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RESEARCH ARTICLE

Effect of training on agility, flexibility, its correlation, and also its correlation with skin fold thickness and body mass index among runners

Jyothi Shivalingaiah[1], Sunil S. Vernekar[2], Adarsh S. Naik[3], Shivaprasad S. Gowdar[2]

[1]Department of Physiology, Karpagam Faculty of Medical Sciences & Research, Coimbatore, Tamil Nadu, India, [2]Department of Physiology, Jawaharlal Nehru Medical College, Belgaum, Karnataka, India, [3]Aravind Eye Hospital, Coimbatore, Tamil Nadu, India

Correspondence to: Jyothi Shivalingaiah, E-mail: drjove@gmail.com

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ABSTRACT

Background: Flexibility and agility are two important parameters for selection of athletes for various competitions; reduced flexibility makes the athletes prone for injury. Reduced agility affects the performance of the athletes. This study was pursued as there is a paucity of literature understanding the effect of training on agility, flexibility and the relationship between flexibility and agility in runners, with skinfold thickness (SFT) and body mass index (BMI). **Aims and Objective:** The main purpose of this study was to analyze the effects of training on agility by side step test and flexibility by sit and reach flexibility tester and to see effect of SFT, BMI on agility and flexibility among runners. **Materials and Methods:** Agility and flexibility of 31 national level runners were compared with that of 31 controls. Runners were subdivided into two groups, Group A (>2 and <3 years of training) and Group B (>3 and <10 years of training). A correlation of agility and flexibility and also with SFT and BMI was done. **Results:** Agility and flexibility were found to be higher for runners and was statistically significant. Among runners agility was higher for Group B players (seniors) and was statistically significant. A negative correlation was found between flexibility and SFT, BMI, also agility and SFT but not statistically significant. **Conclusion:** Improvement in agility and flexibility is seen after give training, reducing the rate of injury and improving the performance. Not much difference happens with SFT and BMI with agility and flexibility.

KEY WORDS: Agility; Flexibility; Body Mass Index, Skin Fold Thickness; Runners

INTRODUCTION

Sports are organized at competitive levels since ancient times. In India, the scientific community has recently started contributing toward upliftment of an athlete. But still looking at the vast sporting population, this contribution appears to be meager.

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Agility is the ability to maintain or control body position while quickly changing direction during a series of movements. Agility training is thought to be a re-enforcement of motor programing through neuromuscular conditioning and neural adaptation of muscle spindle, Golgi-tendon organs, and joint proprioceptors.[1] Agility is an essential component in most field requiring high-speed action (acceleration, maximal speed) and specially team sports competition. Moreover, agility is a combination of speed and coordination.[2] An athlete who displays good agility will most likely possess other qualities such as dynamic balance, spatial awareness, and rhythm as well as visual processing.[3] Developing agility in children continues over a long period of time. The basic methodology of agility training implies the learning of a basic walking

technique, running technique, change of direction, jumps, and landings.[4]

Flexibility is usually described as a component of general physical fitness. Flexibility has been defined as the ability to make movements through the maximum possible amplitude or a range of movement. Flexibility exercise can reduce perception of pain ensuring muscular exercise distress based on decreased level of residual muscle activity as a result of static stretching of the involved muscle. Used prior to exercise static stretching may enhance performance. The latest research has shown that strength developed with exercise on rebound movement can be better enhanced by add - on flexibility training. It is directly caused by reduction in series elastic components stiffness increasing the utilization of elastic strain energy during rebound exercise movement. However, the primary importance of the flexibility is in preventing and reducing the injuries.[5]

Flexibility and agility are two important parameters of fitness for athletes and also for the selection of athletes for any competition. Thus, it is very essential to understand if any relation is present between flexibility and agility to have more beneficial effect on athlete's performance.[4]

Reduction of body fat has been associated with performance improvement in specific sports. Hence, body composition analysis is frequently included in physical fitness assessment. In the era of competitions winning is what being honored; for which the performance counts. The performance depends on many factors but agility, flexibility and its correlation with body mass index (BMI) and skin fold thickness (SFT) is one among that which is not given that much importance. BMI and SFT are very important factors which need to be concentrated more along with other fitness parameters when we look for the performance in a sports event. To our knowledge, there is paucity in literature regarding the relation between flexibility and agility and these parameters relation with SFT and BMI.

