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Effect of Progressive Muscle Relaxation Technique on Maternal-fetal Physiological Parameters and Stress among Preeclamptic Women

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Abstract
Background: Preeclampsia (PE) is the most prevalent serious pregnancy disorder, complicating 2% to 8% of all pregnancies worldwide, and remains the leading cause of maternal and fetal morbidity and mortality. The application of appropriate management is crucial to avoid the associated complication. **Aim:** This study aimed to evaluate the effect of progressive muscle relaxation technique (PMRT) on maternal-fetal physiological parameters and stress among preeclamptic women. **Methods:** A quasi-experimental research design was used. A convenient sample of 80 pregnant women with mild preeclampsia was recruited from El Shatby Maternity University Hospital in Alexandria governorate. Four tools of data collection were used: (1) basic data structured interview schedule (2) Maternal physiological parameters assessment sheet (3) Non-stress test recording strip (the cardiotocograph) (4) Cohen's perceived stress scale short version (PSS-10). **Results:** The results showed a significant decline in systolic, diastolic blood pressure, pulse rate, and proteinuria at 3 and 7 days after practicing progressive muscle relaxation technique among the study group. Also, a statistically significant difference was observed between intervention and control groups in terms of baseline fetal heart rate (0.026), the number of fetal movements (0.005) acceleration (0.005), and reactivity (0.02) based on the non-stress test. Regarding the stress level, PMRT improved stress level in the study group on the 3rd and 7th days following the intervention. **Conclusion:** PMRT has been proven to be an effective, simple, and inexpensive non-pharmacological nursing intervention that enhances maternal and fetal physiological parameters and reduces the stress level in preeclamptic women. **Recommendation:** Maternity nurses should integrate PMRT as non - a pharmacological approaches in their nursing care of pregnant women with preeclampsia.

Keywords: Physiological parameters, Preeclampsia, Progressive muscle relaxation technique & Stress.

Introduction
Hypertensive disorders of pregnancy (HDP) are the most prevalent medical conditions that complicate pregnancy. They are also the leading causes of maternal and perinatal morbidity and mortality worldwide **(Mahran et al., 2017)**. According to the World Health Organization (WHO), HDP was responsible for 14% of all maternal deaths worldwide in 2015, and 99% of these deaths occur in underdeveloped regions. Four different types of hypertensive disorders can occur during pregnancy: chronic hypertension, gestational hypertension preeclampsia-eclampsia, and preeclampsia on top of chronic hypertension. **(World Health Organization [WHO], 2014; Wilkerson and Ogunbodede, 2019)**.
Pre-eclampsia (PE) is a pregnancy-specific syndrome that affects several organ systems and can be identified by new onset of hypertension and proteinuria after 20 weeks of gestation, complicating 2% to 8% of all pregnancies worldwide. Every year, preeclampsia and eclampsia cause about 40,000 deaths in women in developing nations and it affected 6% to 8% of all pregnancies in Egypt **(Ranaet al , 2019;World Health Organization [WHO], 2014, 2015)**
PE has been defined as a "disease of theories" since its etiology is unknown and it is thought to be influenced by a variety of genetic, immunological, and environmental factors. The pathophysiologic mechanisms underlying this illness are divided into two stages. The first stage is characterized by reduced placental perfusion probably due to abnormal placentation with decreased trophoblast invasion and poor remodeling of the uterine spiral arteries. The second stage is the maternal systemic symptoms, which include inflammatory, metabolic, and thrombotic responses that combine to change vascular function and potentially harm several organs. **(Ranaet al , 2019; Armaly et al., 2018)**
Complications from preeclampsia can affect both the mother and the developing fetus. PE can be abruptly aggravated by eclampsia, the development of HELLP syndrome (hemolysis, increased liver enzymes, and low platelet count), hemorrhagic or ischemic stroke, liver damage, acute kidney injury, and acute respiratory distress syndrome (ARDS). Additionally, PE has been linked to fetal complications including intrauterine growth restriction, low birth weight; abnormal testing of fetal well-being as a nonreactive non-stress test, lowered fetal heart rate variability,

fetal distress, and ultimately intrauterine fetal death. **(Gabal et al., 2017; Takahashi et al., 2021)**.

Mothers who have a complication during pregnancy, such as preeclampsia, are more likely to experience stress during their pregnancies. Moreover, maternal stress is the primary risk factor for unfavorable pregnancy and birth outcomes. According to **González-Ochoa et al. (2018)**, stress during pregnancy raises the risk of gestational hypertension and preeclampsia in pregnant mothers. In a stressful event, the hypothalamus activates the sympathetic nerve, which in turn stimulates the adrenal medulla to secrete epinephrine and norepinephrine which will raise blood pressure and blood sugar levels to meet the needs of the brain, heart, muscles, and bones to overcome the stress. **(Pratiwi et al., 2021)**.

