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RESEARCH ARTICLE

MUSCULOSKELETAL CHANGES IN PREGNANCY

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Abstract

Pregnancy is a normal physiological condition that alters the biomechanics, hormone regulation and vascular dynamics to provide a suitable environment for fetal growth. These physiological alterations are associated with a diverse array of musculoskeletal problems. The musculoskeletal changes vary and intensify as pregnancy progresses through the trimesters. The first trimester includes low back pain and muscle cramps; the second includes low back pain, cramps, edema, and carpal tunnel syndrome, whereas the third includes mental stress, leg cramps, edema, and carpal tunnel syndrome. Low back pain is the most common condition, with a prevalence of approximately 30% to 70%.The higher prevalence is due to socio-cultural and environmental factors like housework and working conditions, multipara, increased body mass index before pregnancy, anxiety, depression, violence, and poor antenatal care. The major reasons for musculoskeletal pain include 1) Hormonal surges that increase joint laxity, creating joint pain; 2) Weight gain, changing the center of gravity and altering posture, producing low back pain and pelvic girdle pain; 3) Fluid retention compressing the soft tissue, presenting conditions like carpal tunnel syndrome and tarsal tunnel syndrome; and 4) Neuro-mechanical changes which can disrupt gait, leading to imbalance and reduced equilibrium, which increases the risk of falls. These factors lead to changes in the structure from decreasing bone density to softening the ligament, changes from posture to neurological and vascular alterations. This literature will have an explanation about how the given factors; hormonal surges, weight gain, fluid retention, along with other factors work synchronously to create the pain during and after pregnancy.

Introduction:-

Pregnancy is a significant period of transformation in women's life with extensive biomechanical, physiological and structural changes that occur to provide a suitable environment for nutrition, growth and development of the fetus as well as to prepare the mother for the process of parturition.[3,20] The physiological alterations in biomechanics, hormone regulation and vascular dynamics that occur during pregnancy have been associated with a diverse array of musculoskeletal problems.[12] The prevalence of musculoskeletal problems in pregnancy can vary according to socio-cultural and environmental factors. Heavy house work and working condition, having many children, depression, anxiety and violence can trigger musculoskeletal problems. The most common musculoskeletal problem during pregnancy is low back pain with a worldwide prevalence of approximately 30% to 70%.[14] Annually, over $50

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billion is spent on the diagnosis and treatment of back pain in the united states.[18] After back many describe pubic, pelvic, hip, knee and various other joint discomforts.[18] Swelling, pedal aches and pains, and an unsteady gait have been anecdotally identified as the common lower extremity problems experienced during pregnancy.[17] Explanations for pain include hormonal changes, increased weight, postural differences and impaired strength and active co-ordination of abdominal muscles.[13] The hormones like relaxin, increased serum levels of cortisol, estrogen, and progesterone during pregnancy soften the ligaments and makes the joints more mobile and more vulnerable to injuries by changing the structure of connective tissue.[18,3] This lead to increased incidence of strains and sprains.[3] The hormonal changes and weight gain also affects the respiration by displacing the diaphragm cranially and relaxing bronchial and tracheal smooth muscle.[21] The supine position is still not recommended in late pregnancy as it decreases the diaphragmatic movement. Cultural values, environmental factors, level of physical activity, multiparity, pregnancy at young age, pelvic injury, back pain in previous pregnancy are regarded as the risk factors for musculoskeletal dysfunctions during pregnancy.[7, 14]

Musculoskeletal Changes In Pregnancy

Musculoskeletal changes in pregnancy				
Hormonal surges	Weight gain	Fluid retention	Neuromechanical changes	Vascular changes
⇩	⇩	⇩	⇩	⇩
Produces joint laxity	Changes center of gravity	Compression of soft tissues	Susceptible to musculoskeletal and fall related accidents	Risk of thromboembolism
⇩	⇩	⇩	⇩	⇩
Pelvic, hip , knee pain	Increases lumbar lordosis	Nerve entrapment like carpal tunnel syndrome, tarsal tunnel syndrome	Gait disturbances	Low back pain
	⇩			
	Low back pain and pelvic girdle pain			

