Cross sectional study

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Variability in Flexibility of Dominant and Non-Dominant Shoulder Joints among Healthy Young Adults

Jyoti S. Jeevannavar[1], Purohit Sneha Jalamsingh[2], Nidhi Misalankar[2], Kacha Priyanka Rajesh[2]

[1]Professor, S.D.M. College of Physiotherapy, S.D.M. University, Dharwad, Karnataka, India, [2]Interns, S.D.M. College of Physiotherapy, S.D.M. University, Dharwad, Karnataka, India.

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Abstract

Background: The shoulder joint comprises of a large humerus head and smaller glenoid fossa. It is an incongruous ball and socket type of joint. The joint has sacrificed its articular congruency for more range of motion. The dominant upper limb is involved in activities of daily living (ADLs) such as self-grooming, eating, lifting objects etc. Range of motion of the shoulder may be influenced by various factors and also dominance.

Objective: The study aims to identify variation in flexibility of the shoulder joint in dominant and non-dominant upper limbs and to identify the various factors influencing it.

Method: This cross-sectional study included young healthy adults of either gender between the age group of 18-26 yrs. Participants with history of shoulder injuries, dislocations, generalised hypermobility were excluded from participation. The total sample size was 169 with 37 males and 132 females. The participants performed Apley's scratch test for flexibility measurement bilaterally for both dominant and non-dominant shoulder.

Result: The total number of sample size was 169 out of which 37 were males and 132 were females. Data from 169 participants (165 right-hand dominant and 4 left-hand dominant) was analysed, and it was discovered that the dominant shoulder showed more flexibility than the non-dominant side. There was no gender difference in shoulder flexibility. It showed that the age was inversely proportional to flexibility of the shoulder joint. BMI shows to have a negative influence on the joint flexibility.

Discussion: This study showed the dominant side shoulder to have more positive values according to the Apley's scratch test compared to the non-dominant side. The flexibility values showed negative correlation with BMI.

Conclusion: Flexibility in the dominant shoulder joint is more compared to the non-dominant joint. BMI influences the flexibility of the joint. The shoulder flexibility decreases with age. Gender doesn't seem to have significant variation in the shoulder joint flexibility.

Key words: Shoulder joint; Flexibility; BMI; Age; Hand dominance; Gender.

Corresponding Author: Nidhi Misalankar, Intern, S.D.M. College of Physiotherapy, S.D.M. University, Dharwad, Karnataka. India.

Email ID: nidhimislankar20@gmail.com

Contact No: 7022124205

Introduction:

The shoulder joint comprises of a large head of the humerus and a smaller glenoid fossa.[1] It is an incongruous, ball and socket triaxial type of joint, which enables great mobility of the upper extremity, allowing us to move the hand within a sphere of movement. It has three rotatory and three translatory degrees of freedom.[2]

Both static and dynamic restraints provide joint stability. Static stability is provided by the capsule, ligaments, glenoid labrum and the joint morphology. Dynamic stability reinforces the static restraints, which include tendons of the rotator cuff and muscle contractions.[2]

The joint has sacrificed articular congruency to increase the mobility of the upper extremity and thus is susceptible to degenerative changes, instability, and derangement.[1]

Flexibility is a physiological characteristic that allows an individual to execute the voluntary movement of maximum joint angular amplitude within morphological limits, free of pain and restrictions which is closely associated with muscle extensibility, range of motion, and plasticity of ligament and tendons.[3]

Limited flexibility of the shoulder affects activities of daily living such as self-grooming (brushing teeth, combing hair, washing face), eating, difficulty in lifting object above shoulder level, and limited ability to perform repetitive activities.[2]

Objective

To identify variation in shoulder flexibility between dominant and non-dominant shoulder joints among healthy individuals between the age group 18 to 26 years.

Methodology

Ethical clearance was obtained for the study from Institutional Ethical Committee. This cross-sectional study was conducted among 242 university students present on the day of data collection. 169 students were included and 73 students were excluded due to various reasons. Participants of this study were normal healthy adults aged between 18 to 26 years of either gender. Initially, the demographic data i.e., name, age, gender, and dominance were documented. Thereafter, subjects were assessed for shoulder joint flexibility in both dominant and non-dominant upper limbs by using the Apley's scratch test (Shoulder reach flexibility test)

Inclusion Criteria - Normal healthy adults aged between 18 to 26 years of either gender were included in the study.

Exclusion Criteria - Participants with any shoulder injury, history of recurrent shoulder subluxation, general laxity, hypermobility of joints, chronic and acute shoulder pain, or any musculoskeletal or neuromusculoskeletal conditions which may interfere with the performance of the test were excluded from participation.

