

# The Effect of Breathing Exercises on Breathing Pattern of Pregnant Women

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## ABSTRACT

**Purpose:** Physiological changes during pregnancy impose numerous changes on the respiratory system that can affect the health of both mother and fetus. Regarding the importance of the normal breathing in the health of mother and fetus, this study aimed to investigate the effect of breathing exercise on breathing pattern of pregnant women.

**Methods:** The study population was pregnant women with gestational age of 28 weeks. The sample comprised 52 pregnant women aged 18 to 35 years. The subjects were randomly divided into the intervention and control groups. The intervention group performed specific breathing exercises 3 times a day, each time 15-20 minutes for 10 weeks. In this period, the control group did not receive any training program. Pressure of End Tidal Carbon Dioxide (PETCO<sub>2</sub>) was measured using capnography device before and after this period in both groups. Data were analyzed using SPSS 16 software. Kolmogorov-Smirnov test was used to examine normal distribution of the data. In order to study the changes within each group, paired t-test was used and for comparing the groups, Independent t-test was used. P <0.05 was considered as the significant level.

**Results:** Comparison of PETCO<sub>2</sub> of two groups before performing breathing exercises showed that mean PETCO<sub>2</sub> in the intervention group was 1.08 mmHg less than the control group. This difference was not significant (P= 0.308). However, after performing breathing exercises, mean PETCO<sub>2</sub> in the intervention group was 2.34 mmHg higher than the control group, which showed a significant difference (P= 0.011).

**Conclusion:** According to these results, performing breathing exercises increases the amount of PETCO<sub>2</sub> and pushes it toward the normal range in pregnant women. Therefore, these exercises can help modify breathing patterns in pregnant women, and has a significant role in fetal and maternal health.

## Keywords:

Pregnancy, Breathing exercise, Breathing pattern

## 1. Introduction

**R**egarding pregnancy is a physiological phenomenon that imposes numerous changes on various organs and body systems of pregnant women, including their respiratory system, which naturally affect the health

of both mother and fetus [1, 2, 3]. In pregnant women, because of the increased anteroposterior and transverse diameter of the chest, displacement of the diaphragm, increased stress and need for oxygen, high prevalence of respiratory disorders is observed [4]. Breathing pattern is the clinical presentation of the functional, physiological, biochemical, biomechanical, and psychologi-

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cal factors affecting the respiratory system [5, 6, 7]. Changes in breathing pattern in pregnant women can be the first symptom of a mechanical, physiological, or psychological dysfunction [4]. It is noteworthy that part of the disorders and problems in pregnant women might be due to the disturbances caused by the disruption of the breathing pattern. Therefore, studying the breathing pattern in this group is of high significance. One of the most common breathing pattern disorders is hyperventilation [8]. Incidence of hyperventilation syndrome leads to a drop in normal arterial carbon dioxide pressure or eucapnia (35-45mmHg), which eventually causes a state referred to as respiratory alkalosis [5, 8, 9]. Also, during pregnancy, partial pressure of arterial carbon dioxide decreases [4, 10, 11, 12, 13].

Several studies have pointed out that the level of arterial carbon dioxide of the mother would affect fetal brain oxygen saturation [12, 13, 14, 15]. Thus, a normal breathing pattern, which maintains carbon dioxide pressure at a normal and safe level, has a considerable role in fetal and maternal health [12, 13]. Nevertheless, there is little information about the effect of respiratory physiotherapy on breathing pattern in pregnant women.

A capnograph measures the pressure of the end tidal carbon dioxide. Therefore, it can be considered as a tool for assessing breathing pattern. There is some evidence that suggests pressure of end tidal carbon dioxide largely reflects the arterial carbon dioxide pressure [16, 17]. Thus, a capnograph evaluates the arterial carbon dioxide pressure based on the concentration of end tidal carbon dioxide.

The aim of this study was to investigate the effect of breathing exercise on breathing pattern of pregnant women in the third trimester of pregnancy and the changes in the concentration of end tidal carbon dioxide, as an indication of the arterial carbon dioxide pressure. The main index of breathing pattern, was calculated using a capnograph.

## 2. Materials and Methods

This study is a randomized clinical trial conducted on 52 pregnant women in Imam Khomeini Hospital, Ahvaz, Iran between autumn 2013 and spring 2014. The criteria for inclusion in the research were first pregnancy, the age range of 18-35 years, and gestational age of 28 weeks. Exclusion criteria were history of pulmonary, cardiovascular, or psychological diseases, history of smoking or alcoholism, having gestational diabetes, abortion, pregnancy with twins, or any disorder in fetus.