Hormonal Surges

Relaxin, an estrogen dependent hormone secreted by the corpus luteum from beginning of pregnancy till the 12th week of gestation, then, from the placenta, triggers the collagenolytic system, increases the water content of connective tissues, and activates fibroblasts in the synthesis of new collagen. This results in the mobility of the pelvic complex and the peripheral joints, leading to instabilities of the lower and upper segments that predispose individuals to lower limb dysfunction.[14,18,17,3,5] Estrogen and progesterone increases during pregnancy to maintain the fetus in utero are suggested to be related to an increase in joint laxity.[18] Estrogen potentiates relaxin receptor sensitivity, thereby enhanching its effects on joints. Relaxin relaxes the sacroiliac joint to accommodate delivery.[17] low back, pelvic, hip and knee pain are commonly registered pain. Laxity of the spring ligament lowers the talar head, creating midfoot pronation and partial collapse of the longitudinal arch, presenting the flat foot.[17] In some cases, in the presence of elevated adrenocortical activity during pregnancy, increased weight gain in conjuction with increased interosseous pressure has been linked with necrosis of the femoral head or even clinical signs of osteoporosis due to calcitropic hormonal changes.

Weight gain

It is normal to gain 20 to 40 pounds during pregnancy.[6] The weight gain enlarges the gravid uterus and causes anterior displacement of the center of gravity that increases the moment arm of forces applied to the lumbar spine, producing pelvic ligament laxity and vascular compression.[6,2] This leds to inward curvature of the spine with flexion of neck and the drooping of the shoulders. The intervertebral disc respond to the axial loading by expelling fluid resulting in decreased height and an overall compression of spine.[6] The abdominal muscle stretch thereby placing additional strain on lumbar muscle that compensates for the loss of abdominal muscle tone and strength.[5,6] In addition, anterior pelvic tilt increases as the center of gravity shifts anteriorly, causing a greater load throughout the

sacroiliac ligament as the structures attempt to resist this forward pelvic rotation.[5] As pregnancy progresses, the sacroiliac ligament become more lax and allow increased forward pelvic rotation and lumbar spine hyperlordosis which subsequently place even more strain on pelvis and low back.[5] Lumbar lordosis in turn causes overactivity of the low back and pelvic muscles and hypermobility of the thoracic joints, typically at the T6 to T8 levels of the spine, lumbar spine, and pelvis. This, coupled with the expanding pelvis, leads to increased activity in the paraspinal musculature, as well as the rectus femoris, external oblique, psoas major, and adductor longus muscles bilaterally.[15] Midthoracic pain at the end of second trimester might be compensatory to the hyperlordosis. Lower cervical pain or strain increases in frequency as the pregnant woman gains weight and loses the ability to use her core muscles to move herself from side to side at night. She uses her head as a lever, causing C6 to C7 joint compression.[15]

In addition, with weight gain, there occurs a valgus misalignment of the knees due to middle-lateral displacements of the center of body mass of pregnant women. Another consequence of knees valgus misalignment is the increased moment of force over this joint, which can cause pain, joint instability, and even the development of patellofemoral pain syndrome.[3] The most affected musculoskeletal structures during pregnancy and postpartum are the pubic symphysis and the sacroiliac joints.[2] Physiological widening ≤ 10mm is considered acceptable. Increased risk of symptomatic diastasis is associated with multiparity, fetal macrosomia, precipitous labour, powerful uterine contractions, or previous pathology or trauma.[5] Patients may experience a burning sensation, stabbing in the sacral area or as the pain in the pubic symphysis. This pain may radiate to the groin or posterior thigh. The first symptoms occur in week 18 and reach a maximum intensity in week 36. Factors that can accelerate the onset of pelvic pain in pregnancy are; BMI, multiparity, mental stress, smoking and physical examination.[2]

