# Response of Cardiovascular System to Different Abdominal Muscle Exercise in Premenopausal Women

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## ABSTRACT

**Background:** Premenopause is known with profound reproductive and hormonal changes. These changes have been well chronicled and matched with concomitant symptoms. Estrogen affects almost every tissue or organ system, including the heart and blood vessels. Abdominal exercises may have significant effect on cardiovascular system, therefore, the purpose of this study was to find the effect of abdominal exercises on the cardiovascular system. **Methods:** Forty five premenopausal females were recruited for this study. Participants were assigned equally in three groups. Group (A) performed straight partial sit up, group (B) performed oblique partial sit up and group (C) performed lying hip flexion. Assessment of all groups was carried out through measurement of blood pressure, respiratory rate and heart rate before and after the exercise session. **Results**: The results revealed a significant increase in heart rate, systolic and diastolic blood pressure as well as respiratory rate in all groups (A, B, &C) after the exercise session compared with pre exercise ($p < 0.01$). Between group comparisons pre exercise revealed a non-significant difference in all parameters ($p > 0.05$). Comparison between groups post exercise revealed a significant increase in heart rate of group C compared with that of group A and B ($p < 0.01$) and a significant decrease in systolic and diastolic blood pressure of group C compared with that of group A and B ($p < 0.01$). There was no significant difference between group A and B in all parameters post exercises ($p > 0.05$). Also, there was no significant difference between the three groups in respiratory rate post exercise ($p > 0.05$). **Conclusion:** In healthy premenopausal women, abdominal exercises from different positions influenced the cardiovascular parameters after the end of the training session with more effect of lying hip flexion exercise.

**Keywords:** Abdominal exercises, cardiovascular system, pre-menopausal.

## INTRODUCTION

Menopausal symptoms are highly prevalent, they are sufficiently bothersome to drive almost 90% of women to seek out their healthcare provider for advice on how to cope (Santro., 2016). Premenopause is also called the menopausal transition period. Women start Premenopause at different ages, sometime in 40s. But some women notice changes as early as mid-30s in form of menstrual irregularity (Steiner., 2003).

Estrogen has known effects on the cardiovascular system include a mix of positive and negative. Increases in high density lipid cholesterol (HDL), decreases the low density lipid cholesterol (LDL), promotes blood clot formation and also causes some changes that have the opposite effect .It relaxes, smooth and dilates blood vessels so blood flow increase , soaks up free radicals naturally occurring particles in the blood that can damage the arteries and other tissues. Estrogen probably affects the cardiovascular system in other ways that are as yet undiscovered (Masson., 2003).

A drop in estrogen raises the risk of heart conditions, including atrial fibrillation and high blood pressure. When estrogen levels drop, heart and blood vessels become stiff and less elastic. Because of these changes, blood pressure tends to rise, causing hypertension. Elevated blood pressure can place more strain on the heart. Heart disease is the top killer of women, and a woman's risk for heart disease increases dramatically around the time she goes through menopause typically between ages 50 and 54 (Coylewright.,2008).

The middle-aged female population reveal a reduction in abdominal muscle power due to multiple pregnancies and a lack of regular exercise and therefore, are often advised muscular exercises for abdominal muscle strengthening. A significant increase in systolic and diastolic blood pressure and pulse rate was observed following abdominal wall strengthening exercises (Shin., 2016).

These changes indicate the need for strict supervision during abdominal strengthening exercises, especially for the hypertensive patients. The abdominal exercises may cause significant rise in Systolic Blood Pressure, Diastolic Blood Pressure and Pulse Rate. Breathlessness and palpitations is also found during abdominal exercise. Fatigue in the lower limb muscles also reported (Shah., 2015).

A few studies were conducted to find the effect of abdominal muscle exercises on the cardiovascular system (Cunha., 2014). Therefore, this study aimed to detect the response of cardiovascular system to different adnominal muscle exercises in premenopausal women.

## MATERIALS AND METHODS

Study design

This is a randomized controlled study that was carried out in the outpatient clinic of sheikh zayed specialized hospital, physiotherapy department, between September and December 2019. The study was approved by the Ethics Committee of the Faculty of Physical Therapy, Cairo University.