Management of PE is still a challenging problem in obstetrics; vigorous antihypertensive medication therapy is typically avoided to prevent pharmacological-induced hypotension. Another main concern of administering antihypertensive drugs during pregnancy is the possible negative effect on the fetus. So, effective management is best achieved through a combination of pharmacological and non-pharmacological management. The new evidence supports that a healthy diet, weight reduction, exercise, stress management, and relaxation could reduce the risk of PE. **(Odigboegwu et al., 2018)**.

Many different relaxation techniques have been shown to benefit patients in diverse ways. Among the widely used relaxation therapy is Jacobson's Progressive Muscle Relaxation Technique (JPMRT). It is a form of relaxation therapy that focuses on contracting and relaxing specific muscle groups in sequence. It is composed of both physical and mental components. The voluntary tensing and relaxing of the muscle groups constitute the physical component. The mental component focuses on the differences between the feeling of muscle in its states of tension and relaxation. With mental relaxation, muscles and the body can be relaxed or kept away from stress, anxiety, and sympathetic activity. So, in the clinical field, JPMRT is used as a modality to reduce stress, pain, discomfort, hypertension, cardiovascular diseases, and other chronic diseases. **(Rosdiana and Cahyati, 2019; Vinitha and Madhuri, 2020; Ghorbannejad et al., 2022)**

Maternity nurses have a crucial role in promoting the health of pregnant women especially those with hypertension. Lifestyle modification as relaxation and stress reduction alongside pharmacological treatment is an effective and safe management plan for pregnant women with mild PE to reduce the adverse effect on both mother and fetus**(Ali et al., 2022)**

Significance of the study

Preeclampsia is one of the most frequent life-threatening disorders during pregnancy and its greatest impact is in developing countries. Integration of non-pharmacological interventions as PMRT in the care plan of women with preeclampsia is a promising approach to improve the quality of provided care and prevent the associated consequences. PMRT was used less frequently among preeclamptic women to improve maternal and fetal outcomes, despite being simple to use and inexpensive. **(Ghorbannejad et al., 2022)** Moreover, the previous studies had generated conflicting results in this field. **Therefore**, this study aims to evaluate the effect of the Progressive muscle relaxation technique on fetal and maternal physiological parameters and stress among women with preeclampsia. Such knowledge paves the road for nurses to use safe, effective easy to apply and costless method to control preeclampsia

Aim of the study:

Evaluate the effect of progressive muscle relaxation technique on maternal- fetal physiological parameters and stress among preeclamptic women.

Research hypotheses:

H1: Preeclamptic women who practice progressive muscle relaxation technique exhibit normal maternal and fetal physiological parameters than those who don't practice it.

H2: Preeclamptic women who practice progressive muscle relaxation exhibit less stress level than those who don't practice it.

Operational definition:

Maternal Physiological Parameters: They are blood pressure, pulse, and proteinuria.

Fetal Physiological Parameters: They include baseline fetal heart rate, movement, acceleration, and reactivity which are measured with a cardiotocograph machine (CTG).

Materials and Method

Research design: A quasi-experimental, pre-posttest research design was utilized, where the effect of an independent variable (progressive muscle relaxation technique) on dependent variables (maternofetal physiological parameters and stress level) was examined.

Setting: This study was conducted at the preeclampsia unit of El-Shatby Maternity University Hospital in Alexandria governorate, Egypt. This hospital was chosen because it represents the main maternity health agency in Alexandria and it is the only setting that accepts preeclampsia cases from Alexandria as well as adjacent governorates.

Subjects: A convenient sample of 80 pregnant women attending the previously mentioned setting was recruited according to the following criteria.

- Diagnosed with mild preeclampsia (blood pressure results ≥140/90–160/110) with an anticipated 7 days hospital stay in preeclamptic unit for follow up.
- Singleton pregnancy
- Free from any other medical conditions.

Epi info program version 10 was used to estimate the sample size using the following parameters; population size of 100, 50% expected frequency, 5% acceptable error, and 95%confidence coefficient. The estimated minimal sample size was 80 women

The selected subjects were equally assigned to either the control or the study group. Each group compromised 40 women

Tools of data collection:

Tool I: Basic data structured interview schedule:

This tool was developed and used by the researchers to collect basic data about the study subjects. It included two parts:

Part I: Socio-demographic characteristics including age, level of education, occupation, marital status, and residence.

Part II: Reproductive history such as gravidity, parity, number of abortions, previous pregnancy complications, and weeks of gestation.

