

# Biofeedback Assisted Relaxation and Incidence of Hypertension During Pregnancy

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## ABSTRACT

*This study was performed to determine the effect of biofeedback - assisted relaxation in reducing the incidence of hypertension during pregnancy. Twenty five highly risk pregnant women at 16 weeks' gestation from Obstetrics Outpatient Clinic, Kasr Aini Hospital participated in this study. They performed autogenic relaxation training assisted by galvanic skin response biofeedback device for 30 minutes / session twice daily, 3 times/week for 12 weeks from 16 till the end of 28 weeks' gestation. The outcome measures included: systolic & diastolic blood pressures, pulse rate and proteinuria before as well as every 4 weeks after performing the treatment till the end of 32 weeks' gestation. The results of this study revealed a highly significant decrease in systolic ( $P < 0.01$ ), and diastolic ( $P < 0.008$ ) blood pressures. Also, there was a highly significant reduction ( $P < 0.001$ ) in pulse rate. Three (12%) cases developed hypertensive disorders (2 gestational hypertension and 1 preeclampsia) throughout the study and 22 (88%) subjects remained normal till the end of the study. Accordingly, it could be concluded that biofeedback assisted relaxation was found to be effective as a prophylactic method in reducing the incidence of hypertension during pregnancy.*

**Key words:** Biofeedback-assisted relaxation, Gestational hypertension, Blood pressure, Proteinuria.

## INTRODUCTION

Hypertensive disorders are the most common medical complications of pregnancy<sup>5</sup> especially preeclampsia which is considered one of the commonest causes of maternal and perinatal morbidity world wide<sup>8</sup>. About 585000 women die each year of pregnancy related causes, about 13% of these maternal deaths are due to hypertensive disorders of pregnancy particularly eclampsia<sup>6</sup>.

Preeclampsia was defined as blood pressure constantly greater than 140/90 mmHg, proteinuria exceeding 0.3 g/ 24 hours and pathological oedema. All presenting after 24 weeks' gestation and disappearing within 6 weeks after delivery<sup>22</sup>.

Sympathetic over activity was reported in preeclampsia which can imply that the

autonomic nervous system and perhaps central nervous system may contribute to the risk of this disorder<sup>14</sup>.

Preeclampsia poses a dilemma for both the clinician and those concerned with healthy policy<sup>7</sup>. The basic objective of the management of pregnancy complicated by preeclampsia is based on early detection and termination of pregnancy, this will protect the mother but can result in a significant perinatal morbidity and mortality associated with prematurity, foetal growth restriction and foetal demise<sup>8</sup>. Interest has increased not only in drug treatment but also, in non-pharmacological approaches because there is still some doubt about the safety of antihypertensive drugs during pregnancy as they may adversely affect the fetus where they cross the placenta to exert direct effects on the foetal vasculature and foetal well-being<sup>25</sup>. One

of the non- pharmacological approaches used for the treatment of hypertension is relaxation therapy, which involves teaching the patient to accomplish a state of both muscular and mental deactivation<sup>12</sup>.

One of the relaxation methods is the autogenic training which helps the subject to gain relaxation and encouraging her to think in a certain way in which a particular phrases are learned with repetition that results in physical changes. Learning is progressive and should be supervised by a trained practitioner to gain effective change until it is practiced alone<sup>17</sup>.

Autogenic training is thought to exert a direct influence on autonomic nervous system, reducing levels of physiological arousal through re-establishing a balance between the sympathetic and parasympathetic nervous system<sup>10</sup>.

Biofeedback is defined as a group of non-pharmacological therapeutic procedures that use electronic instruments to measure process and provide information to patients regarding their neuromuscular and autonomic nervous system activity in the form of analogue and visual as well as auditory signals<sup>24</sup>.

The generation of the integrated relaxation response, works when the subject focuses on a mental device like a sound at an object and returns to the focus when interrupting thoughts occur. Thus, it is possible that biofeedback effects can be attributed to this general relaxation response and strengthened by relaxation training<sup>4</sup>. Autogenic relaxation training and biofeedback can lower elevated blood pressure and may prompt the hypertensive patients to adopt a more health – conscious lifestyle<sup>11</sup>.

