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Original Research Article

Anthropometric measurements and agility performance in amateur roller skaters: a correlational study

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ABSTRACT

Background: Research on the body structure of roller skaters has identified that anthropometric attributes are desirable in this sport for a better performance. Leg length has a definite decisive advantage in sport. Explosive leg power is very essential for roller skating as it requires speed, agility and quickness which can be associated with lower limb muscle girth. Hence, it is important to examine the contribution of limb length, calf and thigh muscle circumference, to agility performance.
Methods: 30 healthy amateur roller skaters within age group of 6 to 14 years were assessed for anthropometric measurements – lower limb length, thigh circumference, calf circumference measurement. Participants performed a standardized warm-up of moderate-intensity jogging (5-10 min), static and dynamic stretching (5 min) and brief bouts of high-intensity running, including changes in direction on the ground. They performed agility tests in order of Edgren side step test, t-test and Illinois agility test based on test direction, progressing from uniplanar movements to biplanar and concluding with multidirectional movements. Each test was performed twice with 1-minute rest period between each trial, and a 2 min rest period between each test.
Results: Pearson's correlation showed that lower limb length have a moderately positive correlation with agility (r=0.5-0.7) whereas calf and thigh muscle circumference have a strong positive correlation with agility (r=0.7-0.8) stating that anthropometric measurements have a statistically significant correlation with agility performance with $p<0.05$.
Conclusions: Anthropometric measurements such as lower limb length, thigh and calf circumferences have a moderate to strong positive correlation with agility performances of healthy amateur roller skaters within the age group of 6-14 years..

Keywords: Amateur roller skaters, Anthropometric measurements, Edgren side step test, T-test, Illinois agility test

INTRODUCTION

Roller skating, a lifetime fitness sport, enhances cardiovascular fitness and improves balance and coordination. This sport demands efficient sports-related skills such as speed, balance, coordination and agility.[1] Agility is a significant component of athletic performance as it is the ability to change the direction or speed of a movement both quickly and precisely, more recent definitions have integrated a cognitive component. This

comprehends factors such as anticipation, visual and perceptual recognition, reaction speed, and attention skills.[2] Thus agility is defined as the incorporation of an initiation of body movement, change of direction, or rapid acceleration or deceleration, which involves a physical and cognitive component, such as recognition of a stimulus, reaction or execution of a physical response.[3]

Agility is a complex skill that depends on coordination, common system mobility, dynamic balancing, strength, elasticity, stabilization, explosive strength, speed, and so on.[4] In roller skating, it is desirable to have agile players to enhance sports performance.

Anthropometric variables influence an individual's sports and physical activity. Research on the body structure of roller skaters has identified the anthropometric attributes desirable in this sport. Leg length, one of the components of anthropometric measurements has a definite decisive advantage in sport. Longer strides are possible with longer leg length and it will be helpful to run fast from one end to another end.[5] Calf and thigh circumference has positive relationship with speed performance in players as the girth of calf muscle may contribute to vertical jump, and increase explosive power.[6] Successful sporting performance depends heavily on the explosive leg power of the athletes involved. This explosiveness is very essential for sport like roller skating as it requires speed, agility, quickness, and explosive power.[7] It is important to examine the contribution of calf muscle circumference, thigh circumference, and limb length to agility performance.

Research by Silva et al and Sickles et al has highlighted the significance of improvements in physical performance such as running speed, resistance, agility and strength along with body size and weight throughout growth and development.[6] The years between 6 and 14 defining middle childhood and early adolescence, are a time of important developmental advances including biological and cognitive changes that transform children's bodies and minds.[8] Early adolescence is when both boy and girl hit puberty and go through adolescent growth spurt. Going through adolescent growth spurt during puberty can have a significant impact on athletic performance as increases in body size, hormones, and muscle strength can improve athletic performance.[9] Hence it is important to assess anthropometric measurements and agility performance in age group of 6 to 14 years.

Performance-based outcomes such as ESST, t-test and IAT are used to assess agility performance because these test were found to have excellent interrater reliability and moderate to good test-retest reliability. These tests are valid measures of agility that uniquely assess one or multiple components of agility, including unidirectional, bidirectional, and multidirectional movements along with retropulsion and rapid acceleration and deceleration transitions when changing direction; thus providing a comprehensive assessment of high-level mobility.[10]

While numerous agility tests have been documented in existing literature, there remains a lack of comprehensive assessment utilizing multiple agility tests to accurately gauge proficiency in agility performance alongside anthropometric measurements. In light of this information, the purpose of this study was to investigate the correlation of anthropometric measurements such as lower limb length, thigh and calf circumference with agility performance in roller skaters with the established series of reliable and valid tests providing a comprehensive assessment of agility performance.

