inline skating skill test. J Sports Sci Med. 2016; 15(3):390.
3. Sehgal S, Chahal A, Esht V, Alshehri MM, Beg RA, Shaphe MA, *et al*. Unleashing potential and optimizing adolescent roller skating performance through a structured exercise program-a randomised controlled trial. BMC Sports Sci Med Rehabil. 2023; 15(1):117. https://doi.org/10.1186/s13102-023-00728-x PMid:37735459 PMCid:PMC10515072
4. Imai A, Kaneoka K. The relationship between trunk endurance plank tests and athletic performance tests in adolescent soccer players. Int J Sports Phys Ther. 2016; 11(5):718.
5. Sehgal S, Chahal A, Esht V, Alshehri MM, Beg RA, *et al*. Unleashing potential and optimizing adolescent roller skating performance through a structured exercise program - a randomized controlled trial. BMC Sports Sci Med Rehabil. 2023; 15(1):117. https://doi.org/10.1186/s13102-023-00728-x PMid:37735459 PMCid:PMC10515072
6. Muehlbauer T, Kuehnen M, Granacher U. Inline skating for balance and strength promotion in children during physical education. Percept Mot Skills. 2013; 117(3):665-681. https://doi.org/10.2466/30.06.PMS.117x29z9 PMid:24665789
7. Bhardwaj M, Arora S, Sharma A, Kumari S, Raza M. Correlation between core stability and balance in teenage female roller skaters. 2018; 3(5):34.
8. Slater LV, Vriner M, Schuyten K, Zapalo P, Hart JM. Sex differences in Y-balance performance in elite figure skaters. J Strength Cond Res. 2020; 34(5):1416-1421. https://doi.org/10.1519/JSC.0000000000002542 PMid:29489718
9. Hornikova H, Zemkova E. The importance of core strength for change of direction speed. Front Physiol. 2024; 15:1376422. https://doi.org/10.3389/fphys.2024.1376422 PMid:38595643 PMCid:PMC11002085
10. Bashir SF, Nuhmani S, Dhall R, Muaidi QI. Effect of core training on dynamic balance and agility among Indian junior tennis players. J Back Musculoskelet Rehabil. 2019; 32(2):245- 252. https://doi.org/10.3233/BMR-170853 PMid:30248028
11. De Bruin M, Coetzee D, Schall R. The relationship between core stability and athletic performance in female university athletes. S Afr J Sports Med. 2021; 33(1). https://doi.org/10.17159/2078-516X/2021/v33i1a10825 PMid:36816896 PMCid:PMC9924551
12. Rodríguez-Perea Á, Reyes-Ferrada W, Jerez-Mayorga D, Ríos LC, Van den Tillar R, *et al*. Core training and performance: A systematic review with meta-analysis. Biol Sport. 2023; 40(4):975-992. https://doi.org/10.5114/biolsport.2023.123319 PMid:37867742 PMCid:PMC10588579
13. Ma S, Soh KG, Japar SB, Xu S, Guo S. Maximizing the performance of badminton athletes through core strength training: Unlocking their full potential using Machine Learning (ML) modeling. Heliyon. 2024; 10(15):e35145. https://doi.org/10.1016/j.heliyon.2024.e35145 PMid:39166022 PMCid:PMC11334617
14. Magee DJ, Maske RC. Orthopedic physical assessment, 7th edition; 2020.
15. Rago V, Brito J, Figueiredo P, Ermidis G, Barreira D, Rebelo A. The arrowhead agility test: Reliability, minimum detectable change, and practical applications in soccer players. J Strength Cond Res. 2020; 34(2):483-494. https://doi.org/10.1519/JSC.0000000000002987 PMid:30676390
16. Picot B, Terrier R, Forestier N, Fourchet F, McKeon PO. The Star Excursion Balance Test: An update review and practical guidelines. Int J Athl Ther Train. 2021; 26(6):285-293. https://doi.org/10.1123/ijatt.2020-0106

17. Prieske O, Muehlbauer T, Borde RA, Gube M, Bruhn S, Behm DG, *et al*. Neuromuscular and athletic performance following core strength training in elite youth soccer: Role of instability. Scand J Med Sci Sports. 2016; 26(1):48-56. https://doi.org/10.1111/sms.12403 PMid:25559249
18. Sato K, Mokha M. Does core strength training influence running kinetics, lower-extremity stability, and 5000-M performance in runners? J Strength Cond Res. 2009; 23(1):133-140. https://doi.org/10.1519/JSC.0b013e31818eb0c5 PMid:19077735
19. Hibbs AE, Thompson KG, French D, Wrigley A, Spears I. Optimizing performance by improving core stability and core strength. Sports Med. 2008; 38(12):995-1008. https://doi.org/10.2165/00007256-200838120-00004 PMid:19026017
20. Willardson JM. Core stability training: applications to sports conditioning programs. J Strength Cond Res. 2007; 21(3):979-85. https://doi.org/10.1519/00124278-200708000-00054 PMid:17685697