Original Article

Progressive Muscular Relaxation Versus Breathing Excercise Techniques to Control Blood Pressure among Mild Preeclamptic Pregnant Women

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Abstract

Background: Hypertensive disturbances during pregnancy are the leading cause of maternal and fetal death; unfortunately, no effective treatment exists. Therefore, interventions that reduce the likelihood of developing preeclampsia during pregnancy are required. This study aimed to see how Progressive Muscle Relaxation (PMR) compared to breathing exercise techniques affected Blood Pressure (BP) levels among mildly preeclamptic pregnant women. **Materials and Methods:** A convenience sample was used in a quasi-experimental study of 75 mild preeclamptic pregnant women in the Obstetrical Outpatient Clinics at the Suez Canal University Hospital in Ismailia, Egypt. They were divided into three groups: study group [I]: the deep breathing exercise group; study group [II]: the PMR group; and study group [III]: the control group. Data were collected using two methods: an interviewing information collection tool and a physiological measurement tool. **Results:** There was a statistical significant difference in systolic and diastolic blood pressure after six weeks of training among intervention groups (PMR and breathing excercise technique with p value 0.001 for both groups) compered to contol group. However, there was no statistical difference in BP (systolic or diastolic) after two weeks of intervention among the three groups. **Conclusions:** PMR and breathing techniques could effectively control BP in pregnancy complicated by mild preeclampsia. Both techniques could be introduced in routine antenatal care for women diagnosed with mild preeclampsia. Health and fitness professionals should focus more on preparing and delivering various sports programs incorporating various muscle relaxations and breathing techniques.

Keywords: *Preeclampsia, progressive muscle relaxation, respiratory muscle training*

Introduction

Gestational hypertension, preeclampsia, chronic hypertension, and preeclampsia with chronic hypertension are examples of Hypertensive Disorders of Pregnancy (HDP), which affect 5–10% of pregnancies globally.[1] Preeclampsia is a pregnancy-specific hypertensive disease with multisystem involvement. It is a joint vascular endothelial dysfunction and vasospasm disease that develops after 20 weeks of pregnancy and can last up to 4–6 weeks following delivery (after childbirth). Preeclampsia is a more severe form of hypertension that affects about 14% of pregnant women.[2] Preeclampsia causes a variety of maternal and fetal issues, including an increased risk of fetal and neonatal death due to factors such as low weight for gestational age, intrauterine growth restriction, preterm labor, and placental abruption, as well as maternal mortality due to heart failure, renal failure, and maternal death, all of which are associated with an increase in cesarean section deliveries.[3,4] First pregnancy, elderly, high Body Mass Index (BMI) before pregnancy, many pregnancies, race, diabetes, a history of hypertension, and poor socioeconomic status are all risk factors for preeclampsia. According to the Preeclampsia Foundation, preeclampsia and associated hypertension diseases of pregnancy cause 76,000 maternal and 500,000 newborn fatalities worldwide each year.[5]

Preeclampsia is not dependent on a pharmacological cure; the only known "cure" is to deliver the baby and remove the placenta. Acetylsalicylic Acid (ASA)is often given prophylactically to women at high risk of preeclampsia. Other regularly used drugs reduced Blood Pressure (BP) and its physical implications (e.g., stroke), but did not cure

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the condition. As a result, iatrogenic prematurity is common with HDP to alleviate maternal symptoms, such as organ failure and stroke.[6] Various relaxation techniques have been suggested to help treat preeclampsia in recent years. The most frequent techniques are diaphragmatic breathing, meditation, image therapies, music therapy, massage therapy, progressive relaxation, hypnosis, autogenic training, and biofeedback. Each strategy has unique characteristics that set it apart from the others. Economically, they are more appealing than pharmaceutical approaches because they are less expensive.[7]

The breathing control technique has been demonstrated to lower BP in most cases and affect chronic hypertension. Deep breathing, or diaphragmatic breathing, is a relaxation technique based on mind–body integration.[8] While inhaling and exhaling slowly, preeclamptic pregnant women must contract their diaphragms. Deep breathing appears to raise blood oxygen levels, massage the internal organs in or around the stomach, and stimulate the vagus nerve.[9] Edmund Jacobson created Progressive Muscle Relaxation (PMR) in the 1920s as a method of actively engaged relaxation. Due to preeclampsia's severe maternal and fetal complications, PMR entails preeclamptic pregnant women tightening and gradually releasing muscles to create tension.[7]

Furthermore, there are no proven effective treatments. Aside from the fact that some treatments are not suggested during pregnancy, in most cases, delivery is advised due to unanticipated worsening.[10] Stress management techniques are now used to treat essential hypertension.[11] Previous research has focused on the beneficial effects of relaxation techniques on women with pregnancy-induced hypertension during the postpartum period. However, there has been little research on the combined effect of PMR and deep breathing exercises on mild hypertension during pregnancy.[12] Therefore, this study aimed to see how PMR compared to breathing exercise techniques affected BP levels among mildly preeclamptic pregnant women.

