Effect of Sitting Postures on the Shoulder Range of Motion

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Highlights:

- Effect of Upright Sitting (US) and Slouch Sitting (SS) postures on shoulder Range of Motion (ROM) was evaluated.
- ROM during flexion (Flex), extension (Ext) and abduction (Abd) was measured in 135 young healthy individuals.
- US and SS postures can affect the shoulder ROM in different planes.

Abstract:

The human shoulder joint is one of the most mobile joint of the body and requires uninterrupted scapulohumeral rhythm for normal Range of Motion (ROM). Body posture has been shown to influence scapular position and thus can affect overall shoulder function.

Objective:

To study the effect of US and SS postures on the shoulder ROM during Flex, Ext, and Abd.

Methodology:

This cross-sectional study included 135 young healthy adults, 100 males and 35 females (aged 18–30 years). The shoulder ROM during Flex, Ext, and Abd was measured three times each using a standard 12-inch plastic goniometer during upright and slouch sitting test conditions.

Results:

The Ext-ROM values during both US and SS posture for males were significantly higher than that for females ($p<0.0001$). In both males and females, the Flex-ROM values during upright sitting were significantly higher than SS test conditions and Ext-ROM values were found significantly higher during SS than US test conditions ($p<0.0001$). No effect of the studied sitting conditions was found on the ROM of shoulder Abd.

Conclusions:

The US and SS postures can affect the shoulder ROM in different planes. Clinical protocols for the assessment, treatment and management of shoulder joint pain and dysfunction can be improved by including these findings.

Key words:

Sitting posture, shoulder, range of motion, Flexion, Extension, Abduction

Introduction:

Shoulder is not one joint but infact, a joint complex consisting of the humerus, scapula and clavicle bones, with articulations at the glenohumeral, acromioclavicular, sternoclavicular and thoracoscapular joints.[1,2] The close relationship between scapular and glenohumeral movements during humeral elevation, termed 'scapulohumeral rhythm' has previously been reported. It has been found that there is approximately one degree of scapular rotation for every 2 degrees of humeral elevation.[2] However, the scapulohumeral rhythm varies during the shoulder ROM, as there is larger relative humeral movement than scapula in the initial phase of humeral elevation than in the final phase. The intricacy between the scapula and the humerus of the movement control of the shoulder complex is reflected by the fact that some 17 groups of muscles participate directly or indirectly during its movements.[3] Thus, any factors such as pain or mechanical stress to the muscles attached to the shoulder complex, can affect the normal scapulohumeral rhythm, resulting in changes of the shoulder ROMs.[4] It is previously reported that body posture can influence scapular position and movements and thus, can affect the overall function of the shoulder complex.[2,3,5,6] The relationship between spinal posture, scapular position and shoulder complex function can be due to the direct effect of the changes in muscle lengths, leading to altered biomechanical role of various muscles connecting the spine, scapula, clavicle or humerus and thus, can also affect the normal proprioception function.[7] It is reasonable to speculate that these factors can compromise the scapulohumeral rhythm, leading to changes in the ROM of shoulder. It has been shown that increased thoracic flexion or kyphosis alters the scapulohumeral relationship, which may lead to shoulder complex muscle weakness, decreased shoulder complex ROM and shoulder impingement pathology. Although the influence of body posture on the shoulder ROM is reported in the literature, but there is a lack of systematic and detailed study on this topic. Thus, in order to improve the quality of assessment, treatment and management techniques for shoulder conditions, there is a need to further examine the effects of body posture on the shoulder ROM. The purpose of the present study was to assess the effect of upright and slouch sitting postures on the shoulder ROM during flexion, extension and abduction of shoulder in asymptomatic young male and female adults. It is hypothesized that participants would achieve more ROM for flexion, extension and abduction of shoulder during US than SS posture, as the SS posture seems to restrict the scapular motion more than the US posture.