METHODS

This cross-sectional study commenced after ethical approval from the institutional ethics committee. The population in this study was a sample of convenience made up of thirty healthy amateur roller skaters, of both genders between the ages of 6 to 14 years recruited from the sports ground in Pimpri, Pune. Subjects with a history of lower limb injury or surgery in the past year, chronic knee or ankle joint instability, or other lower limb pathologies were excluded from the study.[3] An informed written consent was obtained from the participant's parents or guardians after explaining the aim and procedure of the study to them.

Basic demographic data was obtained and procedure was explained to the subjects to make them familiar with all assessment procedures and agility tests were demonstrated. Each individual was assessed for anthropometric measurements like height, weight, lower limb length, thigh circumference, calf circumference measurement. All the participants were given a standardized warm-up, consisting of moderate-intensity jogging (5-10 min), static and dynamic stretching (5 min) and brief bouts of high-intensity running, including changes in direction on the ground.[11] The order of administration of the agility tests was ESST, t-test, and IAT, based on test direction, progressing from the uniplanar movement of the ESST to the biplanar movements of the T-Test and concluding with the multidirectional movements of the IAT. Participants were asked to perform 2 trails of each test with 1 min rest period between each trial, and a 2 min rest period between each test. Average of the two trials was selected for data analysis. If a participant was unable to complete a test in 2 trials because of a fatigue or a fall, a third trial was permitted.[10]

Assessment

Tape measurement method for limb length

As shown in Figure 1 participant was positioned supine lying with his lower limbs in the anatomical position. After palpating ASIS tape measurement was taken from ASIS to the point where medial malleolus slopes inferiorly and laterally to measure limb length. The examiner repeated same procedure on subject's opposite lower extremity.

Following this procedure, the subject was asked to stand and to move for one minute and then to return to the supine position and entire procedure was repeated to obtain a second pair of measurements for limb length.[12]

Figure 1: Lower limb length measurement on left leg.

Thigh and calf circumference measurement

Subjects were standing straight on a flat surface with legs slightly open and body weight was equally distributed to both feet. Measurements of thigh and calf muscle circumference were taken using standard flexible measuring tape over the maximum circumference of the thigh muscle and calf muscle respectively. An average of 2 measurements was recorded.[13]

Edgren side step test

Test was administered in a course of 4 m in length with four 1 m (3.28 feet) increments marked with a cone. As shown in Figure 2, on the "go" command, the participant started sidestepping from the far left cone without crossing his feet to the right until his right foot touched or crossed the outside cone. The participants were sidestepping back and forth to the outside cones as rapidly as possible for 10 seconds. One point was given per completion of each 1 m increment and 0 when he failed to keep his trunk and feet pointed forward at all times, crossed his legs, or did not complete the course successfully.[9]

Figure 2: Edgren side step test (ESST).

T-test

Test was administered in a course measuring 10×10 m. On the "go" command, the participant moved as quickly as possible forward to the center cone, side-stepped to the right 5 m to the right cone, was side-stepped to the left 10 m to the far left cone, and then side-stepped back to the right to the center cone without touching the cones. Then he moved backward as quickly as possible to cross the finish line. The time to complete each trial was recorded in seconds. Disqualification with score of 0 was given if the participant failed to run the course as instructed, moved any cones, did not keep his trunk and feet pointed forward at all times, or crossed his legs more than once when sidestepping.[9]

Illinois agility test

The IAT course was 10 m in length and 5 m in width, marked by cones, with four center cones spaced 3.3 m apart and four corner cones positioned 2.5 m from the center cones. The participant was lying prone on the floor behind the starting line with his arms at his side and his head turned to the side or facing forward. On the "go" command, the participants ascended from prone lying to his feet and moved quickly forward to the first tape mark. Participant touched or crossed the tape mark with his foot and turned around to move back to the first center cone, where he weaved up and back through the four center cones. The participant then ran to the second tape mark on the far line to touch or cross the end-line tape marks with his foot. Lastly, the participant turned around and ran across the finish line. The time to complete each trial was recorded in seconds. Disqualification was determined if the participant failed to run the course as instructed.[9]

RESULTS

Data was analysed using the statistical package for the social sciences (SPSS) 21 and level of significance was set at $p<0.05$ with 95% confidence interval. Descriptive statistics were used to find out mean and standard deviation for all the variables and Pearson's correlation was used to assess correlation between anthropometric measurements and agility tests.