Materials and Methods

Data were collected within 12 months, starting in January 2021 and ending in September 2021. A quasi-experimental study was utilized in the Obstetrical Outpatient Clinic at the Suez Canal University Hospital in Ismailia, Egypt. A non-probability convenience sampling technique was used for this study. The sample size was determined using the difference in the mean BP pre- and post-intervention, according to Aalami *et al*.[13] that investigated the effects of gradual muscle relaxation and breathing control on BP during pregnancy.[13] The minimum required sample size was 22 women per group (number of groups = 3). After adding a dropout of 10%, it was estimated to be 25 using a 90% power to detect a standardized effect size in mean BP of 0.371 and a significance level of 95% (p = 0.05). There were 75 women in total in the sample.[13] Any withdrawal for any reason was compensated by replacement to control for attrition (withdrawal) bias.[14] The sample size was calculated using G*Power version 3.1.9.2.[15] A repeated-measures Analysis of Variance (ANOVA)is proposed to assess and compare breathing exercises and PMR for patients with hypertension. The inclusion criteria were mildly preeclamptic pregnant women with elevated BP, systolic pressure from 135 to 150, diastolic pressure from 85 to 95 mmHg, ++ protein, and after 20 weeks of gestation. This study excluded pregnant women with chronic diabetes mellitus, heart or renal diseases, bleeding disorders, or multiple gestations. Seventy-five mildly preeclamptic pregnant women were randomly allocated into three groups (25 women in each group): two interventional groups (groups I and II) and a control group (group III). The study group[1] was the deep breathing exercise group with mild preeclampsia and received structured instruction about deep breathing exercises in addition to routine antenatal care. The study group [II] was a PMR group with mild preeclampsia and received structured instruction about planned clinical PMR in addition to routine antenatal care. The control group [III] compromised women with mild preeclampsia and received only routine antenatal care, including history taking, physical examination, special investigations, instructions, and reassurance. Two tools were used in this study. The tool I, an information collection form, was used to collect the data from pregnant women, and it consists of two parts. Part one included sociodemographic data such as age, education level, and occupation, and part two included the obstetrical history, such as the number of pregnancies, mode of previous deliveries, and the number of abortions. Tool II obtained physiological measurements, including BP (systole, diastole, and mean arterial pressure), pulse, respiratory rate, and oxygen saturation. We investigated local and international related literature on many elements of the research problem to assist in understanding the scope and gravity of the issues and to advise in preparing the necessary data-gathering techniques. The study tools were prepared, and their validity and reliability tests were performed. Tools' validity and reliability were ascertained by a panel of six experts in the obstetrics, medical–surgical nursing, and medicine domains, who piloted and measured Cronbach's alpha value of 0.94.

The sociodemographic data for selected women were assessed, including age, education level, residence, occupation, and obstetrical history (number of pregnancies and deliveries, number of abortions, type of delivery, complications with pregnancy, and type of these complications). The women in groups I and II were trained to apply breathing exercises using the PMR technique. After demonstration, studied women redemonstrate the technique and observed by the researchers and instructed to perform it for 30 minutes per daily for 6 weeks. The researchers contacted the studied women using a telephone call or a contact-by-phone application (WhatsApp) for follow-up to ensure that each woman performed the technique correctly. The PMR technique included the following: finding a peaceful, distraction-free location, then lying down on the floor or reclining in a chair, loosening any tight clothing and removing glasses or contacts, putting her hands in her lap or on the arms of the chair, taking a few deep, even breaths, and then contracting and relaxing specific muscle groups until total relaxation was accomplished. By the researcher's command, pregnant women were requested to contract and then relax their muscles, including their hands, various portions of their face, shoulders, and other regions. Each exercise session lasted about 20 minutes. If she is not ready, spend a few minutes practicing diaphragmatic breathing.[13,16]

A woman used the diaphragmatic breathing exercise technique while lying on her back on a flat surface or in bed with her knees bent and her head supported. She can support her legs with a pillow under her knees. She places one hand slightly below her rib cage and the other on her upper chest. She can feel her diaphragm shift as she breathes in gently through her nose, causing her tummy to slide against her hand. Then, she exhales through pursed lips, keeping her palm on her chest as still as possible. After that, she tightens her stomach muscles, letting them collapse inward as she exhales. Her upper chest hand must remain as still as possible. This workout can be performed while sitting in a chair.[13,17] After implementing the techniques, the researchers evaluated women from the three studied groups three times in the Obstetrics Outpatient Clinic. Three evaluations were conducted after 2, 4, and 6 weeks of the implementation, respectively. Physiological measurements such as Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), pulse, Respiratory Rate (RR), and Oxygen (O_2) saturation by pulse oximeter were assessed.