Tool II: **Maternal physiological parameters assessment sheet:** It was developed by the researchers for recording systolic and diastolic blood pressures, pulse rate, and proteinuria

Tool III: **Non-stress test recording strip (the cardiotocograph CTG graph)**

CTG is essentially a screening test for fetal well-being, especially during PE. It includes a visual representation of the FHR correlating to fetal movement, from which the researchers record the fetal physiological parameters as a baseline fetal heart rate, number of accelerations and decelerations, number of fetal movements, as well as reactivity of NST

Based on Cunningham et al., 2014), the interpretation of the Non-stress test was:

1- Reactive (normal):

- At least two fetal movements in 20 min.
- Acceleration of the FHR by at least 15 beats/min above the baseline rate, and last for at least 15 seconds.
- Presence of variability of at least 10 beats/min.
- A baseline FHR rate within the normal range (120 – 160 bpm).

2- **Non-reactive (abnormal):** It Includes any trace with no or insufficient FHR acceleration (less than 15 beats per minute).

Tool IV: Cohen's perceived stress scale short version (PSS-10):

It was developed by **Cohen et al. (1983)**, and an Arabic version of this tool was published by **Chaaya et al. (2010)** with internal consistency was 0.74.

The latter was adapted and used to measure subjects' levels of stress.

It is comprised of 10 items that ask about thoughts and feelings during the last month.

Each item was rated on a 3-point Likert scale with the following coding:

- Often (3 points).
- Sometimes (2 points).
- Never (1 point).

The total score for each subject ranged from 10 – 30.

Subjects' perceived stress level was categorized as follows:

- Low stress < 17.
- Average stress 17- < 24.
- High stress ≥24

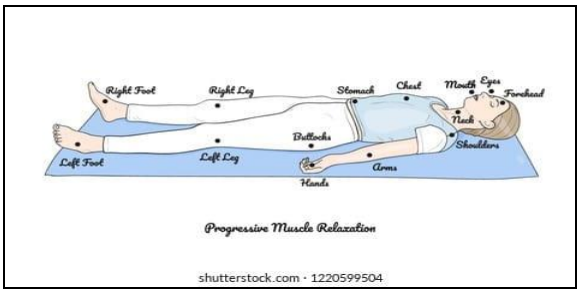
Method

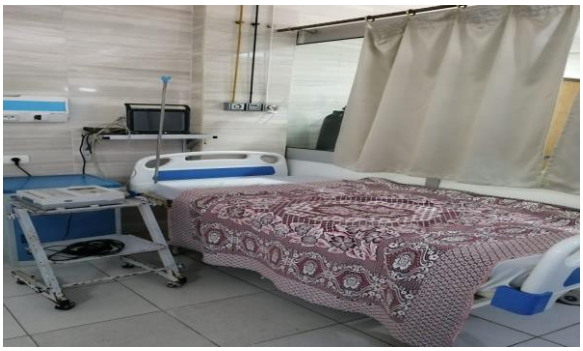
The study was conducted according to the following steps:

1. Approval for conducting the study was obtained from the Ethical Research Committee review board of the faculty of nursing, Alexandria University.
2. The researchers obtained permission for conducting the study from the responsible authorities of the study setting
3. The Researchers attended a training program on progressive muscle relaxation technique at the training unit faculty of nursing, Alexandria University, and an accredited certificate was obtained.
4. Tools were tested for content validity by a jury of 5 experts in obstetrics and gynecology nursing field then the necessary modifications were done.
5. The reliability of the tools was tested using the Cronbach Alpha test (internal consistency) and the results were satisfactory (0.77, 0.84 tool II&III).
6. A pilot study was carried out on eight preeclamptic women (10% of the sample size) to ensure the clarity and applicability of the tools, identify obstacles and problems that may be encountered as well as to estimate the time needed for data collection. Accordingly, the necessary modifications were made. Women participating in the pilot study were excluded from the main study sample.
7. The researchers approached the pregnant women who fulfilled the inclusion criteria and provided them with a detailed description of the nature of the intervention. The recruited pregnant women were assigned either to the study or the control groups.
8. Before the procedure, the basic data, maternal and fetal physiological parameters, as well as level of stress, were assessed and documented for the two groups using tools (I, II, III &IV). Pulse is checked by pressing the radial artery for 1 minute,

blood pressure is monitored by a sphygmomanometer, and proteinuria is checked by dipstick method, to assess fetal physiological parameters, every woman was asked to lie down on the left lateral position and the CTG machine was attached and the non-stress test was recorded for 20 minutes (baseline assessment).

