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## Exploration and effect of flexibility training on the change of performance in agility

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### Abstract

It is needless to stress the fact that agility is the most important factor that contributes to successful performance in a broad spectrum of competitive sports. Here, the very purpose of the study was to examine whether there is any causal relationship with agility performance on the degree of functional flexibility. In order to conduct the experiment, 26 male physical education students of Noida College of Physical Education, Dadri, Uttar Pradesh were taken at random to serve as subjects. All the twenty six students were tested before they were once again assigned to two experimental conditions *viz.*, treatment and control conditions. The subjects in the treatment group were trained with five stretching exercises (both ballistic and static types) which were specially designed for the purpose for improving flexibility at trunk and hip. All the subjects of both control and experimental groups were tested for agility before the treatment. 'Right Boomerang Run' test was used to measure the agility as it was the most reliable and valid agility test compared to any other test. 'Sit and reach' test was used to measure the flexibility of the hip and trunk. Each subject was given three trials to do his best. The best trial was used for the analysis. Analysis of Co -Variance (ANCOVA) was used to test the hypothesis. The pre test scores were used as (Covariate) control variable.

**Keywords:** agility, flexibility, stretching exercises, ANCOVA

### Introduction

Over the past several decades, 'agility' appears to have been referred to as almost anything that requires an athlete to quickly change direction multiple times. As a prime example, the T- test, Illinois agility test, arrowhead agility test, and the pro-agility test have all historically been referred to as agility tests, simply because they require an athlete to complete a pre-planned course of directional changes as quickly as possible. However, it is important to understand from hereinafter these tests are not actually a measure of agility, but instead a measure of 'change of direction speed'. Agility is also influenced by body balance, coordination, the position of the center of gravity, as well as running speed and skill. Agility can be improved with agility training drills but also by improving the specific individual fitness elements of speed, balance, power and co-ordination. Agility is one of the main fitness components, important for success in many sports, such as in the team sports of football and hockey, and in individual sports of tennis and squash. A vote of the top sports requiring agility has the sports of soccer, basketball and tennis ranked highest. See also another list ranking sports in which agility is important.

Agility is the ability to change direction quickly and to control body movements, skill requiring rapid movement of the entire body in different directions and in response to unexpected circumstances. In some activities, the ability to stop and start and to change direction accurately and quickly is much more important than in some others. Agility in a general sense is one's ability to quickly adjust to changing environmental conditions. As related to competitive sports and motor movements, agility is defined as "..... the physical ability, which enable an individual to rapidly change body positions and directions in a précised manner" (Johnson and Nelson, 1979). In the context of human motor movements two types of agility *viz.*, specific and general agility are recognized. Specific agility is concerned with movements of body segments (limbs) as in playing on piano or in ball handling. On the contrary, general agility refers to movement of the body as a whole, as in dodging the opponent or marking an opponent in basketball man to man defense.

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The present investigation is concerned with general agility. Agility is the ability to change the direction of the body efficiently and effectively and to achieve this, you require a combination of:

- **Balance**
  - The ability to maintain equilibrium when stationary or moving (i.e., not to fall over) through the coordinated actions of our sensory functions (eyes, ears and the proprioceptive organs in our joints)
  - Static Balance - ability to retain the centre of mass above the base of support in a stationary position
  - Dynamic Balance - the ability to maintain balance with body movement
- **Speed**
  - The ability to move all or part of the body quickly
- **Strength**
  - The ability of a muscle or muscle group to overcome a resistance
- **Coordination**
  - The ability to control the movement of the body in co-operation with the body's sensory functions, e.g., catching a ball (ball, hand and eye coordination)

**Method**

The purpose of the study was to analyses whether flexibility training has any positive influence on the agility performance. The experimental design adopted, the testing procedure and the statistical analysis involved to realize the purpose of the study are explained in the following sections.

**Subject and sampling**

Twenty six adult male B.P. Ed., students of Noida College of Physical Education, Dadri, Uttar Pradesh, randomly selected for the purpose served as subjects of the study. All the twenty six students were tested before they were once again assigned to two experimental conditions viz., treatment and no treatment (control) conditions. Treatment. The subjects in the treatment condition were trained with some specific stretching exercises three times a week on alternate days for four weeks before they were tested finally (post – test). Prior to each training session, the subjects adequately warmed up. All the subjects of control group as well as experimental group were tested before (pre- test) and after the treatment (post – test) for agility performance (dependent / criterion

variable) as well as flexibility. The testing procedure was as described below. For the purpose of measuring performance in agility of the subjects, “Right Boomerang Run” (RBR) test was used. RBR test was selected because of its high validity co- efficient (r = 0.82) using the sum of T – scores for sixteen tests of agility as criterion (Johnson & Nelson, 1979). There were no other tests of agility with validity co efficient as high as that of RBR test. In the RBR test, the time duration is noted for completing run through the stipulated path by changing the direction within the shortest possible time. Time was recorded to the nearest tenth of a second. There was a penalty of one tenth of one second for violating rules. For the purpose of measuring performance inflexibility of the subjects “Modified sit and Reach test “is used. The equipment used for this test is flexo measure case with yardstick and tape.

