COMPARISON OF EMG ACTIVITY OF SERRATUS ANTERIOR, MIDDLE TRAPEZIUS AND LOWER TRAPEZIUS IN SLOUCHED AND UPRIGHT SITTING POSTURE IN PREGNANT WOMEN-AN OBSERVATIONAL STUDY

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Abstract: Significant musculoskeletal adaptations occur during pregnancy, including slouched posture, causing cervical and thoracic muscles to become overactive, which may lead to upper back pain. The aim of the study was to compare electromyographic (EMG) activity of serratus anterior, middle trapezius and lower trapezius in slouched and upright sitting posture in pregnant women. 20 primigravid pregnant women were recruited for the study. There was no significant difference of electromyographic activity when each muscle was compared for slouched and upright sitting posture. It can be concluded that slouched sitting posture does not elicit muscle activity in Serratus anterior, Middle trapezius and Lower trapezius any differently than upright sitting posture in pregnant women.

Keywords: Electromyography, pregnant women, serratus anterior, slouched posture, trapezius.

Introduction

Pregnancy is a time of tremendous physiological, biomechanical and emotional change. It spans 40 weeks from conception to delivery, and is divided into three trimesters with characteristic changes during each.[1] Maternal physiological changes in pregnancy are the normal adaptations that a woman undergoes during pregnancy to better accommodate the embryo or fetus. Various changes occur in uterus, connective tissue, urinary system, pulmonary system, cardiovascular system, hematologic, metabolic, renal, respiratory system, musculoskeletal system, thermoregulatory system, posture and balance. Total weight gain during pregnancy in a woman carrying a single fetus occurs around 11-16 kg.[2]

The physiological and physical changes occurring during ante-natal and post-natal period require significant musculoskeletal adaptations.[3] The center of gravity shifts upward and forward because of the enlargement of the uterus and breasts. This requires postural compensations to maintain balance and stability. Lumbar and cervical lordoses increase to compensate for the shift in the center of gravity. The shoulder and upper back become rounded with scapular protraction and upper extremity internal rotation because of breast

enlargement; this postural tendency may also persist in the postpartum period due to infant care demands. Tightness of pectoralis muscles and weakness of the scapular stabilizers may be preexisting to or induced by the pregnancy postural changes. The sub-occipital muscles respond in an effort to maintain appropriate eye level and to moderate forward head posture along with the changes in shoulder alignment. A tendency toward genu recurvatum will shift weight towards the heels in an attempt to counteract the anterior pull of the growing fetus.[1] These changes in posture represent adaptations that help to maintain the center of mass over the base of support.[4]

In a study by Dumas et al, it was found that the posture in the postnatal period was not significantly different from that measured at the late stages of pregnancy, the increase in postural curves measured during pregnancy being maintained even three months post-natally. Subsequent pain may well develop as the mother takes on new tasks associated with the care of the newborn.[3]

The gradual increase in loads may have a training effect, increasing strength and endurance of back muscles but it may not be in proportion to the increased load.[5] A woman's posture will therefore alter considerably with each pre-natal trimester period as her baby grows in size and weight. These postural changes may be implicated in the development of pain syndromes.[3] In a study on prevalence of back pain in pregnant women, low back pain was predominant complain in 66.4%, high back pain in 9.6% and posterior pelvic pain in 24.0% subjects.[6]

Slouched posture is defined as a relaxed sitting posture with a flexed thoracic and lumbar spine. This slouched posture is related to musculoskeletal pain and leads to cervical and thoracic muscles becoming overactive which may lead to upper back pain. Slouched sitting results in the kinematics of scapulae to become changed during arm elevation, with the reduction of posterior tipping and lateral rotation of scapulae. During overhead arm elevation movements at the glenohumeral joint, it is important that the scapular-stabilizing musculature be strong enough to properly sustain the scapula. The muscles attached on the medial aspect of the scapula are the key muscles for stabilization. These include the middle and lower trapezius, rhomboid major and minor, and serratus anterior.[7]

Changes in posture do not automatically correct after the childbirth, and the pregnant posture may become habitual. In addition, many child care activities contribute to persistent postural faults and asymmetry.[2] Electromyography (EMG) involves detection and recording of electrical potentials from skeletal muscle fibers.[8] No known contraindications exist for performing EMG on pregnant subjects.[9] Because of the implications for musculoskeletal changes and subsequent pain, it is important to review these postural responses during pregnancy. Very few studies have investigated the effect of scapular stabilizer muscles on different sitting posture and reported quantitatively on muscle activities with electromyography (EMG). So the aim of the study was to compare the quantitative activity of scapular stabilizers- serratus anterior, middle trapezius and lower trapezius in slouched and upright sitting posture in pregnant women which will help in improving their posture and managing the pain.

Methodology

After getting approval from ethical committee, an observational study was carried out on 20 pregnant women from various obstetrics OPD in Rajkot with purposive sampling method. The study was carried out in Shree K.K. Sheth Physiotherapy College, Rajkot. Written and informed consent was taken from subjects who fulfilled the inclusion and exclusion criteria.