Methodology:

It is a cross-sectional study involving one hundred and thirty five healthy adults aged between 18 and 30 years. Participants with previous history of any movement limiting neuro-musculoskeletal condition, inflammatory disease, injury or pain in the upper extremities, trunk and head-neck region were excluded from the study. The purpose of the study was explained to all the participants, who gave their informed consent for participation in the study. The study fully complied with the ethical standards for human research of institutional review board. This study was conducted in a University Medical Center King Saud University Riyadh Saudi Arabia. The independent variables were SS and US postures while dependent variables were shoulder Flex, Ext and Abd, ROM. Before actual measurements of shoulder ROM, data on age, height, weight, and arm dominance was collected, and each participant was asked to do standardized warm-up exercises of shoulder of dominant arm, consisting of 3 repetitions each of Flex, Ext, Abd and scapular retraction movements. Following the warm-up movements, participants were asked to sit on a plinth of adjustable height with their feet on ground with knees at about 90°, arm hanging by the side in neutrally rotated position with palm of the hand facing medially. Their shoulder ROMs were measured using a standard 12-inch plastic goniometer during Flex, Ext and Abd of the dominant arm during SS and US posture. During SS, end range cervical protraction and thoracic flex was achieved, while during US, neutral erect posture (maintaining lumbar lordosis) was aimed using standard verbal instructions and help from the examiner.[8-11] During both conditions care was taken to prevent any anterior translation of head.[12,13] All the values were measured three times by the same examiner and their means were calculated for data analyses. Goniometric measurements (in degrees) were recorded using a universal goniometer as described by Norkins & White.[14] After positioning the participants as described above, its fulcrum was placed one inch below the acromion process, movable arm aligned with the glenohumeral joint axis passing through the middle of glenoid fossa and lateral epicondyle of the humerus, and stationary arm parallel to trunk in vertical line passing in coronal (Flex, Ext) and sagittal plane (Abd).[15] The goniometer dial was covered with a piece of tape to avoid examiner's bias during ROM recording. After each ROM measurement, the reading of degrees on the goniometer was noted from the reverse side. In order to minimize the error in repositioning the goniometer arms and fulcrum during the measurement of ROM during the three repetitions, the position of arms and fulcrum of goniometer was marked on the body with a felt marker for the recordings of Flex, Ext and Abd ROM, respectively. The mean value of three trials for each ROM was used for statistical analysis. Minimum of two minutes rest was given between each attempt and each test condition. The mean and standard deviation (SD) were used for descriptive statistics. The differences between male and female mean values for different test conditions were compared with nonparametric ANOVA (Kruskal-Wallis Test). The differences between the mean values for different test conditions for each gender were compared with nonparametric Willcoxon-signed ranked test. The null hypothesis was rejected at the 0.05 level of significance. The software package InStat 3 (GraphPad Software Inc., USA) was used for all statistical analyses.

Results:

One hundred and thirty-five healthy adults, including 100 males (mean age 23±2.8 years) and 35 females (mean age 21±2.0 years) participated in this study (Table 1). Mean, ROM during SS and US postures during Flex, Ext and Abd movements among male and female participants The ROM values during SS-Ext and US-Ext for males were significantly higher than the corresponding values for females ($p < .100$) However, no significant differences between males and females were found for SS-Flex, US-Flex, SS-Abd and US-Abd test condition is shown in (Table 2). The ROM values during US-Flex were significantly higher than SS-Flex test condition, ($p < .001$) while during extension, the ROM values during SS-Ext were significantly higher than US-Ext test condition for the males ($p < .001$) and females ($p < .001$) (Table 2) However, during shoulder abduction no significant difference between SS-Abd and US-Abd test conditions was found (Figure 1 and 2).

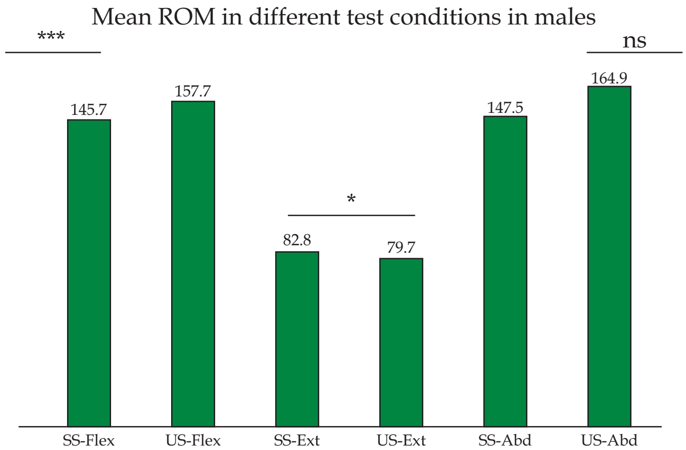
Gender	Age (y)	Height (cm)	Weight (cm)
Males (n=100)	23.3 ± 2.8	173.2 ± 6.5	74 ± 10.2
Females (n=35)	21.4 ± 2.0	159.1 ± 6.7	62 ± 11.5