Fluid Retention

The fluid retention is commonly seen in pregnant woman. Fluid retention causes the compression of soft tissues in pregnancy.[2,10] Carpal tunnel syndrome is the most common compression neuropathy affecting up to 35% of pregnant women.[17] The increased fluid retention during pregnancy lead to venous congestion and hypoxia in the pelvic and lumbar spine.[5] Soft tissue edema during pregnancy is reported by approximately 80% of women. Most notable during the last 8 weeks of pregnancy, making women more likely to develop peripheral nerve entrapment during pregnancy.[3] With fluid retention, there's an increased foot volume of 57.2 ml between the beginning and end of pregnancy. After childbirth, 8.42 ml were reduced; if not reduced fully, it is due to the accumulation of fluid in the soft tissues.[4] Fluid retention exerts pressure on the posterior tibial nerve, indicating a possible tarsal tunnel syndrome, reporting symptoms like tingling, burning or numbness sensations in their feet and legs during their pregnancy along with ankle swelling.

Neuromuscular Changes

The occurrence of pregnancy induced neuromechanical changes, including modifications in stride, posture and sensory input, escalated the susceptibility to musculoskeletal problems and fall related accidents.[12] Weight gain and an anteriorly deviated center of gravity also precipitate gait disturbances in the pregnant women.[17] The pelvis undergoes a tilting motion, causing the back to arch to sustain equilibrium, frequently resulting in suboptimal postural alignment.[12] For maintenance of balance in a standing position, during gait, there are changes in angular kinematic and spatiotemporal parameters.[4] The locomotor pattern with greater mediolateral sway , shorter steps, a wider base of support, and feet laterally rotated is seen. The stretching in the plantar ligament due to weight gain decreases the proprioception.[4] Relaxin induced ligamentous laxity that correlates with the mechanical aspect of lower extremity dysfunction. Rearfoot and midfoot pronnation alters the distribution of plantar pressures. Dynamic gait analysis shows significantly higher forces on the forefoot, midfoot, and hindfoot during pregnancy. Lateralisation of gait line leads to higher lateral forefoot pressures as well.[17] In addition, decreases of the plantar flexor and the propulsion forces resulted in longer step lengths and widths and greater anterior-posterior and medial lateral sways. All of these gait changes resulted in redistributions of the increased loads in the forefoot and decreased loads in the rearfoot throughout the pregnancy. Gait patterns of pregnant women are characterized by greater hip flexion angles, greater extensor and abductor hip moments, and longer stance phase durations from the first to the last trimester of pregnancy. These changes were maintained up to four months after delivery.[4]

Vascular Changes

Vascular changes may also contribute to back pain during pregnancy. A gravid uterus can place considerable compression in both the aorta and vena cava when a women is in a supine position. In addition, the potential risk of venous thromboembolism, the subsequent venous statsis, and decreased regional oxygen saturation compromises the metabolic activity of the neural structures, thereby causing low back pain.[5]