9. **For the study group**: the progressive muscle relaxation technique was performed twice daily in the morning and evening shifts for 7 consecutive days under the supervision of the researchers. The researchers explained to each woman how to practice progressive muscle relaxation technique through different visual materials like videos, and pictures and provided a demonstration of each step. The procedure included the following steps.
   - The woman was asked to evacuate her bladder, lose any tight clothes, assuming a comfortable position. Then she was asked to inhale deeply through her nose, feeling her abdomen rise, and then slowly exhale out the mouth. Repeat 3-5 cycles of deep breathing.
   - After that, they were asked to tense the face muscles groups, wrinkle the forehead, close eyes very tightly, and pursed the lips hold for account 5-7 seconds. Then release the hold gradually.
   - They were also instructed to clench the fist of the hands, and move on to biceps by drawing the forearm up towards shoulder, and slowly bend the elbow by using a strong contraction. Then, slowly release while counting to 10.
   - After that, the researcher instructed the women to shrug the shoulders lightly up towards ears. Slowly turn head to one side until feeling a gentle stretch. Hold them for five seconds and then slowly release.
   - To prevent premature labor contractions, the abdominal muscular contraction was avoided.
   - Finally, the researchers instructed the women to tense the muscles of the legs by lift them off the ground, straighten knees, and point toes backward. Hold them for five seconds and slowly release them.





Pre-eclamptic unit in Elshatby hospital

10. **The control group**: included 40 women who received routine hospital care for a preeclamptic woman (history taking, physical examination and **routine** investigations). In addition to the researcher's physical presence
11. Using tools (II,III) maternal and fetal Physiological parameters were assessed for both group before starting the intervention to record baseline physiological parameters (pretest) and reassessed at 3rd and 7th day after intervention
12. Stress level was assessed for all preeclamptic women in both groups before intervention and at 3rd and 7th day later using the tool (IV)
13. The data collection was conducted from mid of September to the end of December 2022.

Ethical considerations

Before applying the interventions, the researchers approached pregnant women who fulfilled the inclusion criteria and provided them with a detailed description of the nature of the interventions to obtain their informed consent. Researchers also ascertained that participation in the study is entirely voluntary. Their right to refuse to participate or withdraw from the study at any time without any change in the quality of the provided care was also emphasized. Confidentiality of the obtained data, women's anonymity, and privacy were assured.

Statistical analysis, data were loaded into SPSS version 23. The data were analyzed using descriptive statistics such as number, percentage, mean, and standard deviation. To compare the two groups, Chi-square, Fisher exact, and paired t-test were performed. At 0.05, the test results are considered significant.

Results

Table (1): Number and percent distribution of the studied groups according to their socio-demographic characteristics

Socio-demographic Characteristics	Study group No (%)	Control group No (%)	Test of significance	P
Age				
• < 20	7 (17.5)	6 (15.0)	X^2= 0.159	**0.984**
• 20<30	8 (20.0)	9 (22.5)		
• 30- 40	25 (62.5)	25 (62.5)		
Mean ±SD	30±6.965	29.68±6.518	t= 0.022	**0.882**
Level of education				
• Read & Write	12 (30.0)	19 (47.5)	X^2= 0.5806	**0.121**
• Secondary	12 (30.0)	14 (35.0)		
• University	16 (40.0)	7 (17.5)		
Occupation:				
• Housewife	31 (77.5)	35 (87.5)	X^2= 2.812	**0.093**
• working	9 (22.5)	5 (12.5)		
Place of residence:				
• Urban	20 (50.0)	16 (35.0)	X^2= 0.833	**0.361**
• Rural	20 (50.0)	24 (65.0)		

X^2= Chi-Square test *t= Student T test* ** Significant p at ≤0.05*

Table (2): Number and percent distribution of the studied groups according to their reproductive history

Reproductive history	Study group No (%)	Control group No (%)	Test of significance	P
Gravidity	**N=(40)**	**N=(40)**		
• Primigravida	15(37.5)	16(40.0)	X^2= 4.730	**P= 0.292**
• Multigravida	13(32.5)	12(30.0)		
• Grand multigravida (≥ 4)	12(30.0)	12(30.0)		
Parity	**N=(25)**	**N=(24)**		
• Primipara	5(20.0)	3(12.5)	X^2= 3.281	**P= 0.350**
• Multipara	15(60.0)	16(66.7)		
• Grand multipara (≥ 4)	5(20.0)	5(20.8)		
Number of abortion	**N=(40)**	**N=(40)**		
• Yes	25(62.5)	24(60.0)	X^2= 0.556	**P= 0.456**
• No	15(37.5)	16(40.0)		
Previous pregnancies complications	**N=(21)**	**N=(25)**		
• Preeclampsia	10(47.7)	9(36.0)	X^2= 2.222	**P= 0.695**
• Bleeding	9 (42.8)	12(48.0)		
• Gestational diabetes (GDM)	2(9.5)	4(16.0)		
Weeks of current gestation	**N=(40)**	**N=(40)**		
• 28 wks.-	13 (32.5)	18(45.0)	X^2= 4.501	**0.105**
• 32 wks. -	17 (42.5)	19 (47.5)		
• ≥36 wks.	10 (25.0)	3 (7.5)		