Table 1: Demographics of Mean and standard deviation of age, height and weight of participant

Condition	Males	Females	Significance
SS-Flexion	145.7±12.9	138.5±22.2	ns
SS-Extension	82.8±11.6	66.9±15.2	***
SS-Abduction	147.5±23.2	141.4±23.7	ns
US-Flexion	157.7±15.5	151.3±22.6	ns
US-Extension	79.7±15.0	60.1±18.0	***
US- Abduction	164.9±12.9	154.9±22.2	ns

Table 2: Demographics of Ranges in Males and Femaled

*** = p < .0001, ** = p < .001, ns= non-significant



*** = p < .0001, ** = p < .001, ns= non-significant

Figure 1: Graphical Representation of Mean range of motion during different test conditions and their statistical comparison in males

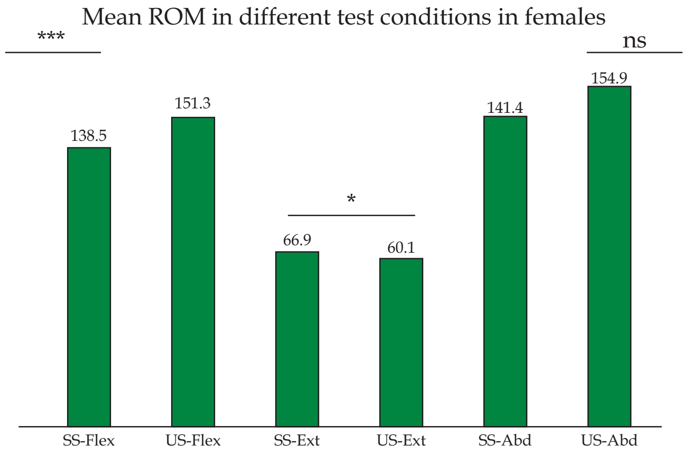


Figure 1: Graphical Representation of Mean range of motion during different test conditions and their statistical comparison in males

Figure 2: Graphical Representation of Mean range of motion during different test conditions and their statistical comparison in females

Discussion:

The main findings of the present work were that for both male and female participants, the Flex-ROM values during US were significantly higher than slouch sitting, while higher Ext-ROM values were found during SS than US. Previous studies on shoulder ROM with respect to gender have varied results. Some studies had reported that shoulder ROM values in females are significantly larger than males.[16-19] In a review of studies on ROM of different joints including shoulder, it was reported that ROM exceed in females as compared to those of males,[20] whereas other studies have reported no differences in shoulder ROM between genders.[21] The present results are in agreement with these findings of Murray *et al*., 1985,[21] but it is found that shoulder Ext-ROM values for males were significantly higher than the corresponding values for females during both sitting posture. (p<0.0001) In fact, to our knowledge, shoulder Ext-ROM with respect to gender has not been previously reported. In contrast to general perception that females are more flexible and have larger ROM of different joints, it is interesting to note that our male participants showed larger shoulder Ext-ROM values than females. This result of limited Ext-ROM in females might be due to anatomical differences in females in presence of breast tissue, causing biomechanical alterations in the pectoral muscles limiting the shoulder Ext-ROM in females, both during US or SS postures. This finding can be of value in clinical setting for treatment of limited shoulder Ext-ROM with respect to gender. It has been shown that hand grip strength is higher during SS compared to US which could be due to relative biomechanical stability of the shoulder girdle due to rounding of shoulders leading to relative fixed position of the scapula that can also provide motor control advantage.[9] These results show that a SS posture was associated with decreased shoulder ROM during flexion and abduction in both male and female participants. Many previous studies have found an association between reduced ROM in shoulder joint, limitations of activities of daily living and increased disability.[22-24] Present results suggest that by avoiding SS posture and adopting US, patients with shoulder ROM limitations, can overcome functional limitation to a certain extent. The reduction in shoulder Flex-ROM during SS may be either due to direct influence on the position of scapulae following an increase in thoracic kyphosis or maybe due to the thoracic spine's inherent contribution to upper quadrant elevation.[25] An increase in thoracic kyphosis can tilt scapulae anteriorly. In addition, during SS, there is a tendency of excessive cervical flex, which can also influence the scapulae position due to tension in the levator scapulae muscles.[26] The resultant change in scapular position may narrow the subacromial space, capable of causing reduction in the overall shoulder Flex-ROM due to possible pressure on suprahumeral soft tissues. In fact, supporting this speculation, patients with shoulder impingement show exaggerated anterior scapular tilt during shoulder Flex. Another possible explanation of reduction in shoulder Flex during SS can be due to a direct effect on shoulder Flex, as it has been shown that the thoracic spine inherently contribute to upper quadrant elevation, the mean change in the thoracic angle closely correlates to the mean difference in shoulder ROM. Irrespective of the underlying causes, the finding of increased shoulder Flex-ROM during US has clinical and rehabilitation implications to improve ADL activities involving shoulder motion may thus be facilitated by postural correction. On the other hand, it is found that unlike shoulder Flex-ROM, the Ext-ROM was larger during SS. Again, the possible explanation for this finding is perhaps also related to the biomechanics of scapulae due to their change in position during US and SS. During extension of shoulder, the scapulae have to move to medially towards the thoracic spine. During US, the scapulae assume more medial position, i.e. closer to thoracic spine, and thus, cannot move more further medially during shoulder extension. Whereas during SS, since the scapulae position is more laterally placed than during US and thus can permit larger Ext-ROM. Again, irrespective of the underlying reason of larger extension ROM during SS has clinical and rehabilitation implications. Despite of availability of various other newer and more technically advanced methods for measuring shoulder ROM,[27] for the present study standard goniometry technique was used as it is cheap and a standard method to measure shoulder ROM in clinical setting. Thus, the methodology and results of the present study can directly be part of clinical routines for the assessment, treatment and management of shoulder joint pain and dysfunction. The SS and US sitting postures can affect the shoulder ROM in different planes. Clinical protocols for the assessment, treatment and management of shoulder joint pain and dysfunction can be improved by including these findings.

Conclusions:

The US and SS postures can affect the shoulder ROM in different planes. Clinical protocols for the assessment, treatment and management of shoulder joint pain and dysfunction can be improved by including these findings.

References:

01- Halder AM, Itoi E, An KN. Anatomy and biomechanics of the shoulder. The Orthopedic clinics of North America 2000; 31(2): 159-76.

02- Inman VT, Saunders JB, Abbott LC. Observations of the function of the shoulder joint. 1944. Clinical orthopaedics and related research 1996; (330): 3-12.

03- Price CI, Franklin P, Rodgers H, Curless RH, Johnson GR. Active and passive scapulohumeral movement in healthy persons: a comparison. Archives of physical medicine and rehabilitation 2000; 81(1): 28-31.

04- Anwer S, Alghadir AH, Al-Eisa ES, Iqbal ZA. The relationships between shoulder pain, range of motion, and disability in patients with shoulder dysfunction. Journal of back and musculoskeletal rehabilitation 2018; 31(1): 163-7.

05- Poppen NK, Walker PS. Normal and abnormal motion of the shoulder. The Journal of bone and joint surgery American volume 1976; 58(2): 195-201.

06- Doody SG, Freedman L, Waterland JC. Shoulder movements during abduction in the scapular plane. Archives of physical medicine and rehabilitation 1970; 51(10): 595-604.

07- Alghadir A, Zafar H, Iqbal Z, Al-Eisa E. Effect of sitting postures and shoulder position on the cervicocephalic kinesthesia in healthy young males. Somatosensory & motor research 2016; 33(2): 93-8.

