Effect of therapeutic exercises on pelvic inclination and low back pain during pregnancy.

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Background: Low back pain (LBP) during pregnancy is the most common musculoskeletal problem that affects pregnant women. 50–70% of pregnant women have experienced some form of LBP during pregnancy. **Purpose:** This study was conducted to determine the effect of therapeutic exercises on low back pain and the degree of pelvic inclination during pregnancy. **Subjects and methods:** Forty primigravida women in the 3rd trimester shared in this study. They were diagnosed as having pregnancy related low back pain and were selected fromthe outpatient clinic, Al Zahraa University Hospital in Cairo. Their ages were ranged between 20-35 years. Their body mass index did not exceed 35 Kg/m^2. They were assigned randomly into two groups equal in number (A&B):Group A: (Control group): 20 primigravida received superficial heat application at the lumbosacral area using an electric heating pad for 15 minutes from side lying position 3 times/week for 6 weeks and advice concerning low back pain during pregnancy. Group B: (Study group): 20 primigravida received the same treatment as group A in addition to specific exercises for low back pain 3 times/week for 6 weeks. Intensity of low back pain and pelvic inclination angle were evaluated by VAS and Palpation Meter respectively before and after treatment program for both groups (A&B).**Results** : Results showed that there is a statistically significant decrease in intensity of low back pain and a statistically highly significant increase in the degree of anterior pelvic tilt angle after treatment in both groups (A&B).When comparing both groups together after treatment, there is a statistically highly significant decrease in low back pain in group B more than group A, while there was statistically significant increase in the degree of anterior pelvic tilt anglein group A more than group B. Also, there is a positive correlation between intensity of low back pain andthe degree of anterior pelvic tilt angle during pregnancy. **Conclusion:** This study concluded that therapeutic exercises are considered an effective method for reducing low back pain and lessen the rate of increasing in the angle of pelvic inclination during pregnancy and confirmed that there is a positive correlation between intensity of low back pain andthe degree of pelvic inclination angle during pregnancy.

Key words: Therapeutic exercises- Pelvic inclination- Low back pain- Pregnancy.

Introduction

Low back pain (LBP) during pregnancy is the most common musculoskeletal problem that affects pregnant women. 50–70% of pregnant women have experienced some form of LBP during pregnancy. The pain symptoms often interfere with work, daily activities and sleep. Some women may be affected to the extent of disability requiring the use of crutches, wheelchair and may even become bedridden [1,2].

During pregnancy the center of gravity changes because of the growing uterus. This causes a postural change involving an increase in pelvic tilt, shortening of the paraspinal muscles, and overstretching of the abdominal muscles resulting in lumbar lordosis. Such changes, together with low muscle endurance, compromise the strength and stability of the low back and pelvis [3].

Hormonal changes during pregnancy also cause inflammation and pain in the back due to making other joints in the body to move abnormally. Some studies have found back pain to correlate with increased levels of relaxin which are produced during pregnancy even though others have not. It has been suggested that the hormone relaxin increases tenfold in concentration during pregnancy. As the structures of the pelvis and lower spine soften and become more pliant, discomfort may result particularly not only in the sacroiliac joint but also generalized over the entire lower back [4].

Another theory has been put forward that LBP during pregnancy, especially pain that worsens at night and is severe enough to wake the patient up, is the result of venous engorgement in the pelvis. The expanding uterus presses on the vena cava, particularly at night when the patient is lying down. This combined with the increased fluid volume from fluid retention during pregnancy leads to venous congestion and hypoxia in the pelvic and lumbar spine [5].

Pelvic tilt has often been measured in clinical practice to identify the presence of abnormal postures that may cause dysfunction and lead to chronic musculoskeletal pain conditions such as low back pain. It often been identified as a risk factor for low back pain [6,7,8].

There are several treatment trials for LBP during pregnancy such as pelvic belt, TENS, acupuncture, physiotherapy, and various pharmacological pain-relief methods to enable the women to achieve a fairly ‘normal’ life. Also the women were encouraged to engage in physical activities, such as under water exercise and swimming [9].

Exercises before and early in pregnancy can strength abdominal, back, and pelvic muscles, which improve posture and allows increased weight-bearing

ability. Low intensity exercise can also alleviate pain once it develops. Exercise three times per week during the second half of pregnancy significantly decreases pain [10].

