

# BIOMECHANICAL CHANGES IN THIRD TRIMESTER OF PREGNANT FEMALES IN COMPARISON TO NON PREGNANT FEMALES OF SAME AGE GROUP

Aneela Zia<sup>1</sup>, Suman Sheraz<sup>1</sup>, Rida Asif<sup>1</sup>, Amna Khalid<sup>1</sup>, Ayesha Razzaq<sup>1</sup>

<sup>1</sup>Department of Rehabilitation Sciences, Riphah International University, Islamabad - Pakistan

## ABSTRACT

**Background:** In pregnancy women experience several changes in body's physiology, morphology, and hormonal system which lead to biomechanical changes for example range of motion at cervical, lumbar and gait patterns, which is considered as part of normal postural adaptations.

**Objective:** To determine biomechanical changes in third trimester pregnant and non-pregnant women in terms of range of motion at cervical and lumbar spine, step length, stride length and speed.

**Methodology:** A comparative cross-sectional study was conducted with sample size of 210 females comprising of 69 pregnant females and 141 non pregnant females for 6 months at Railway general hospital. Non probability convenience sampling technique was used. Females with a history of back pain, 1st or 2nd trimester of pregnancy, females suffering from any degenerative disease or musculoskeletal disorders or any serious pregnancy related complication were excluded. Assessment was done using an iPhone®5S I handy level© app for measuring the ROM at the cervical and lumbar spine. A 6" by 6" POP sheet for measuring step length, stride length, and number of steps.

**Results:** The assessment of cervical and lumbar flexion and extension ROM showed the non-pregnant females' group had greater range in both flexion and extension than pregnant females ( $P < 0.01$ ). Pregnant females presented with, decreased step length, stride length and speed than non-pregnant females having  $P < 0.001$ .

**Conclusion:** Pregnant females had decreased range of motion at cervical and lumbar spine, decrease in speed, step and stride length was observed in comparison to the non-pregnant females of the same age group.

**Key words:** Biomechanical Changes, Third Trimester of Pregnancy

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## INTRODUCTION

The biomechanical changes that occur during pregnancy are part of normal postural adaptations, which is counter balanced with compensatory changes in spinal column<sup>1</sup>. A mother's body undergoes numerous changes in the initial phase of pregnancy to maintain a supportive environment for the embryo and the pregnant female as well. The physiologic adaptations take place all over the maternal body to facilitate the expecting mother to conserve surplus energy to prepare for delivery and labor. Numerous hormones like human chorionic gonadotropin hormone (HCG), human placental lactogen (HPL) and relaxin, would help to sustain an environment that is supportive for the development and embedding of the em-

bryo and to prepare body for parturition.<sup>2,3</sup>

The structural and mechanical changes in spine are a part of the normal physiological changes during pregnancy.<sup>4</sup> During the phase of compensation due to increasing weight, the first area which is targeted to recompense is lumbosacral junction. As the pelvic inclination increases, there would be an exaggerated lumbar curve. Joint laxity at lumbar spine creates notable instability and leads to muscle strain all contributing to low back pain.<sup>5</sup> In 2019 GemmaBivia Roig PT compare effects of pregnancy on lumbar motion pattern in antenatal and postnatal periods. In his results he concluded that there is major decrease in lumbar flexion in pregnant females.<sup>14</sup>

The rise in relaxin hormone has found to be closely related to the changes in foot occurring in pregnancy like the size of foot, pressure on the sole and painful feet. Internal arches also become lax ensuing in flat arch due to the continuous increase in weight. All these changes in the anatomy and physiology of foot might also associate with other musculoskeletal and musculoligamentous changes occurring in the pregnant women body.<sup>6</sup>

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Correspondence

**Dr. Aneela Zia**

Department of Rehabilitation Sciences, Riphah International University, Islamabad - Pakistan

