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Original Article:

Comparison of Ankle Proprioception Between Pregnant and Non Pregnant Women.

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Abstract: Pregnant women report falls especially during their third trimester. Physiological changes along with ligament laxity can affect the joint proprioception in this population. This study was conducted to compare the ankle proprioception between pregnant and non pregnant women. Thirty pregnant and 30 non pregnant women were included in the study and the position of ankles were recorded by a digital camera placed 60 cms away from the feet of the subject. UTHSCSA Image tool software version 3.0. was used to measure the difference between the initial and the final angle. The median repositioning error in the pregnant group was 11.6 (7.6, 12.4) degrees and the median repositioning error in the non-pregnant group was 4.2 (2.1, 6.3) degrees. There was a statistically significant difference in ankle joint proprioception between pregnant and non pregnant women.

Key Words: Pregnancy; Ankle proprioception; Falls; Repositioning error

Introduction:

Pregnancy triggers a wide range of changes in a woman's body which includes weight gain, postural changes, hormonal variations, joint laxity and musculotendinous strength.[1] One of the less investigated but commonly reported change is related to the foot of a pregnant woman. The structural changes could be due to the accumulation of fluid or fat or both or changes in the ligaments caused by the extra weight gain that is carried during pregnancy or by hormonally induced alterations of the connective tissue in the ligaments.[2]

Human postural control during quiet standing involves integration of sensory information from mechanoreceptors on the foot soles[3] and precise modulation in ankle torque through fine adjustment in the length of the plantar flexors.[4,5] This may also get affected due to increased muscle work of the plantar flexors during pregnancy as studies have suggested increased postural sway in women in third trimester compared to women in first trimester.[6]

Physiological changes that occur throughout pregnancy can alter both balance and postural control in a pregnant woman. The lower trunk has significantly greater rates of change in weight than all other body segments during the second and third trimesters of pregnancy. The changing shape and inertia of the lower trunk requires postural adjustments such as elevation of the head, hyperextension of the lumbar spine and extension of knee and ankle joints.[7]

Stabilogram diffusion analysis results suggested differences in postural control mechanisms between pregnant and non pregnant women as increased sway was predominantly directed along the sagittal plane that is in the antero -posterior direction than the medio -lateral direction in the static stance phase.[8] Studies have also indicated that there is an increased reliance on the visual cues to maintain balance during pregnancy which suggests that there could be a proprioceptive loss that leads to postural instability which in turn leads to increased rate of falls in pregnant women when compared to non pregnant women.[7]

A fall rate of 27% was reported during pregnancy especially during third trimester due to a decline in the balancing ability, which persists even after six to eight weeks after delivery.[9] These falls can lead to maternal and fetal complications including 3-7% of fetal deaths.[10,11]. The leading causes of falls at work for pregnant women includes slippery floors, moving at a fast pace and carrying an object or a child.[11]

Even though the balance issues and the visual reliance have been recorded in the pregnant women, the loss of proprioception in them was not studied. Hence we aimed at comparing the ankle joint proprioception sense between the pregnant and non pregnant women.

Methodology:

We selected a random sample of 30 pregnant women, primiparae within age group between 18-35 years in their third trimester. Women with any ankle deformities or contractures, history of arthritis, recurrent ankle sprain, severe pedal edema that restricts the range of motion at ankle and diabetic neuropathies were excluded from the study. We also included 30 age matched non-pregnant women with regular menstrual cycle and the following procedure was followed.

An informed consent was obtained from all the subjects. The subjects were asked to sit in the high sitting position on a high plinth with their feet hanging. The markers were placed at a) lateral aspect of base of fifth metatarsal, b) tip of lateral malleolus and c) 5 cm above lateral malleolus on the shaft of fibula. The subject was blind folded. The tester moved the ankle into dorsiflexion and plantar flexion for 10 times and placed the ankle in a particular position. This was considered to be the target angle. The subjects were asked to feel the position for fif-

teen seconds and remember it. A Sony cybershot 5 megapixel digital camera was placed 60 cm away from the subject's feet on a foot stool perpendicular to the ankle. The target angle was photographed. The subjects were then asked to move the ankle 10 times actively and then position the ankle in the target angle. This position was again photographed and the images were transferred to a computer. The images were then analysed using UTHSCSA Image tool software version 3.0 to measure the difference between the initial and the final angle. The difference in the initial and final angle (reposition error) was noted and taken for analysis.

