AL-MISBAH
RESEARCH JOURNAL
Recognized in "Y" Category Journal by HEC
ISSN (Online): 2790-8828. ISSN (Print): 2790-881X.

Volume IV, Issue III

Homepage: https://reinci.com/ojs3308/index.php/almisbah/index

Category Y

Link:https://hjrs.hec.gov.pk/index.php?r=site%2Fresult&id=1089437#journal_result

Article: **A comparative analysis of flexibility variables in sport participants and sport non-participants**

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Published: 2024-07-30

Article DOI: https://doi.org/10.5281/zenodo.14626922

Citation: Dr. Javed Ali Soomro, Dr. Sheeraz Ilyas Shaikh, and Muhammad Ismail Wasan. 2024. "A COMPARATIVE ANALYSIS OF FLEXIBILITY VARIABLES IN SPORT PARTICIPANTS AND SPORT NON-PARTICIPANTS". AL MISBAH RESEARCH JOURNAL 4 (03):61-71. https://reinci.com/ojs3308/index.php/almisbah/article/view/291.

Published by Institute of Culture and Ideology, Islamabad.
+92-313-305-2561, +92-300-030-9933
www.almisbah.info

AL-MISBAH RESEARCH JOURNAL
Vol.4, No.3, June-2024
Page no: 61-71

A COMPARATIVE ANALYSIS OF FLEXIBILITY VARIABLES IN SPORT PARTICIPANTS AND SPORT NON-PARTICIPANTS

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ABSTRACT

Flexibility is a key factor in sports such as gymnastics, hurdling, high jumping, and tackling. Flexibility is a requirement for most dance forms. If there are inflexible issues, a muscle's ability to apply force over an extended range of motion can be compromised, leading to leanness or slowness. A decrease in speed during exercise can be caused by tight hamstrings that limit knee lift and stride length. This is an example. There is no uniform flexibleness between joints, and different body parts require varying degrees of flexibility for various sports. Flexibility is the capacity of muscles, ligaments and tendons to allow large movements of joints. Ultimately, it can be called flexible movement. Stretching the muscles and, even to a lesser extent, the tendons and ligaments can result in increased flexibility. After interviewing 150 sports and non-sports participants, the study examined flexibility measurements of 300 male adolescent individuals. The selection of sampling size for different body and flexibility measurements was made using a random sampling method in this study. The results of t-test determining in table.no.5 that mean Sit and Reach (front side) flexibility (cm) of participants who participate in sports and those not in athletics do not differ significantly. At a degree of freedom of 298, the probability value is lower than the specified level of significance (0.05), other variables' results are described in results portion. According to the statistical tool, the all-flexibility measurements are not consistent for both participants and non-participants of the sport. Those who participate in sport have higher levels of flexibility for sitting and reaching, shoulder hyperextension, trunk hyper flexibility, and bend twists and touches compared to non-participating individuals. Variability is high among the variables of participants and non-participants' flexibility.

Keywords: Flexibility, comparison, participants and non-participants, t-test

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1. Introduction

Flexibility is the capacity of muscles, ligaments and tendons to allow large movements of joints. Flexibility or mobility is another term used to describe it. The muscles, even to a lesser extent, the tendons and ligaments can be stretched which increases their flexibility. Flexibility is a key factor in sports such as gymnastics, hurdling, high jumping, and tackling. Flexibility is a requirement for most dance forms. If flexibility issues arise, a muscle's ability to exert force across a full range of motion may be impaired, resulting in reduced efficiency or slower movement. A decrease in speed during exercise can be caused by tight hamstrings that limit knee lift and stride length. This is an example. Flexibility differs across joints, with various body parts requiring specific levels of flexibility for different sports.

The flexibility of the associated muscles determines their potential range of motion at the joint. Flexibility measurement is a method used to assess various body parts through different positions and movements, encompassing both static and dynamic states of the human body. This study focuses on specific measurements, including sit and reach, shoulder hyperextension, trunk hyper flexibility, and bend-and-touch flexibility, excluding many other flexibility assessments.