X^2= Chi-Square test *t= Student T test* ** Significant p at ≤0.05*

Table (3): Distribution of the studied groups according to their physiological parameters

Physiological parameters	Before intervention		On the third day (After)		On the Seventh day (After)	
	Study group	Control group	Study group	Control group	Study group	Control group
Systolic BL.P						
Mean ±SD	154.25± 7.17	150.50± 9.80	140.13±8.14	145.12±10.6	119.25±3.3	140.12±17.07
Test of sig,	t = 1.953 p = 0.054		t = 2.361* ,p = 0.021*		t =7.592* p <0.001*	
Diastolic BL.P						
Mean ±SD	95.20±11.17	92.75±12.19	83.15±4.47	87.38±9.80	77.00±4.6	85.38±9.8
Test of sig,	t =0.937 p =0.352		t = 2.484* p = 0.015*		t =4.896*(<0.001*)	
Pulse rate						
Mean ±SD	97.78±16.26	96.05±10.99	85.40± 6.26	91.05±10.26	80.78±3.26	90.78±10.26
Test of sig,	t =0.558 p =0.579		t =2.973* p =0.004*		t =5.875* p <0.001*	
Protein in urine: No (%)						
+1 proteinuria	3 (7.5)	2(5)	17(42.5)	10(25.0)	25 (62.5)	15 (37.5)
+2 proteinuria	37(92.5)	38 (95)	23 (57.5)	30 (75.0)	15 (37.5)	25 (62.5)
Test of sig,	χ^2 = 0.065 p =0.799		χ^2 = 8.116* p = 0.017*		χ^2 =19.515* p <0.001*	

t*= paired t test* *X^2= Chi Square test* ** Significant p at ≤0.05*

Table (4): Distribution of the studied groups according to their fetal physiological parameters using CTG

Fetal physiological parameters	Before intervention		On the third day (After)		On the Seventh day (After)	
	Study group	Control group	Study group	Control group	Study group	Control group
Reactivity	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Non-reactive	9 (22.5)	8 (20.0)	2 (5.0)	9 (22.5)	1 (2.5)	6 (15.0)
Reactive	31 (77.5)	32 (80.0)	38 (95.0)	31 (77.5)	39 (97.5)	34 (85.0)
Test of sig	χ^2 =0.075 p =0.785		χ^2 =5.165* p =0.023*		χ^2 = 3.914 p =0.02*	
Fetal heart rate						
120-160 b/m	32(80.0)	30(75.0)	37(92.5)	30(75.0)	40(100)	34(85.0)
< 120 b/m	8(20.0)	10(25.0)	3(7.5)	10(25.0)	0(0.0)	6(15.0)
Test of sig	χ^2 = 0.287 p =0.592		χ^2 =4.501* p =0.034*		χ^2 =6.486* p =0.026*	
Number of fetal acceleration						
Mean ±SD	2.1 ±1.9	1.5 ±1.5	3.1 ±1.4	2.1 ±1.5	3.43± 1.87	2.70± 1.74
Test of sig	t =1.568 p =0.121		t = 3.082* p = 0.003*		t =2.893* p = 0.005*	
Number of fetal movement						
Mean ±SD	3±3.44	3 ±3.8	4.3 ±2.0	3.3 ±1.8	5.9 ±2.4	4.5 ±1.9
Test of sig	t =0.0 p =1.000		t =2.351* p =0.021*		t =2.893* p = 0.005*	

Table (5) Distribution of the studied groups according to their stress level before and after the intervention

Stress level	Before intervention		On the third day (After)		On the Seventh day (After)	
	Study group	Control group	Study group	Control group	Study group	Control group
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
• **Low stress**	3(7.5)	4 (10.0)	15(37.5)	0 (0)	22 (55)	0 (2.5)
• **Average**	35(87.5)	33 (82.5)	25 (62.5)	37 (92.5)	18 (45)	37 (92.5)
• **High**	2 (5.0)	3(7.5)	0(0.0)	3(7.5)	0 (0.0)	3(7.5)
Test of sig,	χ^2 =0.520 p =0.817		χ^2 = 22.111* p <0.001*		χ^2 = 36.143* p <0.001*	

t*= paired t test* ** Significant p at ≤0.05*

Table (6): Distribution of the study group according to the intervention's effect size regarding systolic, diastolic blood pressure, pulse and respiration mean scores