**Statistical treatment**

Analysis of co-variance (ANCOVA) was used to test the stated hypothesis. Since the primary purpose of this type of analysis to provide an adjustment of post test scores for the difference existing among subjects before the start of the experiment, the pretest scores on agility performance was used as the (Co-Variate) control variable to adjust for chance difference among treatment groups. Campbell and Stanley (1963) have also recommended ANCOVA as more precise and highly desirable in such pre-test post-test control design.

**Results**

The purpose of the study was to see, whether the improvement in flexibility resulting from flexibility training resulted in improvement in agility performance. In order to test the stated hypothesis, the data collected after the treatment conditions (Post-test scores) was subjected to “Analysis of Co-Variance” (ANCOVA) with the test scores collected prior to treatment condition (pre-test scores) as the co Variate or the control variable. The results of statistical analysis and descriptive statistics are presented in the following sections. Presented in Table 1 are the descriptive statistics of pre and post test scores of dependent (agility) and independent (flexibility) variables of control and treatment groups. Also presented in the table are the gain scores from pretest to posttest which were obtained by subtracting pre test scores out of post test scores. The gain scores thus indicate change in scores from pre to posttest situation due to different treatment conditions. Positive gain score in the case of flexibility indicates improvement in flexibility. Since the units of measure for agility is time, the negative gain scores in the case of agility indicates increments in agility performance.

**Table 1:** Mean and Standard Deviations of Agility and Flexibility Pre-test, Post–test and Gain Scores of Control and Flexibility Training Groups

Variables		Control Group			Flexibility Training Group		
		Pre Test	Post Test	Gain Score	Pre Test	Post Test	Gain Score
Agility	$\bar{X}$	14.355	14.465	0.109	14.503	14.317	-0.187
Flexibility	Sd	0.499	0.461	0.473	0.688	0.588	0.285
	$\bar{X}$	11.154	12.923	1.769	8.333	14.667	6.333
	Sd	6.162	6.137	2.315	5.025	5.220	2.693

A cursory examination of the Table 1 indicates that the control group became slower at the post test situation compared to pretest, while the flexibility training group improved in agility. Same trend can be observed in the case of flexibility.

**Table 2:** Summary of Analysis of Covariance of Agility Post test Scores with Pre Test Scores as Co Variate

Source	Sum of Squares	df	Mean Square	F Ratio
Treatment	0.317	1	0.317	2.256 NS
Co – variate	2.651	1	2.651	
Error	2.667	19	0.140	

NS - Not Significant

Evidently, the improvement of performance in agility by the flexibility training group compared to that of the control group was not large enough to be statistically significant. This insignificant result raised doubt whether the flexibility of the experimental group did in fact increase as result of flexibility training. Therefore the flexibility post test scores were also subjected to ANCOVA with its pre test scores as the covariate or control variable. The results of the ANCOVA of flexibility post test scores are summarized in Table 3.

**Table 3:** Summary of Analysis of Covariance of Flexibility Post test Scores with Pre Test Scores as Co-Variate

Source	Sum of Squares	df	Mean Square	F Ratio
Treatment	96.121	1	96.121	15.259*
Co-variate	577.329	1	577.329	
Error	119.684	19	6.299	

The results of the flexibility data analysis indicated that the treatment group did in fact become more flexible compared to control group as a result of flexibility training. Therefore, it was decided to cross check the results of ANCOVA for agility by the analysis of gain score. The ANCOVA of agility gain scores are presented in Table 4.

**Table 4:** Summary of analysis of variance of agility gain scores

Source	Sum of Squares	df	Mean Square	F Ratio
Treatment	0.466	1	0.466	2.789 NS
Error	3.338	20	0.167	

NS – Not Significant

The results of ANOVA of agility gain scores also supported the results of ANCOVA (Table 2). Therefore the Null hypothesis has been accepted and the alternate hypothesis has been rejected. In other words, under the conditions of present investigation improvement flexibility did not significantly influence the performance in agility of physical education students.

## Discussion

The results of the experimental investigation did not establish any causal relationship between flexibility and performance in agility and the stated hypothesis has been rejected. However, the experimental group did improve in agility more than control group though the difference did not reach the desired level of significance.

The analysis of flexibility scores resulted in significant F-ratio showing the experimental group had in fact improved its flexibility significantly. Therefore, it was surprising to observe a result that contradicted the predicted hypothesis. This has raised a suspicion regarding the significant correlation between agility and flexibility.

## Conclusion

Based on the discussion, it was concluded that the experimental investigation has resulted in conclusive evidence that flexibility is not casually related to agility. In other words, the performance in agility is independent of one's level of flexibility. If any correlation is observed between flexibility and agility, it may have been only incidental.

## Recommendation

It was recommended that similar study be undertaken to investigate the dependency of agility on other factors like strength, power, speed in combination or independently.

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