Flexibility in health-related fitness component is diagnosed as one of the essential components that is important for a fit lifestyle and in addition it is a basic element in sports-related performance.[1] Flexibility has remarkable importance in various sports as an example football wherein players with worse flexibility may face the consequences in deficits in some ranges of movement that limit their unique technical competencies and decrease players performance.[2,3] In sports activities this has been mentioned via diverse research that flexibility of the body is laid low with gender, and tactical position.[4]

Enlargement at one side of body [5] and level of competition.[6] In previous studies, it's been noticed that the tendency in direction of lower flexibility when it comes to age is associated with non-playing sports participants.[7] It has also been noted that flexibility decreases with age [8] and tendon stiffening, joint capsule modifications, or muscle modifications can be the major cause for the age-related decrease in flexibility.[9] Growth of muscle and bone plays a vital function in force development, musculoskeletal

ISSN-Online: 2790-8828
ISSN-Print: 2790-881X

loading, and motor control during childhood and adolescence. Reduction in muscular flexibility (i.e., hamstring) and muscular strength can happen due to differential bone growth (i.e., femur) in relation to the length of muscle.[10] During adolescence period, flexibility has been an essential element in performing particular skills such as, sprinting, jumping etc., in growing younger sports participants.[2]

Static (Active) Flexibility

It entails the aptitude to shift the joint over a broad angle, such as during the split process. "Static flexibility" and "dynamic flexibility" refer, respectively, to the range of motion at a joint and the forces that resist movement throughout the joint's range of motion.

Dynamic (Active) Flexibility

This refers to the ability to move swiftly and freely across the full range of motion of both the joint and muscle. Take for instance, the practice of pitching a football or playing hurling an object in baseball without any strain on the hip and hamstrings.

Ding et al. (2020)[11] conducted a research in the field of sports science and collected data from more than 3000 male and female undergraduates who were enrolling in the Four-year Bachelor degree program. Researchers employed the random-intercept panel model (RIPM) to analyze variations in BMI, explosive power, flexibility, and cardiorespiratory endurance across different individuals. A correlation was found between the weight ranges of obese or overweight individuals and those of normal weight, both within the same person and between different individuals of various physiques. Results indicate choosing a physical fitness test for assessment was not associated with any negative associations with BMI values, regardless of gender. The results of this study also revealed a positive correlation between BMI and flexibility, as well as between flexibility and body mass index in both genders. Both male as well as female participants showed positive relationship between their levels of flexibility, explosive power, and cardiorespiratory endurance.[11]

In another cross-sectional study involving 14,880 participants from Peninsular Malaysia, the relationship between physical fitness levels in urban and rural schoolchildren was examined, along with the correlation between body mass index and physical health status. In addition to this, the selection of anthropometric measurements, including total body weight measured after breakfast, the vertical height measured in a standing position

with bare feet (from the bottom of the feet to the top of the head in centimeters), along with the use of power and flexibility tests, was conducted for fitness purposes. The flexibility of schoolchildren may be influenced by the environment or region where they live and study. This research found that school children's flexibility is influenced by their area where they live-in and belong, with urban schooling showing slightly better results than rural schooling. Despite the strong negative correlation between power and body mass index, there is no significant variation in power across school areas or any association between flexibility and fitness.

Bosnia and Herzegovina football players were subjected to research work in 2018, which involved assessing their body composition norms using 10 variables, including human Body height and body mass index (BMI), as well as muscle mass/west waist size and muscle fold (fat %) as determined by skinfold. According to the study, there is a significant difference between football players from the two mentioned clubs regarding the three variables that measure their waist size, skinfold, and biceps.[12]

Kwieciński, et al. (2018)[13] conducted a study involving Polish adolescents found that individuals with obesity exhibit higher levels of flexibility compared to those with a normal body mass index. Results of the study indicate that normal-weight boys performed better than thin as well as overweight or obese boys in sprinting, long jump, and shuttle run. Whereas, normal-weight and thin boys outperformed obese boys in sit-ups and the distance run. However, normal-weight girls excelled in sit-ups, jumping, distance run, and shuttle run compared to thin and overweight/obese girls, and were faster in the sprint than overweight/obese girls. The analysis revealed significant non-linear relationships between BMI and fitness performance for boys and some fitness measures for girls.