Items	Study Group (n=40)			Test of Significance
	Before (Baseline)	After (^{14} session)	Effect size	
	Mean ±SD	Mean ±SD		
Systolic BL.P	154.25±7.17	119.25±33	0.91	t= 19.557 P= 0.000*
Diastolic BL.P	90.20±11.17	77.00±4.6	0.80	t= 9.516 P= 0.000*
Pulse	97.78±16.26	80.78±3.26	0.70	t= 6.483 P= 0.000*
Stress	21.90±0.982	18.30±1.636	0.80	t= 11.932 P= 0.000*

T = Paired t test ** Significant p at ≤0.05*
Effect size 0.0- 0.2 Small effect *0.3 -0.7 Medium effect ≥ 0.8 Large effect*

Table (1): Shows an equal percent (62.5%) of the study and control groups were in their thirties. It was apparent that 30% of the study group just read and write, compared to 47.5% of the control group. The table also reveals that as many as (77.5%, and 87.5%) of the studied groups respectively are housewives. It was observed that the proportion of rural residents in the study and control groups respectively was 50% and 65%. There was no statistically significant difference between the two groups in terms of their socio-demographic characteristics.

Table (2): Reveals that less than one third (37.5% & 40.0%) of the study and control groups respectively were primigravida. Regarding parity 60.0 % and 66.7%, respectively, of the study and control groups were multipara. It was discovered that 37.5% & 40.0% of the study group and control group respectively had no history of abortion. Slightly less than half (47.7 %) of the study group had a history of preeclampsia in a prior pregnancy, compared to 36.0 % of the control group. Where (42.8%, 9.5%) had complained of either vaginal bleeding or GDM, compared to (48.0% & 16.0%) of the control group respectively. As regards weeks of gestation, it was noticed that more than two fifths (42.5%) of the study group were between (32-35) weeks of gestation compared to 47.5% of the control group.

Table (3): Displays the distribution of the studied groups based on their physiological parameters before and after the intervention. The study group's mean systolic blood pressure was 154.25±7.17 before the intervention, compared to 150.50±9.80 for the control group. The mean systolic blood pressure in the study group decreased to 140.13±8.14 on the third day after the intervention, compared to 145.12±10.6 in the control group. On the seventh day, the s mean systolic blood pressure in the study group dropped to 119.25±3.3 whereas it slightly decreased in the control group 140.12±17.07. The mean diastolic blood pressure before the intervention was 95.20±11.17 in the study group compared to 92.75±12.19 in the control group. On the third day following the intervention, the mean diastolic blood pressure decreased to 83.15±4.47 in the study group compared to 87.38±9.80 in the control group. On the seventh day, the mean diastolic blood pressure in the study group dropped to 77.00±4.6 compared to 85.38±9.8 in the control group. There was a statistically significant difference between the two groups in relation to systolic (on 3rd day P= 0.021, on 7th day P= 0.001) and diastolic blood pressure (on 3rd day P= 0.015, on 7th day P= 0.001).

The table also shows that the mean pulse rate was 97.78±16.26 and 96.05±10.99 for the study and control group respectively before intervention. By the third day after intervention, the study group's pulse rate decreased to 85.40± 6.26 and a further decrease was observed by the seventh day to 80.78±3.26. However, in the control group, the mean pulse rate remained high (91.05±10.26, 90.78±10.26) on the third and seventh day respectively after intervention with a statistically significant difference between both groups (on the 3rd day P=0.004, on the 7th day P= 0.001).

In relation to proteinuria, (92.5% & 95%) of the study and control groups respectively had +2 proteinuria before intervention. On the third day, this percentage declined to 57.5% among the study group compared to 75.0% among the control group. By the seventh day, further decline in proteinuria was observed among the study group to (37.5) compared to 62.5% of the control group with a statistically significant difference between both groups (on the 3rd day P= 0.017, on the 7th day P= 0.001).

Table (4): As presented in before intervention more than one fifth (22.5%) of the study group had Non-reactive stress test result compared to 20 % of the control group. By the third day, this percentage dropped to 5% among the study group compared to 22.5% in the control group. While on the seventh day the percentage of the nonreactive non-stress test was among the minority (2.5%) of the study group compared to 15% of the control group. Before the intervention (20%, & 25%) the study and control group respectively had low baseline fetal heart rate (<120b/m). By the third day, this percentage dropped

to 7.5% among the study group however it remained the same (25%) among the control group. By the seventh day, the entire study group had normal baseline fetal heart rate compared to 15% of the control group. There was a statistically significant difference between the two groups in relation to reactivity (on 3rd day P= 0.023, on 7th day P= 0.02) and baseline fetal heart rate (on 3rd day P= 0.034, on 7th day P= 0.026).