Participants

This study was carried out upon 45 premenopausal women. Their age was ranged from 38-48 years. They were medically stable and their body mass index didn't exceed 30 kg/ m2. Participants were excluded if they were smokers, hypertensive or suffer from diabetes mellitus, or had cardiovascular problems or pulmonary problems. Initially, the examiner screened participants against study eligibility criteria, and explained them the aims and procedures of the study. Eligible participants were invited to participate in the study and if they agreed, an informed consent was signed.

Measurement procedures

Participants were asked to wear comfortable clothes, evacuate their bladder before the training session and to sit in upright relaxed position in order to measure systolic and diastolic blood pressure, heart rate and respiratory rate before the exercise session.

Blood pressure was measured by using Sphygmomanometer and stethoscope (O'brien., 2001), while heart rate was measured by palpation the radial nerve for 60 seconds (Sztajzel., 2004). And respiratory rate was measured by counting the chest movement up and down in one minute (Cretikos., 2008).

Exercise procedures

First, the aim and rational of each exercise was explained to every participant, and she was asked to evacuate her bladder to be more relaxed.

Participants were assigned equally in three groups. Group (A) performed straight partial sit up, group (B) performed oblique partial sit up and group (C) performed lying hip flexion.

Straight partial sit up for Group (A):

Participants were asked to lie in crock line position with arms stretched out and fingers pointing toward the knees then raising the torso up as close to her thighs as possible. The exercise consisted of 15 repetitions in 3 sets which was performed in 5 minutes duration with 1 minute break between each set Fig.(1).

Fig. (1) **Straight partial sit up** for group (A)

Oblique partial sit up Group (B)

Participants were asked to lie in crock line position, directing shoulder toward inner thigh, while keeping her lower leg parallel with the floor. Twisting torso to touch right elbow to left knee, then to the other side. The exercise consisted of 20 repetitions in 3 sets (10 repetitions in each side), which was performed in 5 minutes duration with 1 minute break between each set (Fig.2).

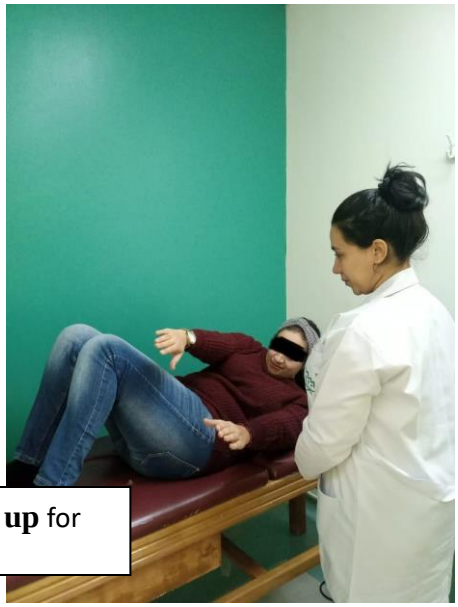

**Fig. (2)Oblique partial sit up Group (B)**

Lying hip flexion for group (C)

Group (C) participants were asked to lie in supine position with the back and both feet on the floor with knees and hips flexed at 90º, flexing the hips to leave the floor slightly and relax. The exercise consisted of 15 repetitions in 3 sets which was

performed in 5 minutes duration with 1 minute break between each set Fig.(3).

**Fig. (3)** Lying hip flexion **group (c)**

Assessment of blood pressure, heart rate and respiratory rate was carried out before and after the exercise session.

Statistical analysis

Descriptive statistics and MANOVA test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. MANOVA was conducted to compare the mean values of heart rate, respiratory rate, systolic and diastolic blood pressure between the three groups. Post-hoc tests using Tukey posttest were carried out for subsequent multiple comparison. [illegible]as conducted to [illegible] pre and post exercise in each group. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

## RESULTS

**Demographic Characteristics:**

There was no significant difference in the mean age, weight, height and BMI between the three groups (A, B &C). Before treatment (P) > 0.05 Table (1).