**Email:** aneela.zia01@gmail.com

**Cell:** +92 336-5869031

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Greater laxity and a rise in body weight can shift body's COG to posterior part of foot that can lead to structural changes in feet which mostly affect the length of ligaments supporting the arches contributing a loss in arch height. In pregnancy length, width and volume of foot is increased which causes the head of talus to move downward due to the effect of relaxin on foot arches and increase in body mass.<sup>6</sup>

It is difficult to identify the major differences between the gait pattern of pregnant and non-pregnant women. There is a doubt that whether gait is much affected during pregnancy or not. Forczek W et.al concluded in his study conclude that during pregnancy plantar flexion and dorsiflexion decreases, hip abduction increases and due to heavy weight of the belly the pelvic tilts anteriorly and waddling gait in pregnant females too.<sup>7</sup> A study conducted in 2019 by Rebecca Conder et al and Rita Santos-Rocha et al. claimed that there is decrease in gait velocity and step length in females during pregnancy.<sup>12,13</sup>

This study was conducted to compare the pregnant females in their third trimester with the non-pregnant females of same age group to determine the biomechanical changes that occur in pregnancy. In this study we specifically assessed those musculoskeletal areas that are thought to undergo most of the changes biomechanically like the cervical and lumbar spine, and gait. There is a lack research findings present to assess effect of pregnancy on cervical range of motion. By these findings physical therapists can better understand the biomechanical complications of the pregnant females and design the antenatal treatment accordingly.

**MATERIAL AND METHOD**

A comparative cross sectional study was conducted for pregnant females at Pakistan railway general hospital Rawalpindi and for non-pregnant was collected from community. By using non probability convenience sampling technique, 210 participants comprising of 69 pregnant females and 141 non pregnant females were selected. Informed consent was taken from each participant prior to participation. Ethical considerations were kept in mind while designing the questionnaire and conducting the survey Data was collected through structured questionnaire for pregnant and non- pregnant women. The study inclusion criteria were pregnant and non-pregnant females between ages 18 to 35 and females in third trimester of pregnancy. Females with a history of back pain, women in first or second trimester of pregnancy, females suffering from any degenerative disease or musculoskeletal disorders and with any serious pregnancy related complication were excluded.

**EXAMINATION**

Assessment of spinal curves range of motion

An Iphone® 5s I Handy© level app was used for the assessment of cervical and lumbar range of motion. In standing position cervical flexion and extension range of motion were assessed by placing the phone on C7 as landmark. For assessing lumbar flexion and extension range of motion in same position the individual was asked to bend forward with knee straight and then from reference position bend backward according to their comfort level. Iliac crest was used a reference point landmark for identification of L4-L5 and phone was placed on it. Participants performed AROM's with one repetition for each movement to be assessed. Assessment of speed, step and stride length For the assessment of gait components a sheet of 6 by 6 feet was placed on a firm surface and plaster of Paris was spread on it uniformly to visualize the foot prints. Participants were asked to walk on it at their regular pace and the time they took to cover the distance was recorded on a stop watch. After these participants' step length, stride length were measured using an inches tape and speed is calculated by dividing the number of steps with time.

**STATISTICAL ANALYSIS**

Data analysis was performed at SPSS 20.

**RESULTS**

In this study sample size was 210 in which 69 were pregnant females and 141 were non-pregnant having the mean age of 27.4±4.34 for pregnant females and 26.3±5.15 for non-pregnant females. In 69 pregnant females 24.6% participants were primigravida, 17.4% were secondigravida, 26% were tertigravida and 31.9% females were multigravida females.28% pregnant females were nulliparous, 31% were primiparous, 17.4% pregnant females exist in each biparous and multiparous category, and only 4.3% females were in grand multipara group. In low back pain 14.5% pregnant females used back support and 85.5% did not use any back support for it.