So, this study was performed to determine the effect of biofeedback assisted relaxation in the form of autogenic training assisted by Galvanic skin response

biofeedback in reducing the incidence of hypertension during pregnancy.

## SUBJECTS, MATERIALS AND METHODS

### Subjects

This study included twenty five pregnant women (12 primiparae and 13 multiparae) at 16 weeks' gestation selected from Obstetrics Outpatient Clinic, Kasr Aini, Cairo University Hospital. Their age ranged from 17 to 37 years.

All subjects were normotensive at the beginning of the study. They were highly risk to develop preeclampsia.

Informed consent form were signed by each subject before starting the treatment.

### Material

- 1- Weight – Height Scale was used to measure body weight and height for each subject at the beginning of the study. Then body mass index (BMI) was calculated to select obese subjects whose BMI were  $\geq 34$  Kg/m<sup>2</sup>.
- 2- A Real – time Gray scale Ultrasonographic Machine was used to estimate gestational age, determine twins and exclude any abnormalities as foetal anomalies or placenta praevia.
- 3- Galvanic Skin Response (GSR) Biofeedback Device was used for biofeedback assisted relaxation training, it is a small, handheld and self-contained GSR monitoring device for biofeedback training. The device precisely monitors stress levels by translating tiny tension-related changes in skin pores. The device measures the increase and the decrease in the autonomic nervous system by measuring subtle changes in the moisture on the palm of the hand and feedback to

the mother through a meter (Dual sensitivity meter), allowing her to learn effectively the whole body relaxation. The device included GSR monitor, body sensors for hands – free use and dual sensitivity meter for visual feedback.

- 4- A Mercury Sphygmomanometer and Stethoscope were used to measure systolic and diastolic blood pressures.
- 5- Plusimeter (Tunturi TPM. 400 DC-6V) was used to measure pulse rate.
- 6- Cotton and Gel were used for the ultrasound machine.
- 7- Stop Watch was used for adjusting the duration of each relaxation session.

## **Methods**

### **A) Evaluation Methods:**

#### 1- Measurement of arterial blood pressure

Systolic and diastolic blood pressures were measured from halflying position (mean of 3 trials of blood pressure measurements with one minute interval between them had been taken) at 16 (before) 20, 24, 28, and 32 weeks' gestation (after) performing autogenic training.

#### 2- Measurement of pulse rate

It was measured from comfortable 1/2 lying position, the ear sensor of the pulsi meter was connected to the woman's ear lobe to measure pulse rate per minute for 3 times with one minute interval then mean was taken at 16, 20, 24, 28 and 32 weeks' gestation.

#### 3- Urine Analysis

All subjects were asked to collect a 24 hours urine samples in sterilized glass bottles for the measurement of protein level in urine at 16, 20, 24, 28 and 32 weeks' gestation. Contamination was excluded by obtaining a clean midstream urine sample after cleaning the vulva with current water.

### **B) Treatment Method:**

Each woman was subjected to relaxation training in the form of autogenic training assisted by Galvanic skin response biofeedback device 3 sessions / week for 12 weeks from 16 till the end of 28 weeks' gestation, 30 minutes/ session, twice daily.

The session began with a few minutes of mental relaxation as the woman was asked to imagine herself in a lovely place that makes her relaxed. Each session included 18 exercises, each exercise was in the form of a group of phrases. Each phrase was recited by the physical therapist in a slow calm and soothing tone and then repeated, mentally or vocally by the learner while she was holding the GSR biofeedback device with her right hand, resting her 2 fingers on the sensory plates as well as looking at the dual sensitivity meter to give her a visual feedback about her relaxation state. About 1 minute was allowed for each exercise and a further 40 seconds was allowed for continuing attention focusing by the mother. The repetition of relaxation – inducing phrases based on six central themes:

- Heaviness in the arms and legs.
- Warmth in the arms and legs.
- Calm and regular heart beats, calm breathing, warm solar plexus.
- Cool fore head.