Moreover, the mean acceleration of the study group was 2.1 ±1.9 compared to 1.5 ±1.5 of the control group prior to intervention. By the third day, it was increased to 3.1 ±1.4 among the study group and 2.1 ±1.5 among the control group. On the seventh day, the mean number of acceleration improved to 3.43± 1.87 in the study group compared to only 2.70± 1.74in the control group. In addition, the mean number of fetal movements among the study group was 3±3.44 compared to 3 ±3.8 among the control group before the intervention. It was increased to 4.3 ±2.0 in the study group by the third day and 3.3 ±1.8 in the control group. On the seventh day, the number of fetal movements increased to 5.9 ±2.4 where as it slightly increased to 4.5 ±1.9 among the control group. There was a statistically significant difference between the two groups in relation to acceleration (on 3rd day P= = 0.003, on 7th day P= 0.005) and fetal movement (on 3rd day P= 0.021, on 7th day P= 0.005).

Table (5): Exhibits the distribution of the studied groups' stress levels before and after the intervention. Before the intervention, 87.5% of the study group and 82.5% of the control group had average stress levels. On the third day following the intervention, progressive relaxation therapy improved stress levels in the study group, with the average stress level dropping to 62.5 % compared to 92.5 % in the control group. on the seventh day after intervention, the percentage dropped to 45% among the study group while it remained the same among the control group (92.5 %), there was a high statistically significant difference between the two groups (P= 0.000).

Table (6): Reveals the distribution of the study group according to the intervention's effect size regarding maternal physiological parameters and stress mean scores. It can be observed that a highly statistically significant difference was found after seven days of the intervention concerning their physiological parameters and stress level where (P=0.000); where the mean score of systolic blood pressure, significantly decreased with a large effect size (0.91); the mean score of diastolic blood pressure decreased with a large effect size (0.80); the mean score of the pulse was decreased with a medium rate effect size (0.70); the mean score of the stress level had decreased with a high effect size (0.80).

Discussion

Preeclampsia is a syndrome of extensive vascular endothelial dysfunction and vasospasm that develop after 20 weeks of gestation. It is the most common medical complication of pregnancy and its prevalence has been increasing globally. In addition, it may make pregnant women anxious about themselves or their unborn child. Therefore, there is an urgent need for novel and unconventional methods to treat hypertension during pregnancy; in particular, non-pharmacological therapies. Relaxation techniques are thought to be an effective treatment for these types of disorders. The relaxation response brings about homeostatic equilibrium. There are many different relaxation techniques, including diaphragmatic breathing, meditation, and imagery techniques; music therapy, massage therapy, and progressive relaxation technique are among the most popular ones **(Aalami et al., 2016; Kamel et al., 2020)**.

According to the findings of the present study it can be observed that both the study and control groups were matching in almost all of their socio-demographic characteristics, and reproductive history. In general, this constant profile of the study participants helped limit extraneous variables that could interfere with the effect of the intended intervention. It also helped in understanding and securing the reliability and relevance of the forthcoming results of the current study.

The study achieved its proposition by illustrating that the progressive muscle relaxation technique is an efficient way of improving maternofetal physiological parameters and reducing stress levels among preeclamptic women. On evaluating maternal physiological parameters, findings of the present study showed a significant decline in systolic and diastolic blood pressure as well as proteinuria among the study group on the 3rd and 7th days after sessions of progressive muscle relaxation, these results suggested that the time duration of performing PMRT is important to achieve its subtle and cumulative effects This could be justified because practicing JPMRT until feeling relaxed and calm can reduce a woman's corticotrophin-releasing hormone (CRH) and adrenocorticotropic hormone (ACTH) levels in the hypothalamus. Due to the reduction in sympathetic nerve activity caused by this mechanism, both the levels of adrenaline and noradrenaline may also drop. As a result, the heart rate, blood vessel resistance, and cardiac muscle exertion all decreased, lowering cardiac arterial blood pressure. **(Pratiwi et al., 2021)**.

The present findings are congruent with **(Puspitasari et al., 2022)** who reported a significant decline in systolic, diastolic blood pressure, and proteinuria after 3 and 7 days of practicing PMRT (P<0.001, P=0.008,

P<0.001) respectively. It also agrees with **(Ghorbannejad et al., 2022)** who concluded that PMRT is a beneficial non-pharmacologic intervention in reducing blood pressure and proteinuria among pregnant women with non-severe preeclampsia. In parallel, **(Rajeswari & SanjeevaReddy, 2020)** observed that six weeks of Jacobson's progressive muscle relaxation improved blood pressure in the intervention group compared to the control group which matched the findings of the current research.