MATERIALS AND METHODS

This study was conducted in the Department of Physiology, Jawaharlal Nehru Medical College, Belgaum, between January 2010 and December 2010.

Study Design

Cross-sectional study.

Method of Data Collection

Source of data

In this study, the data were collected from the runners (National and State level players) practicing regularly at district stadium, Belgaum and students of M.B.B.S, AHSC, BDS, and BPT batch enrolled in KLE University.

Sample size

Based on universal sample size, all the runners aged 16-25 years of Belgaum city who were eligible were enrolled at the time of data collection, and available number of players who fit into the inclusion criteria was 31. For comparison, age (16-25 yrs) and sex matched MBBS, AHSC, BDS, and BPT students admitted in KLE University, Belgaum, were enrolled as controls. The selection was done using random number table. Data collection was done from the month of July to December 2010.

Inclusion Criteria

1. All the runners practicing for a minimum period of 2-year and who were in the age group of 16-25 years
2. Age and sex-matched participants/students coming from the same region who have not undergone any sort of athletic training or carrying out regular exercise were selected randomly in comparative group.

Exclusion Criteria

1. Subjects with respiratory, neuromuscular, cardiac, endocrine disorders in study subjects, and comparative group
2. Students from comparative group who were doing regular physical exercise, meditation and undergoing physical training.

A list of runners were obtained from the stadium and the coach information about their practice schedule, number of players, and their availability was taken from the coaches. Permission was obtained from the Assistant Director, District stadium, Belgaum to carry out the intended study on the players. The study was approved by the Ethical and Research Committee of the institution.

After finding the suitability as per selection criteria, the players were selected for the study and briefed about the nature of the study and written informed consent was obtained from them.

Descriptive data of the participant's age, medical history, training schedule regarding number of years of practice, number of days in a week, number of hours per day, etc., were obtained by interviewing the participants.

The sports participants were subdivided into two groups depending on number of years of training. Group A consisted of runners with >2 and ≤3 years of practice and Group B consisted of the senior players with >3 and <10 years of training. All the players participated in the consistent training. On average, practices were held for 4-5 h/day, 6 times per week. Throughout the year, apart from running practices, all participants were involved in additional sessions of strength training and conditioning, speed, and stretching both

pre-season and during the competitive season. Both groups had been exposed to similar training regimens.

Height (cm) was measured by commercial stadiometer to the nearest 0.5 cm. The participant was made to stand erect with bare foot on the floor board of the stadiometer with his or her back to the vertical backboard of the stadiometer. The weight of the participant was evenly distributed on both feet. The heels of the feet are placed together with both heels touching the base of the vertical board. The buttocks, scapulae, and head are positioned in contact with the vertical backboard.

Weight (kg) was recorded by digital scale with an accuracy of +100 g, participant was asked to come in light clothes and barefoot.

BMI was calculated by from height and weight using Quetelet's equation

BMI=Body weight in kg/(height in meters)^2

SFT (mm)

Were measured by Herpenden skinfold calipers (Anand agencies, Pune).

Seven sites were identified; readings were taken on the right side of the body, 1 cm away from thumb and finger perpendicular to skin fold halfway between crest and base of the fold. Pinch was maintained throughout the recording. Waited for 2 s before recording. A mean of two measurements was considered.

- Triceps: Vertical fold, on the posterior midline of the upper arm, halfway between acromion and olecranon process
- Subscapular: Diagonal fold, 1-2 cm below the inferior angle of the scapula
- Midaxillary: Vertical fold, on the midaxillary line at the level of xiphoid process of sternum
- Abdomen: Vertical fold, 2 cm to the right side of the umbilicus
- Suprailiac: Diagonal fold, in line with the natural angle of the iliac crest taken in the anterior axillary line immediately superior to the iliac crest. The skinfold should slope downward and forward at a 45° angle extending toward the pubic symphysis
- Chest: Diagonal fold midway between the anterior fold of axilla and nipple
- Thigh: Vertical fold, on the anterior midline of the thigh, midway between the proximal border of the patella and the inguinal crease. The participant stood with his weight shifted back on the left leg with the right leg forward, knee slightly flexed and foot flat on the floor.[6,7]

Flexibility

Was tested using Sit and Reach flexibility Tester manufactured by Anand agencies, Pune.