Discussion:-

The changes experienced during pregnancy include dermatological (toenail curvature, hyperpigmenatation of skin, pigmentary demarcation from prolonged uterine compression), Vascular (hyperhidrosis, dishydrosis, vasomotor instability, and perspiration), neurological (carpal tunnel syndrome), and musculoskeletal (low back pain, knee pain, hip pain, osteonecrosis of femoral head, osteoporosis, leg cramp)[17] Elaborating on the muscular part, Ana paul et al[4]. in their study reported that anterior pelvic tilt, increased lumbar lordosis, head posteiorization, knee hyperextension, and lowering of the medial longitudinal plantar arch, as well as increased volume, length, and width of the feet, are the changes in the body during pregnancy. Fulya et al[1]. according to their research, musculoskeletal changes in a pregnancy occur as per gestational period, specifically the trimester. The first trimester lasts from 1 to 13 weeks, the second from 14 to 26 weeks, and the third from 27 to 40 weeks. Similar findings were made by Hafsah et al. in their study about musculoskeletal problems according to trimesters. The first trimester includes low back pain and muscle cramps; the second includes low back and leg muscle cramps, edema and carpal tunnel syndrome; and the third trimester includes mental stress, leg cramps, 10% of pedal edema, and carpal tunnel syndrome. The third musculoskeletal issue in this study was pedal edema, which gradually worsened from the second to third trimester.[14] Felicia fial et al.[2] in their study, determined that the pubic symphysis and sacroiliac joints are the most affected structures throughout pregnancy and postapartum, while Onyemachi et al.[11] reported urinary incontinence, low back pain, carpal tunnel syndrome, arthralgia, Dequervain tensosynovitis, and pelvic girdle pain as the frequent rmusculoskeletal problem of pregnancy. In another similar study done by Thamer et al. low back pain was reported as the most frequent complaint followed by carpal tunnel syndrome.

The higher prevalence is represented as social elements doing home duties, multipara, short interval between pregnancies, overweight before pregnancy, and inadequate antenatal care.[3] Nusrat et al.[7] in their study mentioned multiparity and a sedentary lifestyle as the risks of pregnancy. A relatable study done by Casagrande et al. also reported increased incidence of low back pain in pregnant women with advanced maternal age, a history of back pain during previous pregnancy, increased parity, a higher body mass index and a history of joint hypermobility. Several studies reported musculoskeletal pain during pregnancy and postpartum. The pain is related to postural and hormonal fluctuations, weight gain, and fluid retention. Mary et al. in their analytical study of posture and back in the first and third trimesters of pregnancy, it was concluded that, in standing, the lumbar lordosis and sagittal pelvic tilt increased and head position became more posterior as women progressed from the first trimester to the last trimester.

Soft tissue edema also increases throughout the pregnancy, particularly in the last 8 weeks. Increased fluid retention can cause tenosynovial or nerve entrapment.[9] Several studies have proposed that hormones such as relaxin, estrogen, and progesterone stimulate the collagenolytic system and synthesize new collagen, resulting in loose muscles, joints, and ligaments, and hence musculoskeletal dysfunctions. However, Mary et al. observed in their investigation that joint laxity had no significant correlation with maternal estradiol, progesterone or relxain levels.

Low back pain, pelvic pain, and arthralgia are the most common conditions seen in pregnancy. Non inflammatory causes of back pain, such as mechanical stress on the pelvic area caused by pregnancy, can cause subchondral bone marrow edema that cannot be differentiated from axial spondyloarthritis.[2] During pregnancy, x-rays are not recommended as they are detrimental for diagnostic purpose since they emit radiation. Exposure to x-rays for up to two weeks may result in miscarriage, up to eight weeks in a congenital deformity, and up to sixteen weeks in intellectual incapacity. If the examination of both mother and fetus is required, ultrasound and MRI is recommended. Ultrasound can capture images of soft tissues, ligaments, and muscle, helping diagnosis. If the image is not clear from ultrasound, then MRI is done. There are no proven adverse effects due to MRI either in the pregnant women or in the fetus, and it is a frequently used method today. [2]

Studies suggest exercise as a primary solution for musculoskeletal related conditions. Christopher et al.[18] suggested massage therapy, stretches, exercises, and spinal manipulation, whereas, Ambika et al.[12] suggested antenatal exercises, especially focusing on abdominal tightness, pelvic floor, and foot and ankle movements.

Conclusion:-

In conclusion, the common musculoskeletal pains experienced during pregnancy include low back pain, pelvic girdle pain, hip and knee pain, and carpal tunnel syndrome. These conditions are primarily attributed to hormonal

surges that cause joint laxity, weight gain that results in increased lumbar lordosis due to a shift in the center of gravity, and fluid retention that compresses soft tissues, leading to nerve entrapment.

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