Primigravid pregnant women of age 21 to 35 years in their third trimester having single fetus, having BMI less than or equal to 35 kg/m^2 and having protracted shoulder (medial border of scapula lies at a distance of more than 2 inches from T4 spinous process in standing) were included in the study. Individuals with any history of trauma or surgery to upper extremity or trunk, any fixed deformities of trunk were excluded. Preliminary measurements and demographic data including age, height and weight were collected.

The EMG signals were acquired and analyzed using RMS EMG PK M-II software. Surface electrodes with 10 mm diameter were used to assess the electromyographic (EMG) activity on their dominant side which was assessed using Edinburgh Handedness Inventory. Active electrodes were placed on muscle belly of 6th

rib, midpoint between medial border of scapula & T4 spinous process and midpoint between medial border of scapula & T8 spinous process; reference electrodes were placed at mid-axillary line of 6th rib, on T4 and T8 spinous process for serratus anterior, middle and lower trapezius respectively. The ground electrodes for all the muscles were placed between active and reference electrodes.[7] Each subject was given a verbal explanation and demonstration of the movements to be performed and practice trails were performed. After familiarization, the subjects were instructed to perform 3 repetitions of the following movements and maximum amplitude was taken as final amplitude. Subject's position was high sitting on a plinth. EMG activity of serratus anterior, middle trapezius and lower trapezius were recorded as subjects contracted their dominant shoulder into abduction while tilting 30 degree anteriorly in coronal plane in 1) upright sitting posture and 2) slouched sitting posture (as slouched as possible). Rest period of 1 minute was given between all measurements.

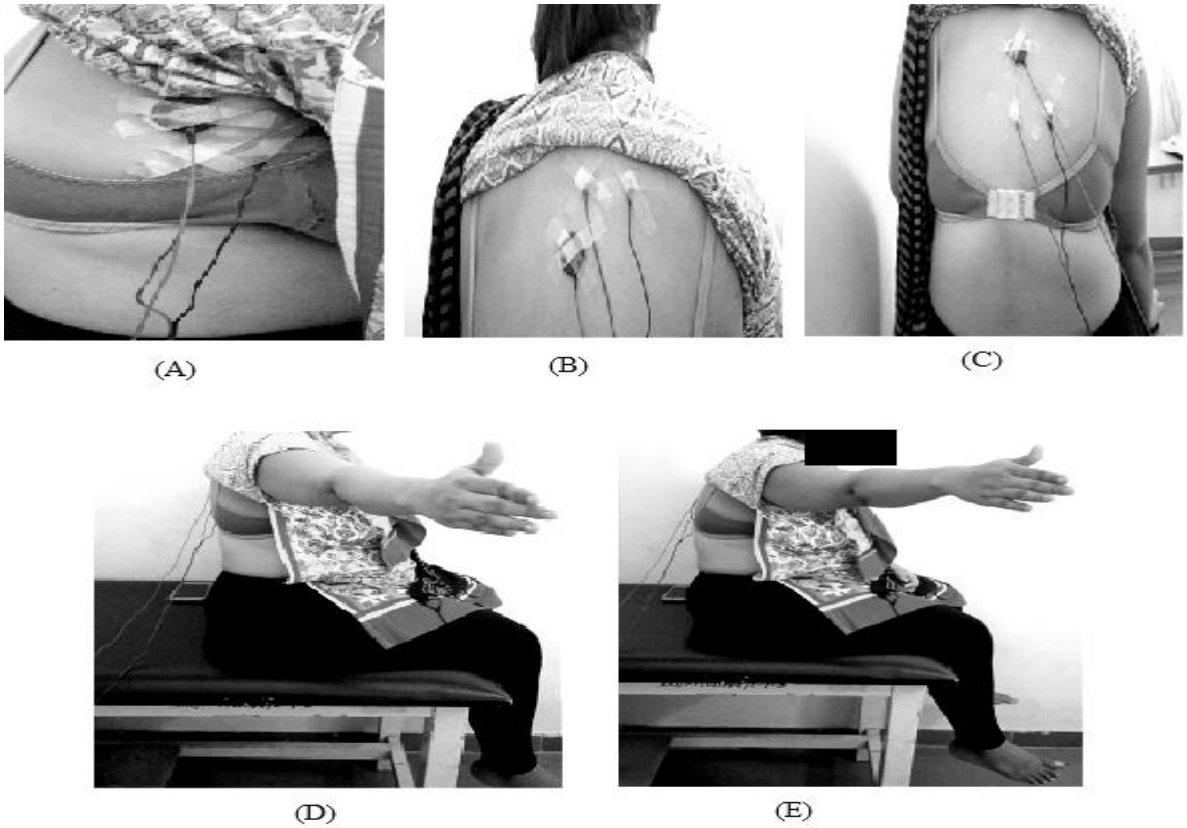

Figure: (A) Placement of electrodes for Serratus Anterior, (B) Placement of electrodes for Middle Trapezius, (C) Placement of electrodes for Lower Trapezius, (D) Subject performing abduction in upright sitting posture, (E) Subject performing abduction in slouched sitting posture