Exercises during pregnancy are associated with higher cardiorespiratory fitness, prevention of urinary incontinence and low back pain, reduced symptoms of depression, gestational weight gain control and decrease the number of women who required insulin. It is also reported that exercise during second half of the pregnancy significantly reduce the intensity of low back pain**.** Pelvic rocking exercises have an important value in decreasing disability level in pregnant women diagnosed as having low back pain, thus improving their quality of life[10,11,12].

Pelvic tilts are particularly effective in relieving lumbar pain. Knee pull, straight leg raising, curl up, lateral straight leg raising, and the Kegel exercises are also successful in relieving LBP in pregnant women because pelvic floor muscle has an important role in lumbar spine stability and lumbar instability as it works together with transverses abdominis to stabilize the pelvis so it was suggested to be one of the causes of LBP [13,14].

Subjects, Instrumentations and Methods

Subjects:

Forty primigravida women in the 3rd trimester shared in this study. They were diagnosed as having pregnancy related low back pain and were selected fromthe outpatient clinic, Al Zahraa University Hospital in Cairo. Their ages were ranged between 20-35 years. Their body mass index did not exceed 35 Kg/m^2.

Women with acute stage of low back pain, history of previous surgeries in the back, serious back injury before and at time of study (disc prolapse, spondylolithesis), concurrent injuries of cervical and\or thoracic spine, risk pregnancy**:** severe hypertension, heart disease and late stages of cancer, heart disease, especially cardiac pacemaker users, infectious diseases, hemorrhagic diseases**:** hemophilia and pelvic tilt asymmetry were excluded from the study. The design of this study was two groups pre-test post-test design. Informed consent form had been signed from each patient before participating in the study. Duration of the study was from July 2017 to December 2017. The patients were assigned randomly into two groups equal in number (A&B):Group A: (Control group): 20 primigravida received superficial heat application at the lumbosacral area using an electric heating pad for 15 minutes from side lying position 3 times/week for 6 weeks and advice concerning low back pain during pregnancy. Group B: (Study group): 20 primigravida received the same treatment as group A in addition to specific exercises for low back pain.

Materials:

1. Weight-height scale:

It was used to measure the body weight and height and then body mass index (BMI) was calculated for each woman in both groups (A&B)before the beginning of the study.

2.Visual Analogue Scale:

It was used to assess the intenisty of low back pain for each woman in both groups (A&B) befor and after treatment.

3.Palpation Meter:

Baseline Evaluation Instrumentations 12-1180 U.S.A. It was used to measure the tilting angle of the pelvis which appears in the inclinometer scale (0 to 30 degree). (PALM) is a reliable, valid, and precise instrument for both healthy and patient populations [15].

4.Electric heating pad:

Pure Relief XL King Size Heating Pad 12 X 24 inches from U.S.A. It was used toapply heat at the lumbosacral area for each woman in both groups (A&B).

Procedures:

All women were given a full explanation of the protocol of the study and consent form was signed for each woman before participating in the study.

A- Evaluation procedures:

1- History taking*:*

A detailed history was taken from each pregnant woman in both groups (A & B) to confirm that the only cause of low back pain is pregnancy and to exclude any neuromuscular or neurological disorders before pregnancy that may be the cause of low back pain.

2-Weight and height measurement:

Weight and height were measured for each woman by using weight-height scale to calculate the body mass index (BMI) according to the following equation:

BMI = weight(kg)/height^2(m^2) kg/m^2 [16].

It was measured for all women in both groups (A & B) before the treatment.

3- Pain assessment:

Pain was assessed by visual analog scale (VAS) for each woman in both groups (A&B) before and after the treatment program. VAS allows continuous data analysis by using a 10cm line with 0 (no pain) written at one end and 10 (worst pain) on the other end [17].

4- Palpation Meter (PALM):

Pelvic inclination angle was measured by using PALM. During measuring, PALM was suspended from the researcher's neck by the adjustable cord to free the fingers for holding both arms of PALM. During measurement PALM should be kept horizontally from front to back by adjusting the cord length by the cord lock. Every patient was advised to stand erect with one foot distance between both feet to increase the base of support and arms were crossed over her chest. With lumbosacral region bared skin, the researcher localized locations of ASIS and PSIS. ASIS was located about 45 degree inferior and laterally to umbilicus and PSIS was located when traced the ilium around from the ASIS to the patient back. It was seen as a large dimple [18]. Then the tilting angle was measured using the pointed tip portion of PALM by placing the pad of the index finger on the flat portion of the tip to guide into proper contact with the respective landmark and read the angle degree from the inclinometer scale (Fig. 1).