The subjects were selected according to the inclusion and exclusion criteria using a convenience method based on availability and after filling the informed consent form, they were randomly divided into the intervention and control groups each consisting of 26 pregnant women. During the study, 3 members of the intervention group and 5 members of the control group left the study.

During the initial assessment, end tidal carbon dioxide pressure and respiratory rate of the subjects in both intervention and control groups were recorded using a capnography device (Viamed Co). The subjects were seated on a comfortable chair to ensure that the subjects were equally relaxed, a documentary about nature was displayed for 10 minutes. During this interval, using a capnography device attached to the subjects with disposable nasal cannulas, the data were recorded and saved.

After the initial assessment, a trained physiotherapist taught the intervention group breathing exercises, including nasal breathing, deep breathing with pause after inhaling, diaphragmatic breathing, deep pursed lip breathing, and breathing exercises along with the movement of upper limbs in which, in a butterfly movement, the subject opens her arms and inhales and then as she closes her arms, exhales (slow breathing) [18, 19]. The control group subjects were given no exercises or training.

The intervention group performed specific breathing exercises 3 times a day each time 15-20 minutes for 10 weeks. Accuracy of performance of the breathing exercises was controlled by the physiotherapist via phone call. In the final assessment after 10 weeks, similar to the initial assessment, breathing indexes in both intervention and control groups were measured and recorded.

In this study, SPSS 16 was used for data analysis. Kolmogorov-Smirnov test was used to examine normal distribution of the data. In order to study the changes within each group, paired t-test was used and for comparing the groups, Independent t-test was used. The significance level was considered to be  $P < 0.05$ .

It should be noted that authorization for this research was obtained from the Ethics Committee of Jundishapur University of Medical Sciences, Ahvaz (ajums. REC.1392.126) and also this research was registered in Iranian Clinical Trial Center (IRCT2014022216678N1).

Table 1. Anthropometric characteristics of the subjects.

Group	Mean age (y)	Mean weight (kg)	Mean height (m)	Body mass index (kg/m <sup>2</sup> )	Gestational age (d)
Intervention	24.52	71.73	1.61	27.46	195.7
Control	25.52	70.14	1.62	26.52	196.3

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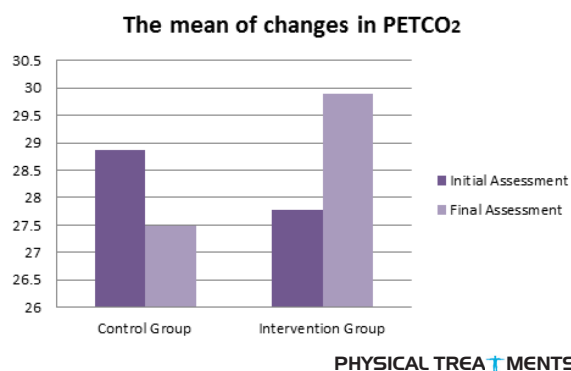


Figure 1. Comparison of the mean of PETCO<sub>2</sub> index between the initial and final assessment of the intervention and control group.

### 3. Results

The Kolmogorov-Smirnov test results indicated normal distribution of data in both groups. The characteristics of the subjects are presented in Table 1.

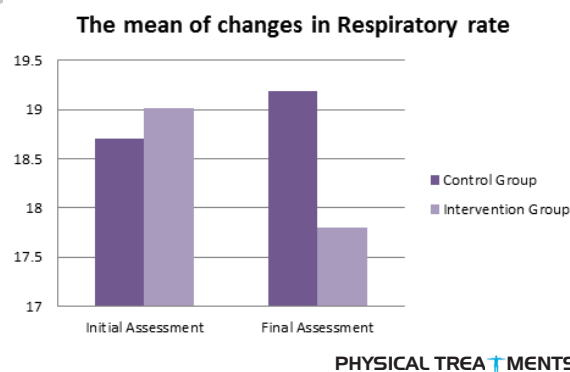
The results of the Independent t-test of comparing the variables of age, height, weight, and body mass index between two groups did not show any significant differences and both groups were similar in terms of these variables.

The mean of the measured indexes related to the initial assessment (before intervention) and final assessment (after intervention) of the control and intervention groups are presented in Table 2.

In the initial assessment (before intervention), the mean of PETCO<sub>2</sub> in the intervention group was 1.08 mmHg less than that of the control group. However, there was no significant difference with the control group (P=0.308). In the secondary assessment (after intervention), the mean of PETCO<sub>2</sub> in the intervention group was 2.34 mmHg more than the control group and there was a significant difference with the control group (P=0.011). The mean of changes in PETCO<sub>2</sub> has been shown in Figure 1.