A research study on correlation among flexibility, length of hamstring muscle and strength was conducted The goal of this investigation was to find the links among back thigh compartment muscle (hamstring muscle), optimum lengths, flexibility, and strength.[14] In this regard, 11 male and 10 female recreational athletes' data on hamstring flexibility and isokinetic strength, as well as three-dimensional (3D) kinematic data for hamstring isokinetic tests, was collected. It was exposed before that what is the ideal lengths of hamstring muscles

ISSN-Online: 2790-8828
ISSN-Print: 2790-881X

to be related to hamstring flexibility and sex, but not to hamstring strength. It must be considered that at its ideal length the longer the hamstring muscle is, the superior the flexibility range is achieved. Furthermore, it was also noticed that males have greater hamstring as compared to female optimum muscle lengths with the same flexibility results. It was accomplished that there was no connection among flexibility and posterior thigh compartment hamstring strength. The ideal lengths of the comparable hamstring muscle lengths in standing were shorter than the comparable the posterior compartment of thigh muscles (hamstring) but were not substantially associated. Final the finding and results were concluded on the point that Hamstring muscle maximal strain in movements may be influenced by hamstring flexibility. Despite identical hamstring flexibility, the maximum tension on the hamstring muscle in a given action may differ between sexes. In musculoskeletal system modeling, when calculating hamstring muscle strain, the hamstring muscle lengths in standing should not be used as an approximation of their ideal lengths.

A study conducted on 21-year-old male tennis players from Jordan found that body composition and physical measurements were positively associated with performance level. Participants were given body measurements, which included their weight, height, arm lengths, body mass index, hemisphere thickness, and arm circumference. They also assessed their physical attributes such as strength, flexibility, set ups (including stretch), leg muscles, fitness test (T), and Vo2 max. This was done using data from all subjects. The results were mixed. According to Al-Haliq (2013)[15], the body and physical dimensions were found to have a greater impact on skill performance when assessed with statistical significance. A sport is a vast area for research. Dynamic flexibility and muscular endurance were tested by a researcher who conducted the study on basketball and volleyball players. A significant difference in dynamic flexibility and muscular endurance was seen between basketball and volleyball players.[16]

2. Materials and methodology

This paper aims to assess flexibility and, ultimately, compare the flexibility measurements between adolescent male sports participants and non-sports participants from the Hyderabad district.

Study Design.

ISSN-Online: 2790-8828
ISSN-Print: 2790-881X

In a quantitative comparative study, the relationship between flexibility and anthropometric measurements was assessed in male adolescents who participated in sports but not in non-sports activities across youth age from 12-19 years.

Sample Size and sampling technique.

Following the survey of 300 male adolescent participants, including 150 sports and non-sports participants. A demographic and physical activity readiness questionnaire (PAR-Q+) was also provided. In this study, random sampling was employed to determine the appropriate sampling size for different body and flexibility measurements.

Sit and Reach Flexibility Test.

This examination aims to assess the extent of trunk extension and the capacity to contract lower back muscles and stretch hamstrings. The test could not be initiated until the participants had adequately warmed up. Place your feet on the floor and press down on top of the ruler's front panel. Keep your knees straight and make contact with the posterior part of lower limbs without bending them. Additionally, stretch out your torso by as much forward as possible. Hold the position for 3 seconds when you can't stretch anymore? The participants were given three attempts with a sufficient recovery period, and the best attempt was recorded. The distance before the edge (toes cannot be touched) is measured in negatives, and passes that go beyond this limit are calculated as pass scores.

Table No. 1: Norms of Sit and Reach Flexibility

Ratings	Score
Excellent	17 to 27
Good	6 to 16
Average	0 to 5
Satisfactory	-1 to -8
Poor	-9 to -19

Source: Flexibility 2000 Normative values for body flexibility

Shoulder Hyperextension Flexibility

The measurement of chest and shoulder hyperextension involved measuring their long-range movements. A group of individuals sat on the floor with their arms straight, gripped a stick shoulder-width apart, held up their hands for 3 seconds while keeping their chin down, and measured its height above the ground.

ISSN-Online: 2790-8828
ISSN-Print: 2790-881X

Table No.2: Norms of Shoulder Hyperextension Flexibility

Rating	Score (cm)
Excellent	≥32
Good	30 – 32
Average	21 – 29
Satisfactory	16 – 21
Poor	≤ 15

Source: Flexibility 2000 Normative values for body flexibility

Trunk Hyperextension Flexibility

To evaluate the flexibility of the anterior trunk, trunk hyperextension was measured. The challenge involved individuals lying on the ground while a partner held them down and supported them with their knees, holding their buttocks and legs, and touching the floor from the chin to the surface.