Data Analysis: Data were analysed using SPSS package version 16.0 and the statistical differences between pregnant and control subjects were determined using Mann- Whitney U test as there was no normal distribution of the data.

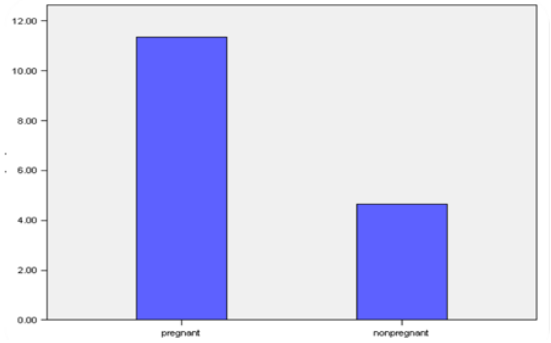
Figure 1: Photograph showing the placement of markers

Results:

Results are shown in the Tables below:

Table 1: Demographic characteristics of the subjects		
Variable	**Pregnant** (n=30)	**Non -pregnant** (n=30)
Age (years)	26±4.2	24± 3.6
Height (cms)	155± 8.7	153± 6.2
Weight (Kgs)	64.6 ± 8.4	56.1 ± 4.2
Foot length (cms)	23.38±0.95	24.23±1.07

Table 2: Median proprioceptive error in degrees			
Subjects	**n**	**Mean proprioceptive error (in degrees)**	**p**
Pregnant	30	11.6 (7.6,12.4)	0.002
Non pregnant	30	4.2 (2.1,6.3)	



Graph 1: Median ankle proprioceptive error between pregnant and non-pregnant women

Discussion:

Pregnant women included in this study were in the age group between 18-35 years in their third trimester as there is more postural instability caused due to various physical and hormonal changes in this period.[3] All the subjects were primiparae that warrants against the variations that could occur due to the effect of hormones between the primi or multiparae women.

Subjects whose sensations were already affected due to diabetic neuropathies were excluded from the study to avoid the influences of the already existing proprioceptive loss. Subjects with ankle deformities, contractures or severe edema affecting the active ankle range of motion were excluded from the study as otherwise their ability to reposition the joint would have got affected. Subjects with history of recurrent ankle sprain injuries were also excluded from the study as the joint proprioception would have been already affected.

All the participants were made to understand the procedure by demonstrating the subjects what they were supposed to do and by showing them the photographs which were previously taken. Two trials for familiarization were provided prior to the actual test and the recordings were done. Due to inability to measure smaller variations in the joint range of motion (ROM) using goniometer, we used a photographic method and the angles were analysed using Image tool software version 3.0 which is a reliable and a valid method to analyse the ranges in uniaxial planes.[12]

The results of the study suggests that when compared to the non pregnant control subjects there is a significant increase in the proprioceptive error in pregnant women. This could be due to the altered proprioceptive input obtained from the lax ligaments around the ankle joint. It has been found that relaxin hormone levels increases upto ten times more during pregnancy which predisposes for ligament and joint laxity that may in turn affect the ability of the receptors to sense the movement.[13,14,15,16] The other factor that could alter the proprioceptive input could be due to the mild oedema around the ankle which is more common during the third trimester.

It has also been documented that there is an increased postural instability during second and third trimesters during pregnancy with increased reliance on visual cues, which indicates reduction in proprioceptive input during this period.[6] This also predisposes them to increased risk of falls. Among the pregnant subjects who participated in this study two of them had reported falls in their 35th and 37th week. The reasons for the falls were reported to be increased frequency of urination in the night which led them to go to toilet and had a fall in the toilet.

This study warrants the necessity of propriceptive training programs in pregnant women especially in their third trimester to reduce the rate of falls due to postural instability.

Conclusion:

Ankle proprioception is significantly affected in pregnant women during their third trimester compared to non- pregnant women.

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