The mean PETCO<sub>2</sub> of the two studied groups were compared using Independent t-test. The results indicated that the difference between the two groups was significant (P<0.0001).

Before the beginning of the program, the respiratory rate of the intervention group was 0.32 times more



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Figure 2. Comparison of the mean of respiratory rate index between the initial and final assessment of the intervention and control group.

Table 2. The mean of breathing indexes before and after intervention in the control and intervention groups

Index	Assessment	Group		Independent t
		Intervention	Control	
PETCO <sub>2</sub> (mmHg)	Initial assessment	27.78	28.86	P=0.308 P=0.011
	Final assessment	29.82	27.48	
Respiratory rate (per minute)	Initial assessment	19.02	18.70	P=0.78 P=0.22
	Final assessment	17.80	19.19	

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than the control group, which statistically, was not a significant difference ( $P < 0.78$ ). After the intervention, the respiratory rate of the intervention group decreased, yet still there was not a significant difference between the two groups ( $P < 0.22$ ). The mean of respiratory rate changes has been shown in Figure 2. The mean of respiratory index of the two studied groups were compared using Independent t-test. The results indicated that the difference between the two groups was significant ( $P < 0.021$ ).

#### 4. Discussion

The results of the present study showed that 10 weeks of exercises for modifying breathing pattern of pregnant women significantly increased  $PETCO_2$  and decreased respiratory rate. According to the assessments conducted in this study, pregnancy in women causes hyperventilation in the third trimester. Several previous studies have confirmed the incidence of hyperventilation and reduction of carbon dioxide level during pregnancy [3, 4, 11], which confirms the results of this study.

The logical interpretation of this phenomenon is that during pregnancy, the increased needs of mother and fetus are associated with an increase in ventilation and discharge of more carbon dioxide. Furthermore, during pregnancy hormonal changes especially progesterone, reduce threshold of respiratory centers and lead to hyperventilation.

Assessment of  $PETCO_2$  after 10 weeks showed the effect of exercises for modifying breathing pattern on increasing  $PETCO_2$  in the studied groups. The results of the present study indicated that there was not a significant difference regarding  $PETCO_2$  between the intervention and control groups before performing breathing exercises. However,  $PETCO_2$  in the intervention group was 3.74% less than the control group.

Yet after performing breathing exercises during the specified period, changes in  $PETCO_2$  of the two studied groups indicated that there was a significant difference between two groups. This index in the intervention group was 7.84% higher than the control group. This shows the effect of exercises on increasing  $PETCO_2$  in the studied groups.

To our knowledge, no study has been conducted on the effect of breathing exercises on the above mentioned breathing index in pregnant women and the present research is the first study in this topic. In order to study respiratory indexes in other groups, a study has been

conducted on patients with asthma in which the effect of breathing exercises (similar to those used in this study) on  $PETCO_2$  have been studied. The results of this study have indicated the increase of this index and its movement towards the normal range in this group [20]. In a similar study conducted by Grammatopoulou et al. in 2011, the effect of respiratory retraining exercises on  $PETCO_2$  in patients with asthma was studied. The results showed the effect of these exercises on  $PETCO_2$  [18].

Because of the similarity between pregnant women and patients with asthma with regard to the reduction of carbon dioxide (hyperventilation), the results of these studies can confirm the increased  $PETCO_2$  observed in pregnant women after 10 weeks of breathing exercise [21, 22].

During pregnancy, in order to meet the needs of mother and fetus, ventilation increases as much as two to four times. This increase in ventilation occurs as a result of an increase in respiratory rate and increased tidal volume [4, 11]. The studies conducted in this research shows the increase of respiratory rate in the control group at the end of the 10-week period (on average 0.49 breath per minute), while in the intervention group, after performing breathing exercises, respiratory rate decreased (on average 1.22 breath per minute).

On the other hand, in order to study the effect of respiratory physiotherapy, West and Holloway used exercises similar to those used in the present study. In their group of patients, respiratory rate in the intervention group also decreased significantly [23]. Similarly, the study conducted by Meuret et al. in 2007 on the patients with asthma showed that breathing exercises increase  $PETCO_2$ , moves this index toward the normal range, and reduces respiratory rate [20].

Performing breathing exercises, in the way conducted in this study, seems to increase the amount of  $PETCO_2$  in pregnant women and pushes it from the hypocapnic to the eucapnia range, which eventually improves the breathing pattern. Taking into consideration the results of the present study, it could be concluded that breathing exercises can be helpful in changing and modifying the breathing pattern in pregnant women. Yet, the studies are not sufficient for reaching a final conclusion regarding the potential benefits of changing the breathing pattern during pregnancy and further research is required.

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