### **Data analysis**

The data of this study was statistically analyzed by using the descriptive statistics including the mean, standard deviation and percentage and t-test for comparison between before and after the treatment. The level of significance (P value) was considered as:  $P > 0.05$  not significant,  $P < 0.05$  significant and  $P > 0.01$  considered highly significant.

## RESULTS

The results of this study revealed that: there were highly significant decrease ( $P < 0.001$  &  $P < 0.008$ ) in systolic and diastolic blood pressures with total mean differences of 11.75 and 6.50 mmHg decrease than the baseline means respectively. (Tables 1a,b and Figures 1a,b). Also, there was a highly significant reduction ( $P < 0.001$ ) in pulse rate

with total mean difference of 14.6 beats decrease than the baseline value (Table 2a,b and Figures. 2a,b).

Three cases (12%) developed hypertensive disorders (2 gestational hypertension at 28 and 32 weeks' gestation and 1 preeclampsia at 24 weeks' gestation) and 22 subjects (88%) remained normal till the end the study. (Table 3 & Figure 3).

**Table (1a): Mean values of Systolic and Diastolic Blood Pressures (mmHg) during the study.**

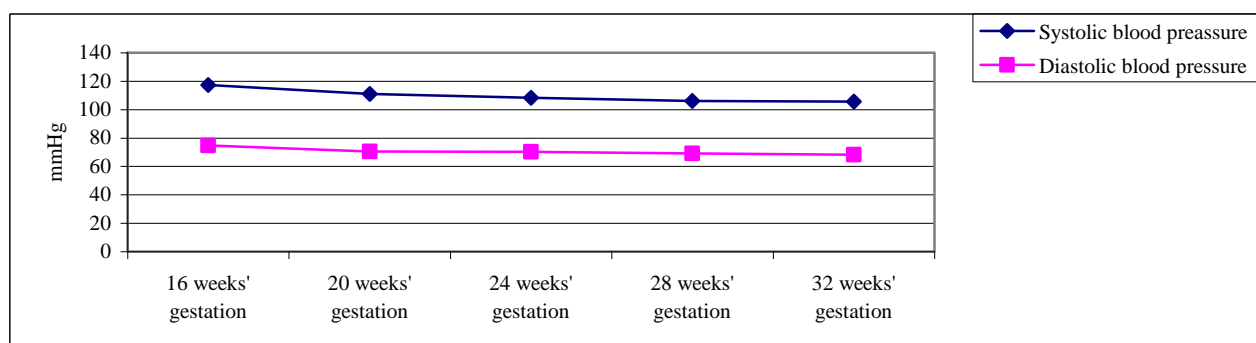
	Systolic Blood pressure (mmHg)			Diastolic Blood pressure (mmHg)		
	Mean $\pm$ SD	t-value	P-value	Mean $\pm$ SD	t-value	P-value
16 weeks' gestation	117.25 $\pm$ 2.94	3.09	< 0.001***	74.75 $\pm$ 2.45	4.31	< 0.002
20 weeks' gestation	111.00 $\pm$ 4.10			70.50 $\pm$ 4.44		
24 weeks' gestation	108.25 $\pm$ 8.63			70.25 $\pm$ 6.09		
28 weeks' gestation	106.00 $\pm$ 10.20			69.00 $\pm$ 7.07		
32 weeks' gestation	105.50 $\pm$ 15.14	0.99	< 0.640*	68.25 $\pm$ 9.88	-1.55	< 0.153