The study included 30 healthy amateur roller skaters, of both genders between the age group of 6 to 14 years. Mean age and standard deviation (SD) of study population were 9±2.3 with 17 males (56.66%) and 13 females (43.33%). Table 1 represents mean and SD of demographic characteristics like age, height and weight, anthropometric measurements like lower limb length, thigh and calf circumference and agility tests – ESST, TT and IAT.

Table 2 represents Pearson's correlation analysis between anthropometric measurements and agility tests. Results revealed that lower limb length showed a moderately positive correlation with ESST, TT and IAT with correlation coefficient value (r value) of 0.67, 0.52 and

0.51 respectively for right leg and with r value of 0.67, 0.52 and 0.52 respectively for left leg. Calf circumference showed strongly positive correlation with ESST, TT and IAT with r value of 0.72, 0.71 and 0.75 respectively for right leg and with r value of 0.72, 0.71 and 0.76 respectively for left leg. Thigh circumference showed strongly positive correlation with ESST, TT and IAT with r value of 0.71, 0.70 and 0.73 respectively for right leg and with r value of 0.71, 0.70 and 0.72 respectively for left leg ($p<0.05$).

As shown in Table 2 Pearson's correlation revealed that moderately positive correlation was detected between lower limb length and agility performance with r value between 0.5 to 0.7 whereas calf and thigh muscle circumference have a strong positive correlation with agility performance with r value between 0.7 to 0.8 at a significance level of $p<0.05$.

Hence, anthropometric measurements have a statistically significant correlation with agility performance of healthy amateur roller skaters within age group of 6-14 years.

Table 1: Mean and SD of variables.

Quantitative measurements	Mean±SD	
Demographic characteristics		
Age	9±2.3	
Height	133.70±14.43	
Weight	31.23±9.02	
Agility performance		
ESST	15.13±4.64	
TT	19.15±5.42	
IAT	23.59±5.02	
Anthropometric measurements	**Right**	**Left**
Lower limb length	71.05±10.14	71.05±10.14
Calf circumference	27.91±4.00	27.91±4.00
Thigh circumference	37.81±5.14	37.81±5.14

Table 2: Pearson's correlation between anthropometric measurements and agility.

Anthropometric measurements	ESST, R value	TT	IAT	P value
Limb length (right)	0.679	0.527	0.519	<0.05
Limb length (left)	0.675	0.527	0.527	<0.05
Calf circumference (right)	0.729	0.710	0.759	<0.05
Calf circumference (left)	0.728	0.710	0.760	<0.05
Thigh circumference (right)	0.715	0.705	0.731	<0.05
Thigh circumference (left)	0.712	0.702	0.729	<0.05

DISCUSSION

In this study correlation of anthropometric measurements like lower limb length, thigh and calf muscle circumference with agility performance in amateur roller skaters were studied and statistical analysis revealed that anthropometric measurements have a statistically significant correlation with agility performance with $p<0.05$.

This study showed that agility performance has moderately strong positive correlation with lower limb length for both right and left lower limb with ($r=0.5–0.7$ and $p<0.05$). This relationship between agility and lower limb length is hypothesized because of the influence of the athlete's centre of gravity. In theory, between two athletes with similar anthropometric data except for limb length, the athlete with the lower centre of gravity would be able to complete the agility movement faster because they would need less time to lower their centre of gravity in preparation for a lateral direction change.[14] Longer strides are possible with longer leg length which is helpful for improved speed performance.[5]

Begu et al conducted a study where the relationship between agility and anthropometric characteristics in 14-15-year-old male basketball players were examined and a low level of relationship was determined between body height, leg length and thigh circumference and agility. The agility test that they performed was a T drill test and we performed the Illinois agility test in our research.[4]

Roller skating has 4 phases namely, right push, right back, left push and left back. For all 4 phases of the linear gait cycle of roller skating explosive strength of lower limb muscles such as hip extensors, abductors, rotators, quadriceps, hamstrings, and calf muscles play a very important role.[15] Explosive strength, a combination of speed and strength is an effort produced by the muscle with a single maximum contraction. This explosiveness is very essential for a sport that requires speed, agility, quickness, and explosive power like roller skating.[7] The total cross-sectional area of muscle is one of the factors that significantly affect muscle strength.[16] For displaying better performance, increasing leg strength is significant for athletes.[13]

This concludes that agility depends on the explosive power of muscle which is influenced by muscle girth. Hence there is vital contribution of thigh and calf muscle circumference in agility performance in roller skaters. ESST - participants need to perform sidestepping to right and left till 10 sec

hence better proximal stability and good hip abductor strength can be attributed to good performance in this test.