The present study findings are also in line with **(Sulaeman et al. 2018)** who concluded that relaxation techniques have shown beneficial improvement in physiological parameters and reduction of blood pressure among pregnant women with mild pregnancy-induced hypertension. Furthermore, **(Azimian et al., 2017)** stated in their study about the effect of PMRT and guided imagery on gestational hypertension that there was a considerable improvement in systolic and diastolic blood pressure after the intervention. Again, the current findings also match with the study conducted by **(Aalami et al., 2016)** on the effects of progressive muscular relaxation and breathing control techniques on blood pressure during pregnancy. They observed that blood pressure decreased not only after 4 weeks but also after the weekly intervention in the relaxation groups, while it showed no significant decrease in the control group.

In evaluating the effect of PMRT on fetal physiological parameters, the results of the current study reveal a statistically significant difference between the control and study groups in terms of the mean number of fetal reactivity, FHR, acceleration, and the number of fetal movements based on NST before and after the intervention (Table 4). This could be explained by improved perfusion and an increase in oxygen delivery to the fetus as a result of a reduction in sympathetic Adreno-medullary system reactivity following PMRT. **(Fink, Urech, et al. 2012)**

The present findings agree with the findings of the previously mentioned study conducted by **(Ghorbannejad et al., 2022)** who found that the baseline fetal heart rate and fetal movement improved, as measured by the NST in the intervention group. The current finding is also in harmony with the study conducted by **(Akbarzade et al., 2015)** who revealed the mean basal fetal heart rate was 138.95±8.18 before the intervention and 133.07±6.9 after the intervention, and the mean number of fetal heart accelerations was 1.5±0.8 before the intervention and increased to 2.2±0.9 after it .they concluded that maternal relaxation plays an important role in fetal health. In addition, **Lorena et al. (2015)** stated in their systematic review about relaxation during pregnancy what are the benefits for the mother, fetus, and the newborn. That relaxation during pregnancy is associated with positive effects on fetal behavior.

Preeclampsia may be caused by anxiety and stress, and anxiety and stress scores were found to be greater in women with PE (severe or non-severe). Therefore, relaxation methods can improve hypertension symptoms and other maternal and fetal outcomes by reducing the anxiety or stress of pregnant mothers **(Damodaran 2015).** In this context, the present study results revealed that the level of stress among the study group was significantly decreased after practicing progressive muscle relaxation technique. This could be explained in the light of the fact that PMR is a technique of tensing and relaxing muscles which is a psychological mechanism that connects the mind and body. PMR focuses attention on muscle activity by paying attention to muscle tension and relaxation so that it has a relaxing effect. In a relaxed state, the body will rest and activate the parasympathetic nervous system. The work of the parasympathetic nerves stimulates the production of endorphin hormones which then provide a comfortable and relaxing effect, which in turn inhibits the secretion of adrenocorticotropin (ACTH) and the hormone cortisol which then causes a decrease in stress and anxiety scores. (**Pratiwi et al., 2021)**

Reshma et al. (2012), observed similar findings in their study about the effect of relaxation therapy on the level of stress and physiological parameters among mothers with mild pregnancy-induced hypertension. They concluded that relaxation therapy had reduced the level of stress in the experimental group. The present finding also is compatible with the systematic review of **(Smith et al., 2020)** who revealed that relaxation therapy had been beneficial in reducing stress during pregnancy among preeclamptic women. Furthermore, a study by **(Vanita & Weljale, 2019)** congruent with the present results revealed that relaxation therapy was effective in reducing stress in antenatal mothers with PIH.

Moreover, the present finding is relatively similar to **(Ekasari et al., 2021)** who concluded that Progressive muscle relaxation therapy is suitable for reducing anxiety in pregnant women with gestational hypertension. Again, **(Damodaran, 2015)** showed that the mean post-test anxiety score was lower than the mean pre-test score of antenatal mothers with PIH in the experimental group.

In Conclusion:

The progressive muscle relaxation technique appears to have a significant effect on systolic and diastolic blood pressure, proteinuria and stress levels among preeclamptic women as well as a significant

improvement in fetal physiological parameters. It is considered to be a useful and cost-effective non-pharmacological intervention for managing preeclampsia.

Recommendations:

1. Training courses for nurses in preeclampsia units on the use of non-pharmacological therapies like PMRT are advised.
2. Evidence-based correct, current information about non-pharmacological interventions for pregnant women with preeclampsia should be included in the curricula of midwifery education.
3. Maternity nurses should integrate PMRT as non - pharmacological approach in their nursing care of pregnant women with preeclampsia.
4. Replication of this research on a larger scale and for a longer period to determine the long-term effects of PMR therapy

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