SD= Standard Deviation

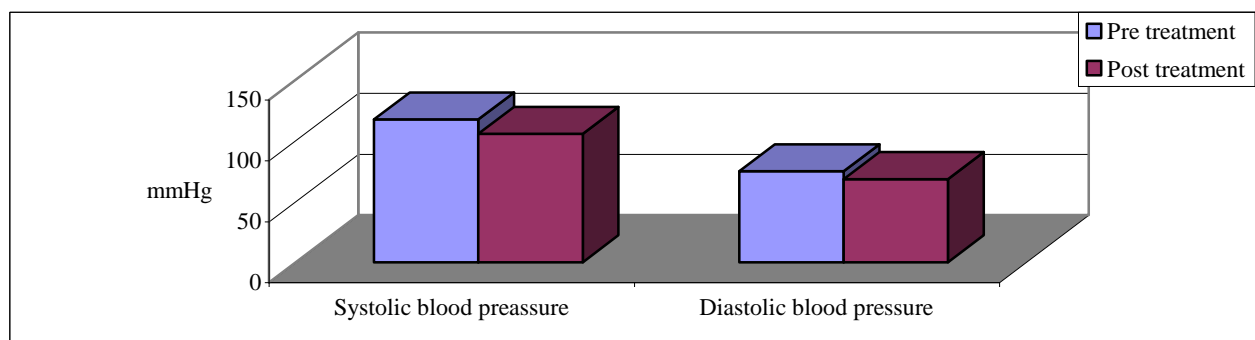
P-value = Probability of Error

**Table (1b): The Total Mean Differences and Percentage of Changes of Systolic and Diastolic blood pressure (mmHg) before and after treatment.**

		Before treatment	After treatment	Total mean difference	Total% of change	t-value	P-value
Systolic blood pressure (mmHg)	Mean	117.25	105.50	11.75	9.85%	4.07	<0.001
	SD	2.94	15.14				
Diastolic blood pressure (mmHg)	Mean	74.75	68.25	6.50	8.47%	3.14	<0.008
	SD	2.45	9.88				



**Fig. (1a): Mean Values of Systolic and Diastolic Blood pressures at 16, 20, 24, 28 and 32 weeks' gestation.**



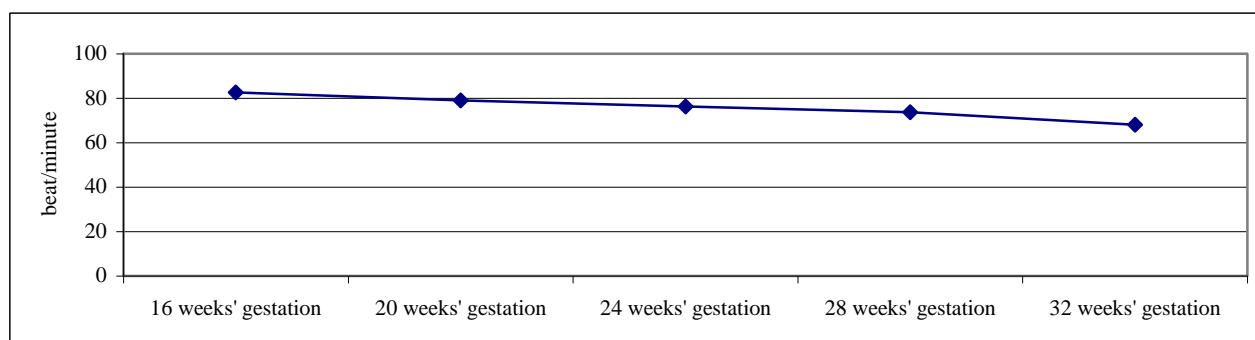
**Fig. (1b): Mean values of Systolic and diastolic blood pressures pre and post treatment.**