Muscle strength is significantly affected by the mass of the muscles involved in the movement, the total cross-sectional areas (physiological cross-sectional area) and the structure of the muscles in the form of leverage systems.[16] Strengthening the lower limb musculature is an important factor for raising competitive results. For displaying a better performance, increasing leg strength is significant for athletes.[13] Ashwini concluded that the girth of calf muscle may contribute to higher vertical jump. Vertical jump performance is developed by improving the explosive strength of the athlete.[7] Yıldırım et al reported that increase in the horizontal and vertical jump distance as the CC and calf length increased may be due to the significant effect of CC on explosive force. Cengizel et al suggested applying the training to increase the CC to provide vertical jump and speed performance in young male basketball players as it was found that increasing CC resulted in a significant increase in vertical jump and speed performance.[13]

Anthropometric reference data can be a beneficial tool in professional skating, both in terms of training for sports performance enhancement and talent hunting and in academies for further research. Anthropometric measurements that may influence agility performance in roller skating were studied in current research which could be beneficial for diverse medical and ergonomic research, enabling clinicians, sports academies and researchers to use these reference values for enhancing sports performance and further research. Future studies can involve a large sample population and study more aspects of an anthropometric profile of roller skaters which may influence agility performance as well as other sports-related skills like speed, balance, explosive power.

CONCLUSION

Anthropometric measurements have a significant correlation with agility performance of healthy amateur roller skaters within age group of 6-14 years. Moderately positive correlation was detected between lower limb length and agility performance whereas strong positive correlation was detected between calf and thigh muscle circumference and agility performance.

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REFERENCES

1. Sehgal S, Esht V. Talent development of roller skating using an exercise program in young males: a study protocol for randomized controlled trial. Phys Therapy Rev. 2019;24(6):308-13.
2. Mackala K, Vodičar J, Žvan M, Križaj J, Stodolka J, Rauter S, et al. Evaluation of the pre-planned and non-planed agility performance: comparison between individual and team sports. Int J Env Res Public Health. 2020;17(3):975.
3. Jeffriess MD, Schultz AB, McGann TS, Callaghan SJ, Lockie RG. Effects of preventative ankle taping on planned change-of-direction and reactive agility performance and ankle muscle activity in basketballers. J Sports Sci Med. 2015;14(4):864.
4. Begu B, Kryeziu AR, Bahtiri A. The influence of anthropometric variables in agility abilities of young basketball players. Sport Sci. 2018;11:57-60.
5. Nagar L, Meena DS, Singh B. Correlation of selected anthropometric and physical fitness variables to basketball performance. Int Scientific J Sport Sci. 2012;1(2):91.
6. Cengizel E, Cengizel C. Investigation of the relationship between calf circumference and jumping, speed, agility in young male basketball players. J Sport Health Res. 2021;13:33-42.
7. Ashwini KN. A study on relationship between calf muscle girth and vertical jump ability. Int J Physiol Nutr Phys Educ. 2018;3(1):362-3.
8. Eccles JS. The development of children ages 6 to 14. Future Child. 1999;9(2):30-44.
9. Brown KA, Patel DR, Darmawan D. Participation in sports in relation to adolescent growth and development. Transl Pediatr. 2017;6(3):150-9.
10. Raya MA, Gailey RS, Gaunaurd IA, Jayne DM, Campbell SM, Gagne E, et al. Comparison of three agility tests with male servicemembers: Edgren Side Step Test, T-Test, and Illinois Agility Test. J Rehab Res Dev. 2013;50(7).
11. Stojanovic E, Aksovic N, Stojiljkovic N, Stankovic R, Scanlan AT, Milanovic Z. Reliability, usefulness, and factorial validity of change-of-direction speed tests in adolescent basketball players. J Strength Conditioning Res. 2019;33(11):3162-73.
12. Beattie P, Isaacson K, Riddle DL, Rothstein JM. Validity of derived measurements of leg-length differences obtained by use of a tape measure. Physical Therapy. 1990;70(3):150-7.
13. Cengizel EL, Cengizel ÇÖ. Investigation of the relationship between calf circumference and jumping, speed, agility in young male basketball players. J Sport Health Res. 2021;13(1).
14. McKinley, Ian A. The relationship between physical factors to agility performance in collegiate tennis players. Undergraduate Honors Theses. 2018;216.
15. Chen J, Xu K, Ma H, Ding XL. Motion characteristics of human roller skating. Biol Open. 2019;8(4):bio037713.

16. Maughan RJ, Watson JS, Weir J. Muscle strength and cross-sectional area in man: a comparison of strength-trained and untrained subjects. Br J Sports Med. 1984;18(3):149-57.

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