Mean ± SD of cervical, lumbar Range of motion step length, stride length, and speed in pregnant and non pregnant females with the P value is mentioned in (Table. no.1).and Figure.no.1 Shows gestational age of pregnant

**Table 1: Shows Mean ± SD of cervical, lumbar Range of motion step length, stride length, and speed in pregnant and non pregnant females**

Variables	Pregnant	Non pregnant	P value
Cervical flexion	40.2±9.82	51.9±12.1	0.001
Cervical extension	-55.7±12.1	-62.9±11.1	0.001
Lumbar flexion	45.4±20.4	52.9±14.4	0.002
Lumbar extension	-9.15±5.5	-15.3±7.87	0.007
Step length	17.0±3.4	20.9±4.1	0.001
Stride length	34.8±5.96	41.3±7.3	0.001
Speed	0.92±0.29	1.13±0.32	0.001

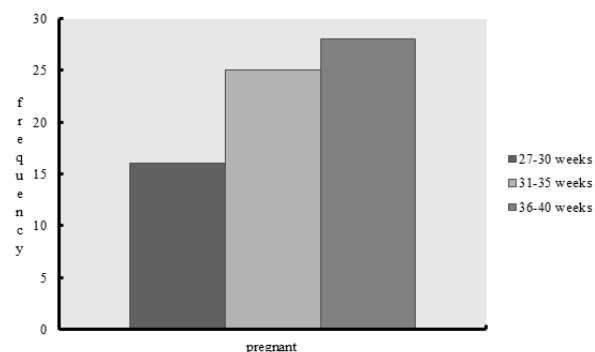


Fig 1: Shows gestational age of pregnant females.

females.

## DISCUSSION

Pregnancy creates change in the patterns of lumbar motion, with decline in the percentages of lumbar flexion during spine flexion in the time of pregnancy. A study carried out by Gemma Bivia Roig PT et al. In 2019 concluded that there is profound decrease in lumbar range of motion especially flexion in females during their gestation phase. In current study there is also a significant decrease in pregnant woman lumbar flexion as compared to non-pregnant woman with P value (0.002\*)<sup>14</sup>

Rebecca Conder et al. conducted a systematic review in 2019, after his conclusion he claimed that there is profound decrease in trunk range of motion, gait velocity, step and stride length most commonly in third trimester of pregnant females. Likewise in current study our results concluded that there is also significant decrease in lumbar flexion extension, gait speed, step and stride length in third trimester of pregnancy in comparison with non pregnant.<sup>15</sup>

Wendy L Gilleard mentioned there will be an increased step width ( $p = 0.05$ ) and significant decrease in stride length ( $p = 0.05$ ) and the overall pelvic range of motion will decrease ( $p = 0.03$ ) as an individual progressively entered third trimester. But in our study step length and stride length both decreased in pregnant females for the duration of gestation.<sup>10</sup>

Eldeeb, A. M et al. in 2016 conducted a research study to check the relationship between trunk and pelvis kinematics during pregnancy trimesters. The result concluded that during pregnancy women has increased maximum anterior pelvic tilt, and reduced maximum trunk flexion.<sup>11</sup> In current study women who were pregnant had reduced ROM at cervical and lumbar region also.

Not much work has been done on the effects of increased lumbar lordosis on rest of the spinal curves i.e thoracic and cervical in gestation or what could be the effect of pregnancy on cervical spine range of motion (flexion and extension). According to our results likewise

the decreased lumbar range of motion, cervical ranges in flexion and extension also decreased during pregnancy in comparison to non pregnant females. Overall the females during gestation experienced compromised ranges of motion at cervical and lumbar region (flexion and extension).

## CONCLUSION

This study concludes that reduced range of motion at cervical and lumbar spine, a drop in arch height, pronated foot position, a decrease in speed, step and stride length was observed in the pregnant females when compared to the non-pregnant females of the same age group.

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#### **AUTHOR'S CONTRIBUTION**

Following authors have made substantial contributions to the manuscript as under

**Zia A:** Design, data analysis and interpretation, data collection, writing

**Sheraz S:** Concept, data analysis,

**Razzaq A:** Critical review

**Asif R:** Data interpretation, data collection

**Khalid A:** Data interpretation, data collection

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.