This test involved subject sitting on the floor with legs stretched out straight ahead. Shoes were removed and toes pointed upward. The soles of the feet were placed flat against the center limbs of the tester. Both knees were to be locked and pressed flat to the floor - the examiner assisted by holding them down. With the palms facing downward, and the hands on top of each other or side by side, the subject reached forward along the measuring line as far as possible. It was seen to that the push was smooth and static, no bouncing or lunging was allowed. Care was taken that the hands remained at the same level, not one reaching further forward than the other. After some practice, the subject reached out and held at that position for one-two seconds while the distance was recorded.

Scoring - The score was recorded to the nearest centimeter as the distance reached by the hand. The level of the feet was the zero mark on the scale.[6,7]

Agility

Agility was assessed by side step test where we drew lines accordingly as shown in the Figures 1 and 2 on the plane ground.

A center line was drawn on the ground where the test has to be conducted. Two more lines on each side of the center

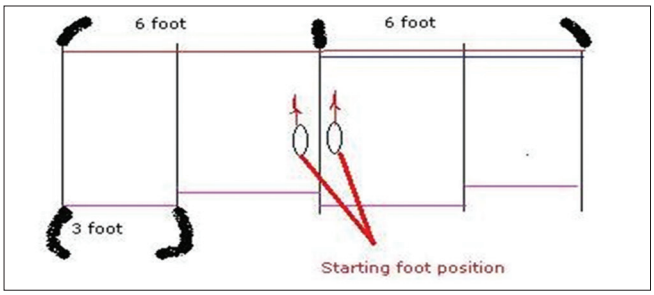

Figure 1: Measurement of side step test marking to be drawn

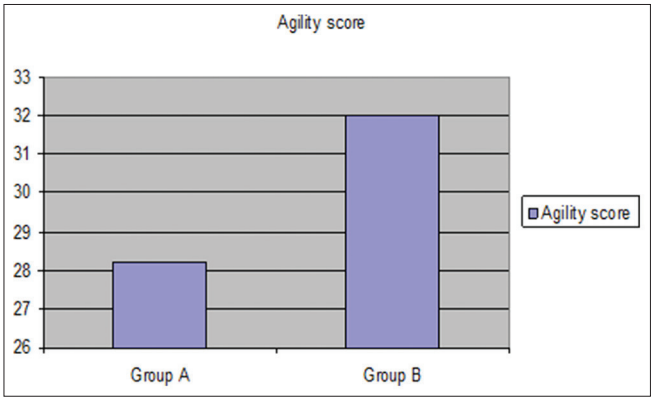

Figure 2: Comparison of agility between two groups of runners

line which were 3 ft and 6 ft apart from the center line were drawn using a measuring tape. To start with from the position on the center line.

- The participant side stepped on the signal went to the right until his foot had reached or touched the outside line to the right
- Participant then side stepped to the left until his left foot had touched or crossed the outside line to the left
- The participant repeated these movements as rapidly as possible for 10 s.

Scoring: One foot tick mark placed between center line and outside line, each trip from center line across marker counts as follows: Moving across right crosses tick (1), outside line to right (2), then back tick (3), center (4), across left tick (5), outside line to left (6), back tick (7), and center (8). One completed cycle gives a score of eight points. A total score within 1 s was taken.[6,7]

A statistical analysis was performed using SPSS 16.0. Mean and standard deviation for agility and flexibility was calculated and the difference between mean of the two groups was tested using unpaired *t*-test, where significance of the $P < 0.05$. Pearson correlation analysis was done for agility, flexibility with SFT and BMI, and is significant at the 0.05 level.

RESULTS

Mean agility and flexibility score measured by side step test and sit and reach test were found to be higher for runners compared to controls and the difference was statistically significant ($P < 0.05$) (Table 1). Mean agility score measured by side step test was found higher for Group B compared to Group A, and the difference was statistically significant ($P < 0.05$). Mean flexibility test score was similar for both groups (Figure 2). No correlation was found between agility and flexibility. There was a negative correlation between flexibility and SFT, BMI; agility and SFT but was not statistically significant.