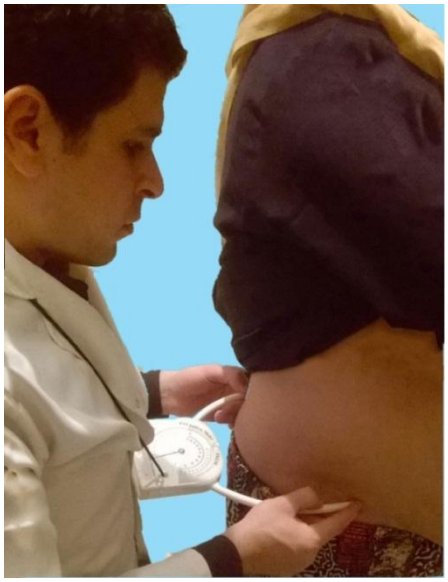

Fig. (1): PALM measuring pelvic tilt angle.

B- Treatment procedures:

1- Superficial heat application for both groups (A & B):

Each woman in both groups (A & B) received superficial heat application at the lumbosacral area using an electric heating pad for 15 minutes from side lying position 3 times/week for 6 weeks.

2- Therapeutic exercises:

The following exercises for low back pain were performed only by women in group (B). The exercise treatment program was repeated three times per week for six weeks.

I) Stretching exercises:

a) Stretching exercise for thehip flexor muscles.

b) Stretching of the lower back muscles fromside lying position.

II) Strengthening exercises:

a) Strengthening exercise for hip extensors (Quadruped resisted leg raising exercise).

b) Strengthening exercise for abdominal muscles:

1. Static abdominal exercise from crock lying position.

2. Dynamic abdominal exercise as antero - posterior flexion of the trunk from supine lying position.

III) Postural correction exercises:

a) Postural correction from supine lying position.

b) Postural correction from standing position.

Statistical analysis:

IBM SPSS statistics software program version 22 was used for all statistical calculations. Descriptive analysis will be done for data collection to calculate the mean and standard deviation. Paired T- test to compare pre and post treatment results in the same group. Comparison between the results of the both groups will be compared by a t-test for non-pair values. The correlation between pelvic inclination and the severity of low back pain was tested by person correlations coefficient. The p-value is the degree of significant. A significant level value was considered when p-value $\leq$ 0.05 and highly significant level value was considered when p-value $\leq$ 0.01.

RESULTS

I-Physical characteristics of the women:

Independent t-test showed that there was no statistical significant difference in the mean values of age, height, weight and body mass index (BMI) between group (A) and group (B) (Table 1).

Table (1): Physical characteristics for all pregnant women for both groups (A&B).

Variables	Groups	Mean	SD	Comparison		S
				t-value	P-value	
Age (yrs)	Group (A)	24.05	±1.959	0.161	0.873	NS
	Group (B)	23.95	±1.959			
Height (Cm)	Group (A)	161	±3.325	0.951	0.348	NS
	Group (B)	160	±3.325			
Weight (kgs)	Group (A)	82	±4.353	0.646	0.522	NS
	Group (B)	81.1	±4.459			
BMI (kg/m^2)	Group (A)	31.603	±0.4345	0.589	0.559	NS
	Group (B)	31.688	±0.4713			

*SD: standard deviation, P: probability, S: significance, NS: non- significant**.**

II. Intensity of low back pain:

A) Within groups:

There was a significant decrease in group A and a highly significant decrease in group B in intensity of low back pain as revealed by the paired t-test between pre and post treatment. The percentage of improvement was 13.57 % and 40.43 % respectively (Table 2) (Fig. 2).

Table (2): Mean and ±SD of intensity of LBP pre and post treatment for both groups (A&B).

	Intensity of low back pain			
	Group A		Group B	
	Pre treatment	Post treatment	Pre treatment	Post treatment
Mean	7	6.05	7.05	4.20
±SD	±1.487	±1.356	±1.538	±1.735
Mean difference	0.950		2.850	
Percentage of increase	13.57 % ↓		40.43 % ↓	
DF	19		19	
t-value	2.230		6.042	
P-value	0.038		0.001	
S	S		HS	