The Research Ethics Committee of the Faculty of Nursing at the Suez Canal University approved the study on April 28, 2019, by code 55/4/2019. The researchers informed the studied pregnant women about the study's nature, process, and expected outcomes, reassured them that the study would be safe, and assured them that the information obtained would be confidential and used for research purposes only. The researchers informed the studied women about their right to withdraw from the study throughout the study, and then, written approval was obtained from the studied women.

The Statistical Package for the Social Sciences (SPSS) software (ver. 21) was used to evaluate the collected data. SPSS Statistics is a statistical software suite developed by IBM for data management: advanced analytics, multivariate analysis, and business intelligence. The qualitative data were provided in terms of frequency and percentage, whereas the quantitative data were presented in terms of mean and standard deviation for repeated measurements. The Chi-square test was used to compare qualitative variables, and ANOVA was used to examine quantitative data between the three groups. At a level of 0.05, the *p* value was declared significant.

Ethical considerations

The Research Ethics Committee in the Faculty of Nursing at Suez Canal University gave the researchers permission to perform the study on date 28/4/2019 by code 55/4/2019. The researchers had a breifing sssion with the participants before data collection to explain the aim andsignificance of the current study to the pregnant women risked for preeclampsia. Participants were informed about the right to refuse participation and the right to withdraw from the study at any phase of data collection even if they had signed the informed consent without any negative consequences in order to insuring voluntary participation. Data coding was used to secure anonynmity and confidentiality of collected data. the researchers clarify to the participants that the collected data will not reused in another study without their permission.

Results

The researchers had a briefing session with the participants before data collection to explain the aim and significance of the current study to the pregnant women risked for preeclampsia. Participants were informed about the right to refuse participation and the right to withdraw from the study at any phase of data collection even if they had signed the informed consent without any negative consequences in order to insuring voluntary participation. Data coding was used to secure anonymity and confidentiality of collected data. The researchers clarified to the participants that the data will not rused in another study without their permission.

There were no statistically significant differences between the groups regarding sociodemographic data [Table 1] and obstetric history before intervention [Table 2]. No significant differences were found between the studied groups in the baseline of SBP (p = 0.457) and DBP (p = 0.065) at the beginning of the study. However, after 2, 4, and 6 weeks of training, significant differences were found between the studied groups in SBP (p = 0.013, <0.001, <0.001, respectively) as well as after 6 weeks of training in DBP ($p < 0.001$). However, no significant difference was found between groups after 2 and 4 weeks of intervention in DBP (p = 0.390 and 0.228, respectively). Regarding mean arterial pressure, no significant differences were recorded between studied groups during baseline and after 2 weeks (p = 0.122 and 0.832, respectively); however, significant differences were detected after 4 and 6 weeks of training (p = 0.004, <0.001, respectively) [Table 3].

Discussion

This study aimed to see how PMR compared to breathing exercise techniques affected BP levels among mildly preeclamptic pregnant women. According to the findings of this study, there is a statistically significant difference between the two study groups and the control group in terms of the mean score of SBP measurement post-intervention at 2, 4, and 6 weeks after performing deep breathing and PMR techniques compared to routine antenatal care and after 6 weeks of training in DBP.

This study matches the results of a study conducted by Soliman *et al.*,[18] who noted no statistically significant