Statistical Analysis and Results

Statistical analysis was done by software SPSS 20.0. Mean and Standard Deviation (SD) were calculated as a measure of central tendency and measure of dispersion respectively. Shapiro-Wilk test showed that all the variables did not follow normal distribution. Mann-Whitney test was used for comparison between two groups -upright and slouched sitting posture for all muscles. Friedman test was used for analysis of a single group (posture). Level of significance was set at 5%

Table 1: Analysis of upright sitting posture

Posture	Muscle	Mean	Std. Deviation	p
Upright Sitting	Serratus Anterior	111.80	68.02	0.00
	Middle Trapezius	182.80	60.78	
	Lower Trapezius	144.35	65.65	

Table 2: Analysis of slouched sitting posture

Posture	Muscle	Mean	Std. Deviation	p
Slouched Sitting	Serratus Anterior	107.40	65.24	0.001
	Middle Trapezius	181.30	73.50	
	Lower Trapezius	139.65	83.20	

Table 3: Comparison of Serratus Anterior in Upright and Slouched sitting posture

Muscle	Posture	Mean	Std. Deviation	Z	p
Serratus Anterior	Upright Sitting	111.80	68.02	-0.365	0.715
	Slouched Sitting	107.40	65.24		

Table 4: Comparison of Middle Trapezius in Upright and Slouched sitting posture

Muscle	Posture	Mean	Std. Deviation	Z	p
Middle Trapezius	Upright Sitting	182.80	60.78	-0.338	0.735
	Slouched Sitting	181.30	73.50		

Table 5: Comparison of Lower Trapezius in Upright and Slouched sitting posture

Muscle	Posture	Mean	Std. Deviation	Z	p
Lower Trapezius	Upright Sitting	144.35	65.65	-0.663	0.507
	Slouched Sitting	139.65	83.20		

Discussion

The results of the present study show that there was no significant difference of electromyographic activity of serratus anterior, middle trapezius and lower trapezius in slouched and upright sitting posture in pregnant women. (Table 3, 4, 5) But there was a significant difference in the electromyographic activity of all the three muscles in individual postures each (upright and slouched sitting posture). (Table 1, 2)

Weeks 1–12, 13–28, and 29–40 of the pregnancy period are classified as first, second, and third trimesters, respectively, and pregnancy related back pain normally increases in intensity during pregnancy, reaching a peak in both prevalence and severity in the third trimester. Pregnancy related back pain in the third trimester has been found to be associated with disability and a reduced quality of life during pregnancy as well as postpartum depression.[10] So subjects who were in their third trimester were included in the study. Also all the subjects included in this study were primigravid to maintain the uniformity of the changes in posture.

Almost all women seem to experience some musculoskeletal discomfort during pregnancy, and about 25% have disabling symptoms. Moreover, some women develop musculoskeletal disorders after delivery due to hormone effects and the ergonomic stress of caring for a newborn. The prevalence of back musculoskeletal discomfort during puerperium ranges from 16 to 61%. Pain in the upper back during pregnancy has been associated with pain in the same region after delivery, at a prevalence of about 40%. In a Brazilian study, the highest prevalence of discomfort was in the lower back (54%), followed by the upper back (35%) and cervical region (11%) in the puerperal period. [11]

A research by Seok et al stated that in healthy adults activities of MT and LT increased significantly more in the slouched sitting posture than in the erect one, which is contrary to the result of current study.[7] A study by Ludewig and Cook indicated no significant differences in the EMG activities of the upper and lower trapezius, levator scapula and serratus anterior in different head positions- 0°, 25° and 50° of sagittal plane flexion during humeral elevation in the scapular plane, without an applied load. In another study by Jong-Hyuck Weon, however, EMG activities of the upper and lower trapezius and serratus anterior were significantly different between neutral head posture and forward head posture during elevation of their arm in the sagittal plane with a 2-kg weight to simulate a real work position. These different findings may have been due to the pattern of arm elevation (i.e., the plane of arm elevation or external load application) affecting the scapular movement pattern. In that study, subjects were asked to elevate their arm in the sagittal plane with a 2-kg weight to simulate a real work position, in contrast to the unloaded arm elevation in the scapular plane in the study of Ludewig and Cook.[12] In the present study, there was no significant difference in muscle activity in upright and slouched posture during arm elevation in scapular plane. This may be because the muscles did not work under any load and the arm movement did not simulate a real work position.

Limitations

This study was limited by its small sample size. Surface electromyography was used to capture the muscle activity so there exists a possibility of cross talk phenomenon.

Future Scope

The study can be performed with needle electrodes. Integration of other dynamic components of sitting posture needs to be done as it may have different activation patterns. Prospective studies including change in EMG activity of muscles 3 to 6 months postnatally needs to be done.

Conclusion

It can be concluded that slouched sitting posture does not elicit muscle activity in Serratus anterior, Middle trapezius and Lower trapezius any differently than upright sitting posture in pregnant women.

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