***SD: standard deviation, P: probability, S: significance, S: significant, DF: degree of freedom.**

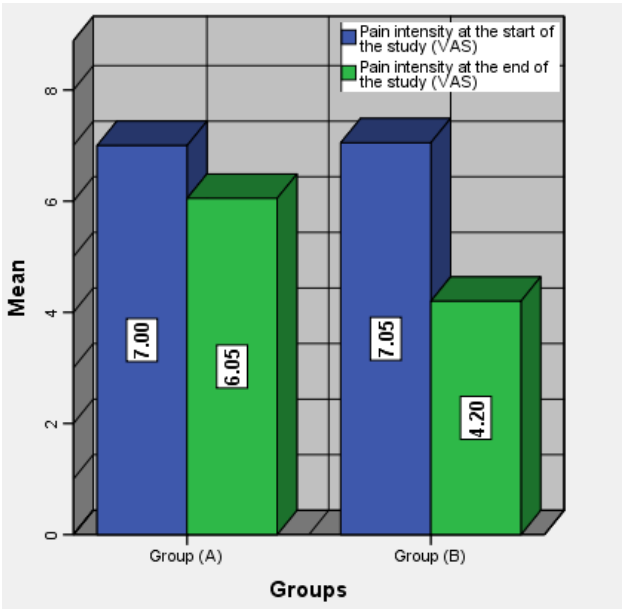

Fig (2): Mean intensity of LBP pre and post treatment for group (A).

B) Between groups:

There was no significant difference in intensity of LBP in pretreatment values between both groups (A and B). But there was a highly significant difference in the post treatment values (more decrease in group B) (Table 3) (Fig. 3).

Table (3): Independent t-test between both groups (A and B) for intensity of LBP pre and post treatment.

Independent t-test	Intensity of LBP	
	Pre	Post
Mean difference	0.05	1.85
t-value	0.105	3.757
P-value	0.917	0.001
S	NS	HS

***SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.**

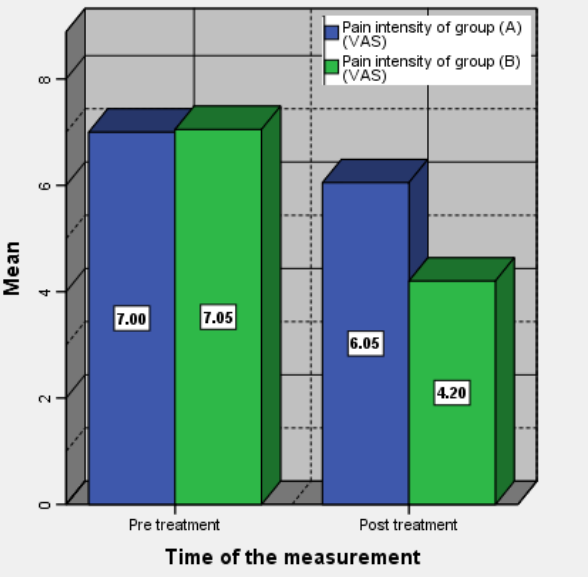

Fig.(3): Mean intensity of LBP pre and post treatment for both groups (A&B).

III. The degree of pelvic inclination (Anterior pelvic tilt angle):

A)Within groups:

There was a highly significant increase in both groups (A&B) in anterior pelvic tilt angle as revealed by the paired t-test between pre and post treatment. The percentage of increase was 7.17 % and 1.35 % respectively (Table 4) (Fig. 4).

Table (4): Mean and ±SD of anterior pelvic tilt angle pre and post treatment for both groups (A&B).

	Anterior pelvic tilt angle			
	Group A		Group B	
	Pre treatment	Post treatment	Pre treatment	Post treatment
Mean	25.80	27.65	26	26.35
±SD	±2.215	±1.631	±1.919	±1.981
Mean difference	1.85		0.35	
Percentage of increase	7.17 % ↑		1.35 % ↑	
DF	19		19	
t-value	-11.103		-3.199	
P-value	0.001		0.005	
S	HS		HS	

***SD: standard deviation, P: probability, S: significance, S: significant, DF: degree of freedom.**

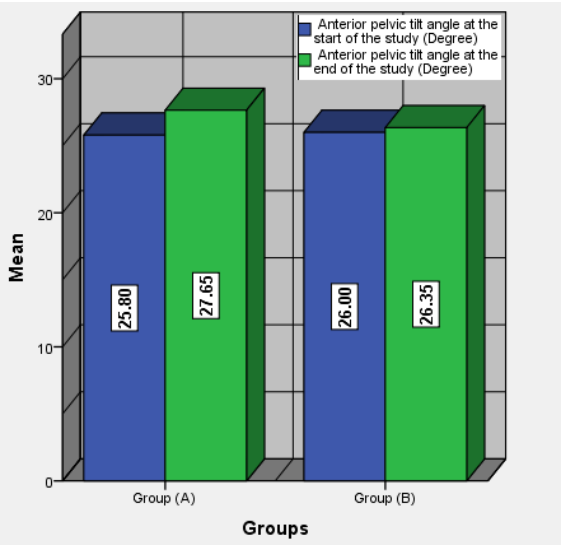

Fig.(4): Mean of anterior pelvic tilt angle pre and post treatment for both groups (A&B).