Table No.3: Norms of Trunk Hyperextension Flexibility

Ratings	Score
Excellent	≥ 38
Good	30 – 37
Average	22 – 29
Satisfactory	14 – 21
Poor	≤ 13

Source: Flexibility 2000 Normative values for body flexibility

Bend Twist and Touch Flexibility

To demonstrate dynamic flexibility, one must perform a set number of rotational movements on both the left and right side within 20 seconds. The bend twist and touch test is also known as the dynamic flexible test. All contestants are given the opportunity to stand before a line that is 0.5m away from the wall. After a whistle is played, the participant should hold on to the floor while touching the ground with both hands. Then, they must return to their standing position and rotate their bodies in order to touch the wall behind them. In as little time as possible, all participants repeated this in 20 seconds.

Table No.4: Norms of Bend Twist and Touch Flexibility

Rating	Score
Excellent	19 +
Good	18
Average	17
Satisfactory	15 – 16
Poor	≤ 14

Source: Flexibility 2000 Normative values for body flexibility

Statistical Data Analysis

In this research study, SPSS version 26.0 was utilized to conduct various statistical analyses, enabling the evaluation of the data collected on flexibility variables. The software provided the necessary tools for data processing, ensuring accurate and reliable results. To compare the flexibility measurements between different groups, t-tests were employed. This statistical method was used to determine whether there were significant differences in flexibility between the groups, allowing for a robust analysis of how factors such as sports participation might influence flexibility in adolescent males. The use of t-testing helped identify any statistically significant variations in flexibility, contributing to the study's overall conclusions.

3. Results

Table No.5: Comparison of Sit and reach (front side) flexibility (cm) between participants and non-participants

T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
8.796	298	.000	8.560	.973	10.475	6.645
-8.796	286.7	.000	8.560	.973	10.475	6.645

The results of t-test determining in table.no.5 that mean Sit and Reach (front side) flexibility (cm) of participants who participate in sports and those not in athletics do not differ significantly. At a degree of freedom of 298, the probability value is lower than the specified level of significance (0.05).

Table No.6: Comparison of Shoulder Hyper Extension Flexibility (cm) between sports participants and non-sports participants

t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
-7.107	298	.000	-8.593	1.209	-10.973	6.214
-7.107	242.8	.000	-8.593	1.209	-10.975	6.212

Table No.6: shows the findings of a t-test that indicates that the mean shoulder hyper extension Flexibility (cm) of sports participants and non-sports participants is not identical. The probability value is less than the degree of significance (0.05) at a degree of freedom (298).

ISSN-Online: 2790-8828
ISSN-Print: 2790-881X

Table No.7: Comparison of Trunk Hyper Extension Flexibility (cm) between sports participants and non-sports participants

t-test for Equality of Means						
T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
-4.514	298	.000	-4.307	.954	-6.184	-2.429
-4.514	297	.000	-4.307	.954	-6.184	-2.429

The results of t-test described in table.no.7 that mean Trunk Hyper Extension Flexibility (cm) of participants who participate in sports and those not in athletics do not differ significantly. The probability value at a degree of freedom 298 is below the specified level of significance (0.05).

Table No.8: Comparison of Bend twist and touch dynamic flexibility (seconds) between sports participants and non-sports participants

t-test for Equality of Means						
T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
14.386	298	.000	-3.747	.260	-4.259	-3.234
-14.386	297.6	.000	-3.747	.260	-4.259	-3.234

Table no 8 revealed that the Bend twist and touch dynamic flexibility measures of sports participants differed from those of non-sports participants, as indicated by t-test results. The probability value is less than the degree of significance (0.05) at a degree of freedom (298).

4. Conclusion

As per the statistical tool's findings, the all-flexibility measurements are not consistent for both participants and non-participating individuals in sports. Sport participants exhibit greater levels of flexibility in activities such as sitting and reaching, shoulder hyperextension, trunk hyper flexibility, and bend twists and touches compared to non-sports participants. The good amount of variability is found in the variables of flexibility of participants and non-participants.

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