Table 1: Percentage distribution of studied groups regarding demographic data

Variables	Breathing group (*n*=25) *n* (%)	Progressive. group (*n*=25) *n* (%)	Control group (*n*=25) *n* (%)	Statistical test	*p*
Age (years)					
18-<22	7 (28.0)	8 (32.0)	8 (32.0)	$X^{2}*_{8}$=3.59,	*p***0.905
22-<26	4 (16.0)	3 (12.0)	6 (24.0)		
26-<30	5 (20.0)	2 (8.0)	3 (12.0)		
30-<34	5 (20.0)	7 (28.0)	4 (16.0)		
≥34	416.0	5 (20.0)	4 (16.0)		
Mean (SD)	24.68 (3.69)	25.59 (4.64)	24.48 (4.69)	$F***_{2}$=0.43,	*p*0.651
Education					
Read and write	1 (4.0)	1 (4.0)	1 (4.0)	$X^{2}*_{8}$=3.59,	p^{MC}0.904
Primary school	1 (4.0)	0	0		
Preparatory school	4 (16.0)	0	0		
Secondary school	5 (20.0)	2 (8.0)	1 (4.0)		
Intermediate	14 (56.0)	9 (36.0)	2 (8.0)		
Higher education	1 (4.0)	13 (52.0)	9 (36.0)		
Occupation					
Unskilled manual working	0	0	1 (4)	$X^{2}*_{4}$=2.41,	p^{MC}0.861
Housewife	16 (64)	18 (72)	16 (64)		
Professional	9 (63)	7 (28)	8 (32)		
Marital status					
Married	22 (88.0)	23 (92.0)	24 (96.0)	$X^{2}*_{4}$=1.58,	p^{MC}0.894
Divorced	1 (4.0)	1 (4.0)	0		
Widowed	2 (8.0)	1 (4.0)	1 (4.0)		

*X^2: Pearson's Chi-square test; ***p*-value is significant if <0.05; ****F*=one-way ANOVA test

Table 2: Percentage distribution of studied groups regarding the obstetrical history

Variables	Breathing group (*n*=25) Mean (SD)	Progressive group (*n*=25) Mean (SD)	Control group (*n*=25) Mean (SD)	*F*-test	*p*
Gestational age (week)	28.32 (0.56)	28.24 (0.52)	28.80 (0.04)	F_2=4.12,	*p* 0.020
Number of pregnancy	2.04 (1.02)	2.44 (1.19)	2.08 (1.077)	F_2=1.01,	*p* 0.371
Number of delivery	1.00 (1.00)	1.24 (1.09)	0.96 (1.06)	F_2=0.52,	*p* 0.597
Number of abortion	0.04 (0.20)	0.16 (0.37)	0.08 (0.28)	F_2=4.12,	*p* 0.341

difference between the study and control groups regarding mean SBP or DBP scores pre-intervention. At the same time, there is a statistically significant difference between the study and control groups regarding the mean score of BP post-intervention ($p < 0.001$). Moreover, another study compared two groups that performed breathing exercises and PMR; they found a considerable drop in SBP and DBP after 4 weeks than the control group that received antenatal care only.[19] Besides, the results of this study agree with Aalami *et al.*,[13] as they reported a significant decrease in the BP levels of the PMR and breathing control groups. However, they were not statistically significant in the control group, as they had suggested that both interventions decreased SBP compared to DBP after 4 weeks. After 6 weeks of treatment, Awad *et al.* found a substantial drop in systolic, diastolic, and proteinuria in both the exercise and relaxation groups.[20]

This may be explained by deep breathing increasing parasympathetic activity, which decreases the heart rate and dilates blood vessels, further reducing BP. Furthermore, PMR may help prevent preeclampsia by lowering the oxidative chemicals produced by pregnant women due to stress, promoting vascularity and development in the placenta, and preventing endothelial dysfunction.[21] Relaxation causes skeletal muscle tension to be released, which increases peripheral blood flow, lowering BP and heart rate and allowing for slower, deeper breathing. Relaxation suppresses the sympathetic response of the hypothalamus, which was considered to lower BP. When sympathetic activity is reduced, plasma renin–angiotensin activity and aldosterone concentration are reduced, resulting in lower BP.[21,22]

Excercise has been proven to significantly impact autonomic nervous system responses and stress reduction,[23] although it has few effects on reducing BP.[24] Also, this study was inconsistent with another study that stated that the relaxation techniques used were effective in generating a subjective feeling of relaxation, as indicated by a significant decrease in subjective stress rating post-relaxation compared to pre-relaxation and a decrease in depressive and anxiety symptoms.[25]