B) Between groups:

There was no significant difference in pretreatment values of anterior pelvic tilt angle between both groups (A and B). But there was a significant difference in the post treatment values (more increase in group A) (Table 5) (Fig. 5).

Table (5): Independent t-test between both groups (A and B) for anterior pelvic tilt angle pre and post treatment.

Independent t-test	Anterior pelvic tilt angle	
	Pre	Post
Mean difference	0.20	1.3
t-value	-0.305	2.266
P-value	0.762	0.029
S	NS	S

***SD: standard deviation, P: probability, S: significance, NS: non-significant, S: significant.**

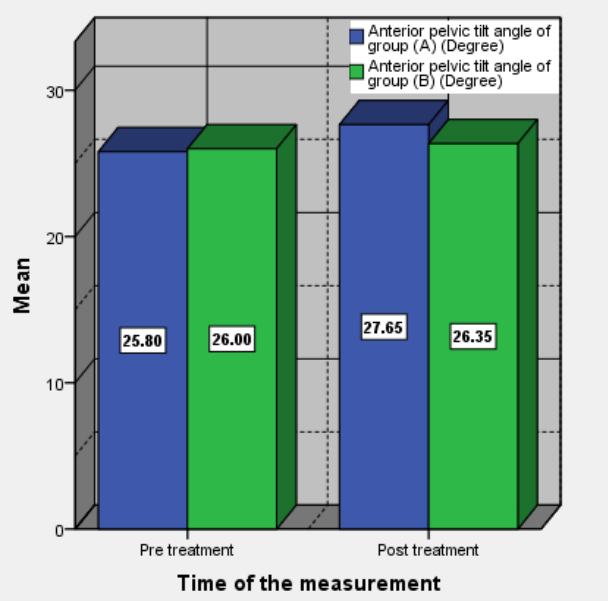

Fig.(5): Mean of Anterior pelvic tilt angle pre and post treatment for both groups (A&B).

III. Correlation between intensity of LBP and the degree of pelvic inclination:

There was a positive correlation between intensity of LBP andthe degree of anterior pelvic tilting angle in pre treatment values where the r value equals (+0.571) and had an associated probability value of (0.001)(Fig. 6).

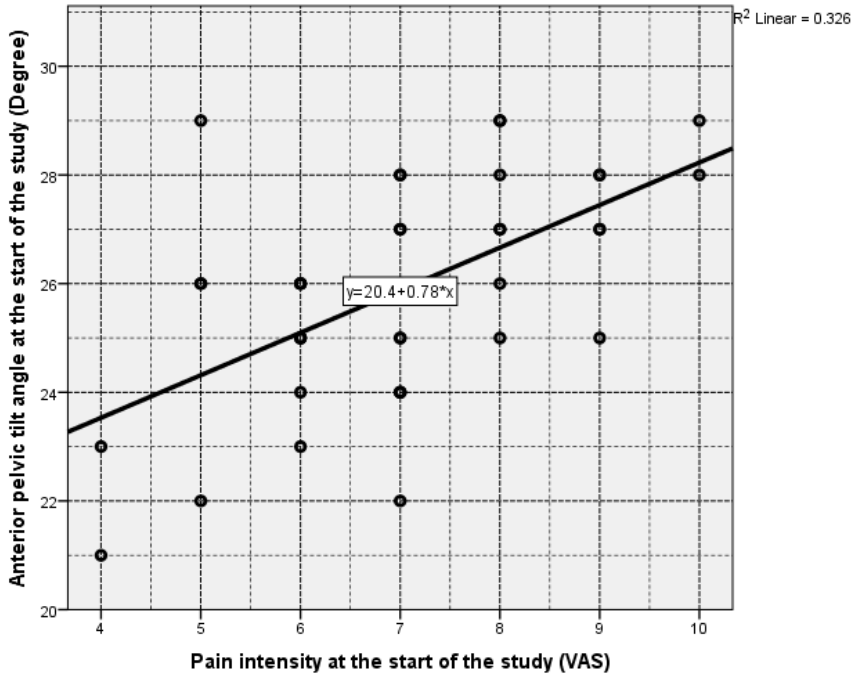

Fig. (6): Correlation between intensity of LBP and the degree of pelvic inclination.