Testing Procedure:

Appropriate loose clothing was ensured that does not restrict movement. The test was performed in standing position. Placing one hand behind the head and back over the shoulder, and reaching as far as possible down the middle of the back, the palm touching the body and the fingers directed downwards. The other arm was placed behind the back, palm facing outward, and fingers upward and attempting to touch or overlap the middle fingers of both hands. If the finger tips touch, then the score was taken as zero. If they did not touch then, the distance between the fingertips was measured (as a negative score), if they overlapped it was measured by how much distance (as a positive score).[3]

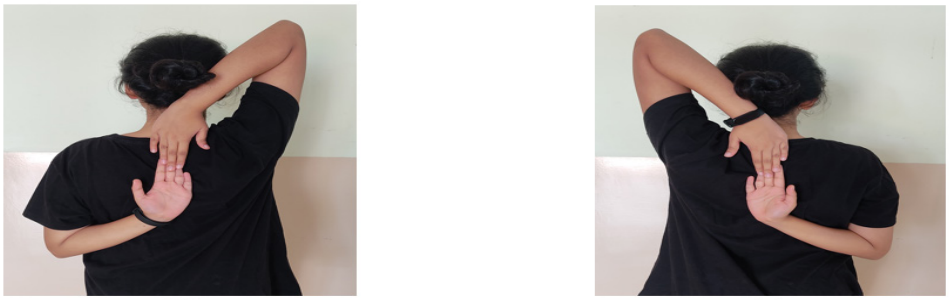

Figure 1: Performance of the Apley's back scratch test a) Right side b) Left side

Result

The data to identify variation of shoulder flexibility among dominant and non-dominant upper limbs was collected from 169 young adults and was subjected to analyses using Statistical Package for the Social Sciences (SPSS) version 20.0.

As the Kolmogorov Smirnov test showed that the data collected was not normally distributed it was subjected to nonparametric tests like Mann Whitney U test, Kruskal Wallis test and Spearman's correlation.

The 169 participants consisted of 37 (22%) males and 132 (78%) females with a mean age of 21.3 (±2.4) and 21.8 (±2.0) respectively. Ages of the female and male participants were not significantly different with a z-score of 1.82 and *p*-value of 0.067.

Age shows to have a negative correlation with shoulder flexibility in both dominant and non-dominant upper limbs, according to Spearman's rho. It gave r s=-0.2 and p =0.002 for dominant side while r s=-0.2 and p= 0.001 for the non-dominant side. Although the correlation was technically weak it was statistically significant for the given sample.

165 (98%) participants in the study were right-hand dominant while 4 (2%) were left-hand dominant.

The mean flexibility of the dominant shoulder among the female participants was 2.3(±4.3) while in male participants was 2.4(±4.7) which was statistically not significant with a U-value of 2385.5, z-score of -0.2129 and *p*-value of 0.8.

The mean flexibility of the non-dominant shoulder among the female participants was -1.4 while in male participants it was -1.2 which was statistically not significant with a U-value of 2263, z-score of -0.67 and p-value of 0.5.

The result is not significant at $p < 0.05$. Thus, according to the data analysis gender did not seem to influence the shoulder flexibility.

However, the difference in the flexibility of Male participant's dominant and non-dominant upper limb showed a U score of 499.5 with a z-score of 1.99 and p-value of 0.046.

Similarly, the difference in the flexibility of Female participant's dominant and non-dominant upper limbs showed a U score of 5515.5 with a z-score of 5.15 and p-value of < 0.00001.

The variation in the flexibility of dominant and non-dominant shoulder including both the genders gave a U value of 9371 and z score of 5.5 at a p-value of <0.00001.

Frequency distribution of participants according to BMI into underweight [23(13%)], normal [109(64%)], overweight [28(16%)] and obese [7(4%)] with a mean flexibility of 2.3(±6) and -2.3(±8); 2.8(±4) and -0.4(±6); 0.2(±4) and -4.5(±7); 1.1(±5) and -4.3(±9) respectively on dominant and non-dominant sides; showed a significant variation between the four BMI classes with a p-value of 0.003 when subjected to Kruskal Wallis rank sum test for multiple independent samples. The p-value was below the respectable critical threshold of 0.05 so post-hoc pairwise multiple comparison tests were conducted to discern which of the pairs had significant differences. Conover test suggests that there is a significant difference between overweight and normal weight.

Table 1: Post hoc analysis for Kruskal Wallis test

	Normal Weight	Obesity	Overweight
Obesity	1.00000		
Overweight	0.00097*	0.4	
Underweight	1.00000	1.0000	0.15

*p≤0.05 was statistically significant

Thus, it can be inferred that BMI seems to affect the shoulder flexibility with significant variation among normal weight and overweight participants.

Discussion

This study intended to identify any variations in the flexibility of the dominant and non-dominant shoulder joints of normal young adults. The number of young adults included after screening for inclusion and exclusion criteria was 169. The mean age of both male and female participants was not significantly different. However, it was observed that as age increased the shoulder flexibility decreased. This result is supported by other articles which also report similarly.[5,7]

Gender did not influence the shoulder flexibility as reported by another study.[7]

It was found that the shoulder joint of the dominant arm has more flexibility than the non-dominant arm. This result is in concurrence with other studies.[3,8] This could be possible due to repeated involvement of the dominant limb in activities of daily living (ADL's) such as self-grooming activities like combing, putting on shirt, buttoning of shirt; eating and lifting objects.

Participants with greater BMI had lower shoulder flexibility. This result is in coherence with another article which also reports that individuals with higher BMI have lower shoulder joint flexibility.[3] Other articles also suggest that BMI negatively corelates with shoulder joint flexibility.[4,6,9,10]

This could be attributed to the fact that high BMI is usually seen in people with sedentary lifestyle, leading to stiff joints and tight muscles without regular movement. Inactivity can lead to chemical changes in connective tissue of joints, thus restricting the flexibility.

Conclusion

The study concludes that flexibility in the shoulder is influenced by age, BMI and dominance. The flexibility is greater in the dominant shoulder joint, which needs to be taken into consideration during measurement of outcome measures while delivering rehabilitation services.

Ethical Clearance: Ethical Clearance was obtained from the Institutional Ethical Committee.

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