**Table (2a): Mean Values of Pulse Rate (beat/minute) during the study.**

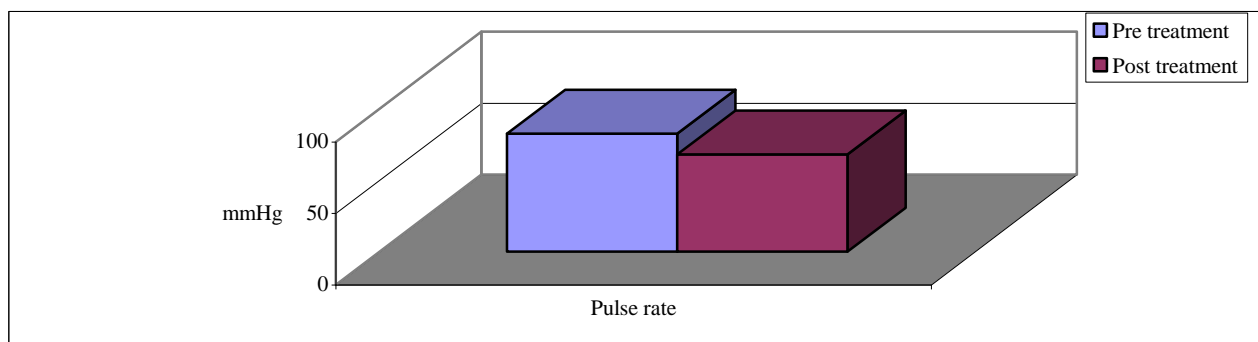
Pulse rate (beat/minute)			
	Mean $\pm$ SD	t-value	P-value
16 weeks' gestation	82.60 $\pm$ 7.80	- 3.07 -2.94 3.36 4.20	< 0.000
20 weeks' gestation	79.05 $\pm$ 8.35		< 0.000
24 weeks' gestation	76.25 $\pm$ 8.32		< 0.002
28 weeks' gestation	73.65 $\pm$ 9.24		< 0.000
32 weeks' gestation	68.00 $\pm$ 9.14		< 0.000

**Table (2b): The Total Mean Difference and Percentage of Change of Pulse Rate (beat/minute) Before and After Treatment.**

Pulse rate (beat/ minute)						
	Before treatment	After treatment	Total mean difference	Total % of change	t- value	P- value
Mean	82.60	68.00	14.60	17.67%	3.49	< 0.001
SD	7.80	9.14				



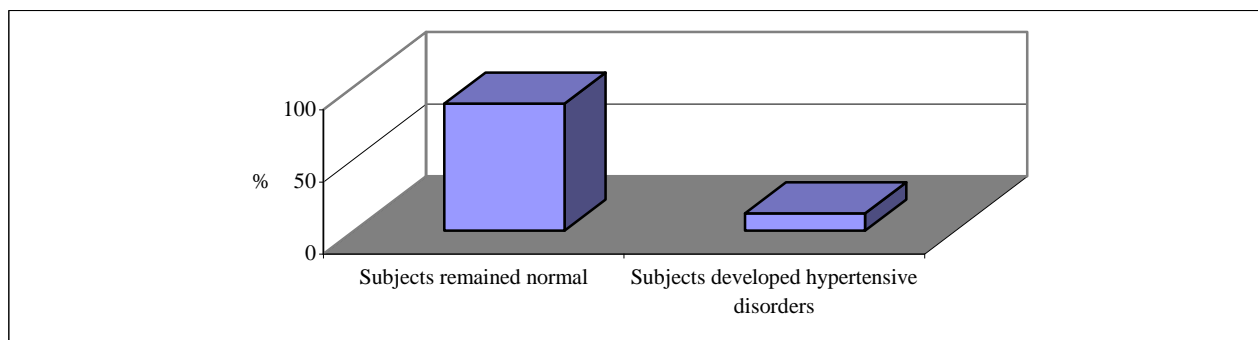
**Fig. (2a): Mean Values of Pulse Rate at 16, 20, 24, 28 & 32 weeks' gestation.**



**Fig. (2b): Mean Values of Pulse Rate pre and post treatment.**

**Table (3): Numbers and Percentages of Subjects who remained Normal or developed Hypertensive Disorders.**

Subjects remained normal	Subjects developed hypertensive disorders		24 weeks' gestation	28 weeks' gestation	32 weeks' gestation	Total (No.) %
22 (88%)	3 (12%)	Gestational hypertension	-	1 (4%)	1 (4%)	25 (100%)
		Preeclampsia	1 (4%)	-	-	



**Fig. (3): Percentage of Subjects who remained Normal or developed Hypertensive disorders throughout the study.**

## DISCUSSION

Pregnancies complicated by hypertension are associated with reduced uteroplacental blood flow and increased rates of perinatal mortality and morbidity especially smallness for gestational age and prematurity<sup>19</sup>. So, it is very important to predict, diagnose and apply suitable prophylactic measures as early as possible during pregnancy because hypertension may result in life threatening consequences for both

mother and fetus<sup>15</sup>. Early identification of patients at risk and effective prophylactic treatment would permit a safe completion of pregnancy for the mother and her fetus<sup>8</sup>. Relaxation therapy was proved to lower blood pressure in essential hypertensive Patients<sup>13</sup> and in hypertensive pregnant women<sup>21,26</sup>. Also, it produced significant reduction in heart rate, respiratory rate, systolic and diastolic blood pressures in normotensive subjects<sup>23</sup>.