DISCUSION

Pregnancy is a time of tremendous musculoskeletal, physical and emotional changes. Back pain is one of the most common complaints during gestation. During pregnancy, relaxin hormone is present in ten times more than its normal concentration in the nonpregnant female body. It relaxes the joints of pelvis. Also, it causes abnormal motion in many joints of the body causing inflammation and pain [19].

Low back pain is the second most common neurological ailment. Pregnancy is considered as one of the major contributing factors for the development of this clinical entity.Pregnancy-related low back pain (PRLBP) is reported to be one of the most common reasons for sick leave during and after pregnancy [20].

Pelvic alignment in the sagittal plane changes in pregnant women. The pelvis of the pregnant female has more anterior inclination due to pregnancy-related abdominal swelling and relaxation of the pelvic joints as the pregnancy-related hormones have anti-fibrotic properties and affect the ligaments and bone in the pelvic region, and the pelvic ligaments gain laxity [21,22].

This study was conducted to determine the effect of therapeutic exercises on low back pain and the degree of pelvic inclination during pregnancy.

The results of this study revealed that: In group (A), the percentage of decrease in intensity of low back pain was found to be 13.57 % after treatment which indicated a statistically significant decrease (P=0.038).

This comes in agreement with the study of Scott and Nadler [23],who reported that superficial heat application was

helpful in diminishing pain and decreasing local muscle spasm. Also,Nadler et al. [24], stated that thermotherapy triggers decline in pain especially low back pain through inhibiting pain signal.

Muscle pain mechanism has been described partially as resulting from the accumulation of metabolic waste when blood irrigation is insufficient in certain muscles, inducing them to anaerobic metabolism. The increase of metabolic residues within the muscle stimulates and perpetuates pain and spasm even after elimination of the factor causing them. Thermotherapy, therefore, relieves the pain by causing vasodilation and consequently increasing local blood circulation, therefore causing oxygenation and removing metabolic residues. One of the advantages of superficial heat compared to drug therapy and other techniques for pain relief is that it can be applied locally, directly on the pain spot [25].

Scott and Nadler [23], stated that superficial heat can produce local heating effects at a depth limited to between 1 cm and 2 cm. Deeper tissues are not directly heated owing to the thermal insulation of subcutaneous fat and the increased cutaneous blood flow that dissipates heat.

Christena and Kenneth [26],tested the effect of application of electrical heating pad for 20 minutes over the calf skin area. Surface and intramuscular temperatures at a depth of 2 cm in the musclewere measured with type-T thermocouples. They found that dermal temperature increased to about 9.4^{o} C and intramuscular temperature increased to about 7^{o} C.

Not only does blood flow in local arterioles and capillaries increase when exposed to heat, but sympathetic vasodilatation occurs in distant areas as well. Local metabolism also accelerates; nerve sensitivity decreases, and the pain threshold rises. The sensitivity of muscle spindles, nerve endings that affect muscle tone, decreases in response to heat, and muscle spasms are prevented. The extensibility of connective tissue increases, and joint contractures are relieved. The increase in muscle blood flow is also associated with the removal of substances related to fatigue and pain-inducing substances within the muscle. In this way heat has a rapid effect in relieving low back pain [27].

Some of the benefits provided by topical heat therapy may be mediated directly in the brain. Functional brain imaging research has revealed central effects of non-noxious skin warming with increased activation of the thalamus and posterior insula of the brain. In addition, innocuous tactile stimulation of the skin activates the thalamus and S2 region of the cerebral cortex. These direct effects on the brain may mitigate the sensation of pain in the brain, thereby providing pain relief [28].

On the other hand,Chandler et al. [29], stated that scientific evidence for theanalgesic effects of heat was limited although heat has been used for years with the belief that it relieves pain. The authors have attributed this finding to the lack of well-organized studies. Similarly, Ones et al. [30], mentioned that although heat application has been used extensively for outpatient treatment, the randomised controlled studies were to be limited in number.

Concerning the advice about low back pain during pregnancy for group (A), Ostgaard et al. [21],came in the same line with the results of the present study as they stated that low back pain symptoms during pregnancy can be treated effectively through proper body mechanics and instructions to improve posture.