Table 3: Comparison of groups by physiological measurements for studied groups

Variables	Breathing group (n=25) Mean (SD)	Progressive. group (n=25) Mean (SD)	Control group (n=25) Mean (SD)	F-test (p), Partial eta squared (η^2)
Systolic blood pressure				
Baseline	147.56 (3.73)	148.80 (6.43)	147.28 (7.21)	0.46 (0.635) η^2(0.01)
2 weeks	138.48 (7.40) *	140.32 (5.35) *	144.68 (11.21)	3.63(0.013) η^2(0.09)
4 weeks	132.88 (7.40) *	132.08 (4.19) *	141.88 (12.74)	9.45 (<0.001) η^2(0.21)
6 weeks	124.40 (4.85) *	123.60 (4.68) *	139.20 (7.64)	55.69 (<0.001) η^2(0.61)
F (p) (η^2)		11.88 (<0.001), η^2(0.248)		
Diastolic blood pressure				
Baseline	92.60 (4.35)	90.96 (8.09)	88.44 (5.58)	2.85 (0.065) η^2(0.07)
2 weeks	89.88 (5.03)	89.88 (2.04)	88.08 (7.43)	0.96(0.390) η^2(0.03)
4 weeks	86.52 (4.68)	84.68 (4.24)	87.20 (6.67)	1.51 (0.23) η^2(0.21)
6 weeks	80.80 (3.73) *	81.84 (3.31) *	85.76 (5.26)	9.76 (<0.001) η^2(0.21)
F (p) (η^2)		4.78 (<0.001), η^2(0.117)		
Mean arterial pressure				
Baseline	110.91 (3.14)	110.24 (6.47)	108.05 (5.08)	2.16 (0.122) η^2(0.06)
2 weeks	106.08 (4.11)	106.69 (2.07)	106.94 (7.71)	0.18(0.832) η^2(0.01)
4 weeks	101.97 (4.39) *	100.47 (2.60) *	105.42 (7.48)	5.88 (0.004) η^2(0.14)
6 weeks	95.33 (3.50) *	95.76 (2.43) *	103.57 (4.88)	38.43 (<0.001) η^2(0.52)
F (p) (η^2)		11.06 (<0.001), η^2(0.235)		
Pulse				
Baseline	90.84 (3.51)	91.92 (2.76)	87.40 (14.09)	1.91 (0.156) η^2(0.05)
2 weeks	90.80 (6.64)	91.32 (3.43)	89.24 (2.90)	2.62(0.079) η^2(0.07)
4 weeks	88.88 (3.59)	88.96 (3.45)	83.92 (14.13)	2.78 (0.069) η^2(0.07)
6 weeks	86.80 (4.41)	87.12 (3.30)	86.96 (3.08)	0.048 (0.953) η^2(0.01)
F (p) (η^2)		1.44 (0.234), η^2(0.039)		
RR				
Baseline	19.00 (1.52)	19.20 (1.68)	21.64 (15.53)	0.66 (0.521) η^2(0.02)
2 weeks	19.64 (1.18) *	19.68 (1.31) *	20.68 (1.40)	5.09 (0.009) η^2(0.12)
4 weeks	19.68 (1.49)	20.28 (1.33)	23.40 (13.93)	1.50 (0.228) η^2(0.04)
6 weeks	20.04 (1.30)	20.60 (1.08)	20.76 (1.20)	2.48 (0.09) η^2(0.07)
F (p) (η^2)		0.861 (0.371), η^2(0.01)		
O2 Sat.				
Baseline	97.92 (2.10)	97.12 (1.01)	97.16 (0.47)	2.69 (0.075) η^2(0.07)
2 weeks	97.16 (1.95)	96.88 (0.78)	96.88 (0.72)	0.40 (0.674) η^2(0.01)
4 weeks	97.68 (1.14) *	96.36 (1.46) *	97.04 (0.73)	8.15 (0.001) η^2(0.19)
6 weeks	97.68 (1.40)	97.76 (1.05)	97.20 (0.76)	1.87 (0.161) η^2(0.05)
F (p) (η^2)		1.76 (0.109), η^2(0.05)		

The F-test is repeated-measures ANOVA; p value is significant if <0.05, *→ significant compared to the control group (Bonferroni *post hoc* test was used)

In Switzerland, researchers investigated the impact of two techniques on pregnant women: PMR and mental imaging. The intervention and control groups showed no meaningful differences. This may be related to using the quick approach and only one muscle relaxation session.[26] The current findings contradict those of a study that evaluated the immediate effects of two PMR techniques and mental imagery on the mental of pregnant women.[27] This study showed a significant difference between the intervention and control groups in SBP in the first session and SBP and DBP in several sessions because both techniques need a long time to show an effect, and this is what happened in this study. The research was limited by the low number of women involved, the timing and duration of implementation, and the procedure variations used in breathing and PMR techniques.

Conclusion

Muscle relaxation and breathing techniques could effectively control BP in pregnancy, which is complicated by mild preeclampsia. Both techniques could be introduced in antenatal care for women diagnosed with mild preeclampsia. Health and fitness professionals should focus more on preparing and delivering various sports programs incorporating various muscle relaxation and breathing techniques, as well as encouraging pregnant women to participate in such activities.

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Conflicts of interest

Nothing to declare.

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