This study was performed to determine the effect of biofeedback assisted relaxation in

the form of autogenic relaxation training assisted by GSR biofeedback as a prophylactic measure in reducing the incidence of hypertension during pregnancy.

Twenty five highly risk pregnant women at 16 weeks' gestating were selected from Obstetrics Outpatient Clinic, Kasr Aini Hospital to participate in this study.

Assessment of systolic & diastolic blood pressures, pulse rate and proteinuria were performed to each woman before starting the study and every four weeks after treatment at 16, 20, 24, 28 and 32 weeks' gestation.

Concerning the changes occurred in systolic and diastolic blood pressures, the results showed highly significant decrease ( $P < 0.001$ , and  $P < 0.008$ ) with total mean differences of 11.75 and 6.50 decrease than the baseline means respectively. Also, the total mean difference in pulse rate was 14.6 beats decrease from the initial value which was found to be highly significant decrease ( $P < 0.001$ ). In fact, there is no previous studies used relaxation techniques as a prophylactic method to guard against development of hypertensive disorders during pregnancy.

Relaxation techniques were used only in the treatment of the already diagnosed hypertensive pregnant women as Little et al., (1984)<sup>16</sup> who determined the effectiveness of systematic relaxation alone or combined with biofeed back in the treatment of sixty hypertensive pregnant women with blood pressure  $\geq 135/85$  mmHg who were divided randomly into 3 groups receiving relaxation training or combination between relaxation training and biofeed back or no treatment. They concluded that systolic and diastolic blood pressures were significantly lowered in experimental groups than control group and there was non-significant difference between both experimental groups.

Also, Youssef et al., (1999)<sup>26</sup> determined the effect of Mitchell's simple physiological relaxation technique on mild hypertensive pregnant women who continued receiving antihypertensive medication all through the study. They reported 14.03% and 7.85% of reduction in systolic and diastolic blood pressures respectively between before and after four weeks of treatment. There was significant reduction in blood pressure and proteinuria in relaxation group and it was concluded that it would be excellent from every point of view to carry on Mitchell's approach to treatment of hypertension during pregnancy as it cheap and simple conservative treatment and can be used for mothers at high risk of hypertension during pregnancy.

In addition, Kim, (1994)<sup>13</sup> proved that thirty minutes of relaxation programme was an effective behavioural therapy to reduce blood pressure in patients with essential hypertension.

Also, Salt and Kerr, (1997)<sup>23</sup> concluded that relaxation technique produced significant reduction in heart rate, respiratory rate, systolic and diastolic blood pressures in normotensive subjects and it was reported that during pregnancy, mothers could get maximum benefit form extra rest resulted from using relaxation technique and this is especially important if there is a tendency towards hypertension<sup>20</sup>.

Bell and Saltikov, (2000)<sup>2</sup> also reported a significant reduction in heart rate of normotensive subjects who received Mitchell's simple physiological relaxation technique. Additionally, it was suggested that there was a highly significant reduction in systolic, diastolic, mean arterial pressures, heart rate and albumin level in pregnant women with mild preeclampsia who received relaxation in the form of breathing control and it was concluded that breathing control was an

effective adjunct therapy modality in treating mild preeclamptic mothers<sup>21</sup>.

Jacob et al., (1986)<sup>12</sup> concluded that there was a significant reduction in systolic, diastolic pressures, heart rate and plasma rennin activity of mildly hypertensive patients who were treated by relaxation training. Aivazian et al., (1988)<sup>1</sup> used relaxation therapy in the form of autogenic training with the use of biologic feedback device in the treatment of essential hypertension and they showed a marked decrease in blood pressure.