Also,Margaret and Jill [31],stated that the vast majority of primigravida experience so many different pains. They further stated that self help coping strategies can be taught so that women can treat themselves.

Also, the results of the present study concerning group (A) revealed that thepercentage of increase in the degree of anterior pelvic tilt angle was found to be 7.17 % after treatment which indicated a statistically highly significant increase (P=0.001).

The results of this study is supported by Shivani et al. [32], whoreported that there was a gradual increase in the measurement of pelvic inclination angle that was seen from the first through the third trimesters.

The increase in pelvic inclination angle during pregnancy could be explained by the changing in hormones levels. Progesterone and estrogen are well known hormones for causing salt and water retention, also relaxin secreted by the corpus luteum till the 12th weeks gestation, then from placenta after that, tends to softens the ligaments, thus joints are more vulnerable to injuries [33].

The increasing weight is distributed primarily in the abdominal girth. After 12 weeks of pregnancy, the uterus expands out of the pelvis and moves superiorly, anteriorly and laterally. So, many of the problems evoked are postural, caused by inability of the woman to adapt to her forward movement of C.O.G that resulted in increasing the lumbar lordosis and anterior tilting of the pelvis [34].

This increase could be explained as pelvic tilt is controlled by muscular action of the abdominal muscles, hip flexors, hip extensors and spinal extensors muscles. The alternation of strength or resting length of these muscles will also change the angle of pelvic tilt and, in turn, the lumbar curvature. Increased lordosis will result from a forward tilt of the pelvis occurring due to weak abdominal muscles [35].

In group (B), the percentage of decrease in low back pain intensity was found to be 40.43% after treatment which indicated a statistically highly significant decrease (P=0.001). Also, there was statistically highly significant increase (P=0.005) inthe degree of anterior pelvic tilt angle, the percentage of increase was 1.35 %.

This came in agreement withScott and Nadler [23], who stated that superficial heat should be used as an adjunct to facilitate an active exercise program.

AlsoRenata et al. [25],added thatsuperficial heat is widely used and can be applied preceding exercises and handling techniques.

Wadsworth [36],reported that exercise is associated with fewer pregnancy discomforts such as back pain and lower extremity edema.

Beyaz et al., and Kluge et al. [37,14],found reduction in pain intensity following 10 week exercise intervention. George et al. [38], confirmed the same results after 5-9 weeks of home exercise program.

Elden et al. [39], compared effects of additional stabilization exercises and acupuncture with standard care only (which included advice, home exercise and pelvic belt) for six weeks in pregnant women with pelvic girdle pain (PGP). Both, stabilization exercises and acupuncture group, had significantly reduced intensity of pain measured by VAS compared to control group, but acupuncture showed more benefit than stabilization exercises in the evening pain scores.

Ozdemir et al. [40],conducted a study to evaluate the effect of exercise programs on pregnancy-related low back and pelvic pain. Patients in the intervention group received an exercise program for four weeks in addition to, illustrated booklets showing how to develop correct posture, body mechanics and ergonomics during activities of daily living during pregnancy. The study revealed that there was a statistically significant decrease in pain intensity measured by visual analogue scales in intervention than control group.

Nirupma and Ona [41],determined the effect of home exercises program for 3 weeks in addition to precautions and postural education given to each patient through a compiled bookleton pregnant patients diagnosed with low back pain. They concluded that the exercise program and postural education given to women early in their pregnancy decreased the severity of low back pain.

Mary and Susan [42],stated that treatment of low back pain in pregnant women consists of a program of postural correction, pelvic tilt and strengthening of the abdominal as well as lumber musculatures. They added that the majority of women will respond to this conservative regimen.

Garshasbi and Faghih [10],conducted a study to investigate the effect of exercise during second half of pregnancy on the intensity of low back pain. The exercise programs was to strengthen the abdominal muscles, hamstrings muscles and to stretch iliopsoas and para vertebral muscles. The exercise program was applied three times a week for 12 weeks. They concluded that exercise during second half of the pregnancy significantly reduced the intensity of low back pain.

Maryam and Sedigheh [43],conducted a study to determine the effect of exercise training on disability due to low back pain in pregnant women. The intervention group received 8 sessions. These exercises were repeated at least 2 times per week at home. This study showed that exercise training could reduce the disability due to low back pain in pregnant patients during third trimester.