08- Bullock MP, Foster NE, Wright CC. Shoulder impingement: the effect of sitting posture on shoulder pain and range of motion. Manual therapy 2005; 10(1): 28-37.

09- Alghadir A, Zafar H, Iqbal ZA. Effect of upright and slouch sitting postures and voluntary teeth clenching on hand grip strength in young male adults. Journal of back and musculoskeletal rehabilitation 2017.6(8).10-19.

10- Alghadir AH, Zafar H, Al-Eisa ES, Iqbal ZA. Effect of posture on swallowing. African health sciences 2017; 17(1): 133-7.

11- Zafar H, Albarrati A, Alghadir AH, Iqbal ZA. Effect of Different Head-Neck Postures on the Respiratory Function in Healthy Males. Biomed Res Int 2018.9(8).20-29.

12- Kebaetse M, McClure P, Pratt NA. Thoracic position effect on shoulder range of motion, strength, and three-dimensional scapular kinematics. Archives of physical medicine and rehabilitation 1999; 80(8):45-50.

13- Caneiro JP, O'Sullivan P, Burnett A, et al. The influence of different sitting postures on head/neck posture and muscle activity. Manual therapy 2010; 15(1): 54-60.

14- Sabari JS, Maltzev I, Lubarsky D, Liszkay E, Homel P. Goniometric assessment of shoulder range of motion: comparison of testing in supine and sitting positions. Archives of physical medicine and rehabilitation 1998; 79(6): 47-51.

15- Hayes K, Walton JR, Szomor ZR, Murrell GA. Reliability of five methods for assessing shoulder range of motion. The Australian journal of physiotherapy 2001; 47(4):89-94.

16- Allander E, Bjornsson OJ, Olafsson O, Sigfusson N, Thorsteinsson J. Normal range of joint movements in shoulder, hip, wrist and thumb with special reference to side: a comparison between two populations. International journal of epidemiology 1974; 3(3):53-61.

17- Clarke GR, Willis LA, Fish WW, Nichols PJ. Preliminary studies in measuring range of motion in normal and painful stiff shoulders. Rheumatology and rehabilitation 1975; 14(1): 39-46.

18- Barnes CJ, Van Steyn SJ, Fischer RA. The effects of age, sex, and shoulder dominance on range of motion of the shoulder. Journal of shoulder and elbow surgery / American Shoulder and Elbow Surgeons. 2001; 10(3): 42-56.

19- Roy JS, Macdermid JC, Boyd KU, Faber KJ, Drosdowech D, Athwal GS. Rotational strength, range of motion, and function in people with unaffected shoulders from various stages of life. Sports medicine, arthroscopy, rehabilitation, therapy & technology : SMARTT. 2009; 1: 4.8-19.

20- Laubach LL, McConville JT. Notes on anthropometric technique: anthropometric measurements--right and left sides. American journal of physical anthropology 1967; 26(3):7-9.

21- Murray MP, Gore DR, Gardner GM, Mollinger LA. Shoulder motion and muscle strength of normal men and women in two age groups. Clinical orthopaedics and related research 1985;92(7).68-73.

22- Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. Arthritis care and research : the official journal of the Arthritis Health Professions Association 1991; 4(4):3-9.

23- Chakravarty K, Webley M. Shoulder joint movement and its relationship to disability in the elderly. The Journal of rheumatology 1993; 20(8):59-61.

24- Triffitt PD. The relationship between motion of the shoulder and the stated ability to perform activities of daily living. The Journal of bone and joint surgery American volume 1998; 80(1): 41-6.

25- Lewis JS, Wright C, Green A. Subacromial impingement syndrome: the effect of changing posture on shoulder range of movement. The Journal of orthopaedic and sports physical therapy 2005; 35(2): 72-87.

26- Ludewig PM, Cook TM. The effect of head position on scapular orientation and muscle activity during shoulder elevation. Journal of occupational rehabilitation 1996; 6(3):47-58.

27- Mejia-Hernandez K, Chang A, Eardley-Harris N, Jaarsma R, Gill TK, McLean JM. Smartphone applications for the evaluation of pathologic shoulder range of motion and shoulder scores—a comparative study. JSES open access 2018; 2(1): 09-14