Also, it was reported a significant reduction in blood pressure in hypertensive patients who were treated by biofeedback – assisted relaxation<sup>9</sup>.

The mechanisms of blood pressure reduction are complex and not completely clear. Evidence in laboratory animals suggested that reduction in proprioception lowered the sympathetic responsiveness of the hypothalamus which was expected to lower blood pressure. Profound relaxation of the skeletal muscles obtained by relaxation technique would elicit relaxation response as it was proposed that the release of tension in the skeletal musculature had the effect of calming the mind increasing peripheral blood flow, lowering heart rate and blood pressure and leads to slower and deeper breathing. Relaxation response counteracted the effects of sympathetic activity by promoting the action of parasympathetic nervous system, thereby exploiting the reciprocal nature of the two parts of the autonomic nervous system<sup>3</sup>.

Also, the sympathetic nervous system is one of the controlling factors of renin angiotensin aldosterone system which is one of the regulators of the blood pressure. When there is lowered sympathetic activity, there is reduction in plasma rennin activity and aldosterone concentration and this leads to lowering in blood pressure.

The decrease in pulse rate could be attributed to the effect of relaxation in promoting parasympathetic action.

In the present study, three cases (12%) developed hypertensive disorders (2 gestational hypertension & 1 preeclampsia) and 22 subjects (88%) remained normal. By this way we can conclude that the incidence of hypertensive disorders was 12%. So that, it can be concluded that biofeedback assisted relaxation appeared to be an effective, safe, successful, easy to perform, non-invasive and simple prophylactic alternative measure in reducing the incidence of hypertension during pregnancy. Yet, it provided highly significant reduction (improvement) in systolic and diastolic blood pressures as well as pulse rate. Consequently, it reduced the incidence of hypertension during pregnancy.

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### الملخص العربي

#### الاسترخاء المساعد بالتغذية الرجعية الحيوية ومعدل ارتفاع ضغط الدم أثناء الحمل

الهدف من الدراسة هو معرفة تأثير الاسترخاء المساعد بالتغذية الرجعية الحيوية لتقليل معدل حدوث ارتفاع ضغط الدم أثناء الحمل. ولقد أجريت هذه الدراسة علي خمس وعشرون سيدة حامل في الأسبوع السادس عشر وقد كن من السيدات الأكثر عُرضه لحدوث ارتفاع ضغط الدم أثناء الحمل ولقد عولجن باستخدام تدريب الاسترخاء المساعد بالتغذية الرجعية الحيوية لمدة 30 دقيقة لكل جلسة مرتين في اليوم، 3 مرات أسبوعياً لمدة اثني عشر أسبوعاً من الأسبوع 16 وحتى نهاية الأسبوع 28 من الحمل . وقد تضمنت القياسات المسجلة: قياس ضغط الدم الانقباضي والانبساطي وقياس معدل النبض وكذلك قياس نسبة البروتين (الزلال) في البول وحساب عدد ونسبة الحالات اللائي أصبن بإضطرابات في ضغط الدم وذلك قبل بداية العلاج وكل أربعة أسابيع بعد العلاج حتى نهاية الأسبوع 32 من الحمل . وقد أثبتت النتائج أن هناك انخفاض ذات دلالة إحصائية عالية في قياس ضغط الدم الانقباضي والانبساطي وكذلك معدل نبضات القلب . وقد أصبن 3 سيدات بإضطرابات في ضغط الدم أثناء الدراسة (حالتين ارتفاع ضغط دم مصاحب للحمل وحالة تسمم حمل) بنسبة 12% وظلت 22 سيدة طبيعية بنسبة 88% حتى نهاية الدراسة وهكذا يمكن أن نستخلص أن تدريب الاسترخاء المساعد بالتغذية الرجعية الحيوية كان فعال كوسيلة وقائية لتقليل معدل حدوث ارتفاع ضغط الدم أثناء الحمل .

**الكلمات الدالة :** الاسترخاء المساعد بالتغذية الرجعية الحيوية- تسمم الحمل - ارتفاع ضغط الدم المصاحب للحمل - ضغط الدم - زلال البول .