Bandpei et al. [44],stated that training and performing exercise and considering ergonomic recommendations had a significant effect on reducing pain and disability due to back pain during pregnancy.

Yan et al. [45], indicated that balance exercises with the ball were effective in reducing back pain and improving physical functions during pregnancy.

Areerat et al. [46],revealed that sitting pelvic tilt exercise for 8 weeks during the third trimester in primigravidae could decrease back pain intensity .

The results of the present study comein contrast with Stuge et al. [47], as they concluded that there was no strong

evidence to support the effect of exercise on pelvic and lower back pain; however, the methods of exercise often differ between studies.

Similarly, Nilsson-Wikmar et al. [48], reported that pelvic stabilization exercises during pregnancy and the postpartum period did not relieve the severity of low back and pelvic pain and did not shorten the postpartum healing process.

Also ,Eggen et al. [49], did not find significant difference in severity of low back pain and pelvic girdle pain in pregnancy after aerobic and strengthening exercises intervention for local and global muscles and lasted between 16 and 20 weeks.

Stafne et al. [50], conducted a study on 855 pregnant women and divided them randomly into intervention and control groups. Women in both groups received written recommendations on pelvic floor muscle exercises, diet and pregnancy-related lumbo-pelvic pain. In addition to that, women in the intervention group received aerobic activity, strength training and balance exercises program for 12 weeks. They revealed that there were no differences between groups regarding pain intensity as well as exercises during pregnancy do not influence the prevalence of lumbo-pelvic pain.

Being inactive leads to deconditioning and weakening of muscles, which in turn predisposes to loss of function and experience of pain. There is evidence for an association between reduced muscle function and development of LPP in pregnant women [51].

The results of this study found that there was a statistically highly significant difference between both groups (A&B) after treatment in intensity of low back pain (more decrease in group B).

The results of this study agreed withMayer et al. [52],who concluded that combining continuous low-level heat wrap therapy with directional preference-based exercise during the treatment of acute low back pain significantly improves functional outcomes compared with either intervention alone or control.

Kluge et al. [14], conducted a study to investigate the effect of specific stabilizing exercises for strengthening of the transversusabdominis in addition to pelvic floor exercises program for 10 weeks on low back pain during pregnancy. Patients in both groups (study and control) received advices and a pamphlet on back care. Patients in the study group received advice in addition to the exercises program. They revealed that there was a significant improvement in pain intensity in the both groups. There were significant differences in pain intensity and functional ability scores between the both groups at the end of the study. The absence of worsening of pain intensity and disability as the pregnancies progressed in the control group may be due to advice and a pamphlet on back care which they received.

There was statistically significant increase ($P<0.029$) inthe degree of anterior pelvic tilt anglein group (A) compared to group (B).

This comes in agreement with Eva et al. [53], who proved that physically active pregnant women had lower values for the angles of pelvic inclination thanphysically inactive women.

Won-gyu [54],suggested that an approach of individual resistance exercises is necessary for the effective and fast strengthening of the pelvic posterior tilt muscles (rectus abdominis, gluteus maximus, hamstring) in case of LBP with excessive lordosis

Anterior pelvic tilt can be the result of a combination of weak anterior abdominal muscles, tight hip flexors (especially iliopsoas), tight low back musculature, and weak hip extensor muscles. Tight low back and weak hip extensors are seldom found as the primary cause, but when found in conjunction with hip flexor shortness and abdominal weakness, the associated pelvic tilt and lordosis tend to be more exaggerated. Due to the abdominal muscles' attachment on the pelvis, it is logical that when the muscles are activated and in a shortened position relative to an upright posture, the pelvis will tilt posterior [55].

Strengthening exercise which involve gluteus maximus as the attachment of gluteus maximus to the iliac crest will produce posterior pelvic tilting [56].

There is a positive correlation between intensity of low back pain andthe degree of anterior pelvic tilt angle. This come in agreement withEva et al. [53], who proved that the inclination of the pelvis correlates with pain occurrence in the lower parts of the spine and pelvisduring the 2nd half of the 3rd trimester of pregnancy.

In contrast, Franklin and Conner-kerr [35],concluded that the magnitudes and the changes of posture variables during pregnancy were not related to back pain.

Conclusion:

This study concluded that therapeutic exercises are considered an effective method for reducing low back pain during pregnancy and lessen the rate of increasing in the angle of pelvic inclination during pregnancy and confirmed that there is a positive correlation between intensity of low back pain andthe degree of pelvic inclination angle during pregnancy.

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