DISCUSSION

The purpose of the study was to evaluate the effect of agility and flexibility in runners, to correlate between them and with SFT and BMI. In this study, both the groups were tested for agility, runners scored better than controls. This defines the agility of the players, a component enhanced due to training. Flexibility score was very low in controls than runners indicating that the players who are highly flexible have got a wide range of movement. Decrease in flexibility score among controls might be due to their sedentary lifestyle, high-fat percentage. The outcome in this study for flexibility showed increased flexibility for Group B than Group A but the increase was not statistically significant. Whereas, there was statistically significant more flexibility of runners than controls. This difference might be due to the stretching sessions during their training. More efforts should be paid to improve flexibility in the Group A.

Table 1: Comparison of agility and flexibility between runners and controls

Parameters	Runners	Controls	*P* values
Agility score	30.5±3.46	15.4±3.42	0.000*
Flexibility score	13.3±4.86	4.9±2.93	0.000*

**P* value significance <0.05

Agility testing by side step test showed significant increase in agility score in Group B than in Group A. Improved agility by agility training programes have implications in the reduction of ligament injuries during the game.[8] In a study done by Drinkwater among different ball game players and general untrained college students found that the agility of the players was better than the college students. Relay races require fast directional turns during the game for which better agility is very essential.[9] Good flexibility helps in avoiding various leg attacks. The demanding kinetic characteristics of the players requires more muscle power of the lower limbs and increased flexibility for better performance and injury prevention. Flexibility is also highly correlated to the athletes jumping ability and as a result with lower limb strength, and therefore, the reason that flexibility is a factor concluded in most research studies that describe physical condition.[10] In a study done by Amrinder Singh, there was no improvement in agility with training.[1] Another study reported that improvements were a result of enhanced motor unit recruitment patters. Neural adaptation usually occurs when athletes respond or react as a result of improved coordination between the central nervous system signal and proprioceptive feedback.[1]

The results of this study showed no correlation between flexibility and agility, it may be because flexibility is unidirectional activity while agility is a multidirectional performance. Flexibility method used in this study was static, while agility is dynamic activity.[11] None of the studies gives a correlation of agility and flexibility with SFT, BMI; in our study, we could not find any correlation.

CONCLUSION

Improvement in agility and flexibility is seen after giving training reducing the rate of injury and improving the performance. No association was there between agility and flexibility; also agility/flexibility with SFT and BMI. More studies have to be done on agility and flexibility with SFT, BMI to fill the gap.

REFERENCES

1. Singh A, Boyat AV, Sandhu JS. Effect of a 6 week plyometric training program on agility, vertical jump height and peak

torque ratio of Indian Taekwondo players. Sport Exer Med Open J. 2015;1(2):42-6.
2. Homoud MN. Relationships between Illinois agility test and reaction time in male athletes. Swedish J Sci Res. 2015;2(3):28-33.
3. Behm DG, Chaouachi A. A review of the acute effects of static and dynamic stretching on performance. Eur J Appl Physiol. 2011;111(11):2633-51.
4. Thakur D, Motimath B. Flexibility and agility among children and adolescent Athletes: An observational Study. Int J Physiother Res. 2014;2(4):653-6.
5. Dopsaj M. Extent of flexibility among athletes in different sports games – Soccer, volleyball, basketball and handball. Sci J Facta Univ. 1994;1(1):51-60.
6. Johnson B, Johnson BL, Nelson JK. Practical Measurements for Evaluation in physical Education. 3rd ed. New Delhi: Surjeet Publications; 1988.
7. Balady JG, Gibbons RJ, Bricker JT. ACSM'S Guidelines for Exercise Testing and Prescription. 6th ed. Philadelphia, PA: Lippincott, Williams and Wilkins; 2000.
8. Jung AP. The impact of resistance training on distance running performance. Sports Med. 2003;33(7):539-52.
9. Drinkwater DT, Ross WD. Anthropometric fractionation of body mass. In: Ostyn M, Beunen G, Simon J, editors. Kinanthropometry II. Baltimore: University Park Press; 1980. p. 177-89.
10. Young WB, McDowell MH, Scarlett BJ. Specificity of sprint and agility training methods. J Strength Cond Res. 2001;15(7):315-9.
11. Miller MG, Herniman JJ, Ricard MD, Cheatham CC, Michael TJ. The effects of a 6-week plyometric training program on agility. J Sports Sci Med. 2006;5(3):459-65. eCollection 2006.

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