**Table 1. Participant characteristics.**

| | Group A | Group B | Group C | p-value |
|---|---|---|---|---|
| | mean ± SD | mean ± SD | mean ± SD | |
| **Age (years)** | 41.73 ± 2.21 | 43.13 ± 2.94 | 43.46 ± 2.06 | 0.13 |
| **Weight (kg)** | 68.4 ± 5.61 | 67.46 ± 4.91 | 67.86 ± 4.17 | 0.87 |
| **Height (cm)** | 163.13 ± 5.61 | 162 ± 5.5 | 164.53 ± 5.84 | 0.47 |
| **BMI (kg/m²)** | 25.67 ± 1.26 | 25.72 ± 1.7 | 25.08 ± 1.37 | 0.41 |

**SD, Standard deviation; p-value, Level of significance**

**Mean values of heart rate, respiratory rate, systolic and diastolic blood pressure before and after treatment in the three studied groups (A,B &C).**

**Within group comparison**

Within-group comparison revealed a significant increase in heart rate, respiratory rate, systolic and diastolic blood pressure in the three groups post exercise compared with that pre exercise ($p < 0.01$). (Table 2).

**Between group comparison**

Between group comparisons pre exercise revealed a non-significant difference in all parameters ($p > 0.05$). Comparison between groups post exercise revealed a significant increase in heart rate of group C compared with that of group A and B ($p < 0.01$) and a significant decrease in systolic and diastolic blood pressure of group C compared with that of group A and B ($p < 0.01$). There was no significant difference between group A and B in all parameters post exercises ($p > 0.05$). Also, there was no significant difference between the three groups in respiratory rate post exercise ($p > 0.05$). (Table 2).

**Table (2).** ***Mean heart rate, respiratory rate, systolic and diastolic blood pressure of group A, B and C:***

| | Group A | Group B | Group C | p-value | | |
|---|---|---|---|---|---|---|
| | mean ± SD | mean ± SD | mean ± SD | A vs B | A vs C | B vs C |
| ***Heart rate (beats/min)*** | | | | | | |
| **Before treatment** | 71.8 ± 4 | 72 ± 2.85 | 72.6 ± 3.73 | 0.98 | 0.81 | 0.89 |
| **After treatment** | 79.2 ± 2.3 | 80.33 ± 2.31 | 83.13 ± 2.16 | 0.36 | 0.001 | 0.004 |
| MD | -7.4 | -8.33 | -11.57 | | | |
| % of change | 10.31 | -10.53 | 14.5 | | | |
| | ***p = 0.001*** | ***p = 0.001*** | ***p = 0.001*** | | | |
| ***Respiratory rate (breaths/min)*** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Before treatment** | 13 ± 1.13 | 13.13 ± 0.91 | 13.26 ± 0.88 | 0.92 | 0.74 | 0.92 |
| **After treatment** | 27.53 ± 2.13 | 27.8 ± 1.9 | 28.93 ± 2.52 | 0.94 | 0.2 | 0.34 |
| MD | -14.53 | -14.67 | -15.67 | | | |
| % of change | 111.77 | 111.73 | 118.17 | | | |
| | ***p = 0.001*** | ***p = 0.001*** | ***p = 0.001*** | | | |
| **Systolic blood pressure (mmHg)** | | | | | | |
| **Before treatment** | 121.33 ± 6.11 | 121 ± 6.03 | 120 ± 6.81 | 0.98 | 0.83 | 0.9 |
| **After treatment** | 132 ± 5.27 | 133.33 ± 5.56 | 126 ± 6.03 | 0.79 | 0.01 | 0.003 |
| MD | -10.67 | -12.33 | -6 | | | |
| % of change | 8.8 | 10.2 | 5 | | | |
| | ***p = 0.001*** | ***p = 0.001*** | ***p = 0.01*** | | | |
| **Diastolic blood pressure (mmHg)** | | | | | | |
| Before treatment | 80 ± 5.66 | 80.66 ± 5.93 | 79.66 ± 7.18 | 0..95 | 0..98 | 0.9 |
| After treatment | 89 ± 5.41 | 89.33 ± 4.57 | 83.33 ± 6.17 | 0.98 | 0.01 | 0.01 |
| MD | -9 | -8.67 | -3.67 | | | |
| % of change | 11.25 | 10.75 | 4.61 | | | |
| | ***p = 0.001*** | ***p = 0.001*** | ***p = 0.001*** | | | |

**SD, Standard deviation; MD, Mean difference; p-value, Level of significance**

## DISCUSSION

This study aimed to find the effect of different abdominal muscle exercises on blood pressure, heart rate and respiratory rate for the premenopausal women. There was significant increase in heart rate of group C compared with that of group A and B ($p < 0.01$) and a significant increase in systolic and diastolic blood pressure of group C compared with that of group A and B ($p < 0.01$). There was no significant difference between groups A and B in all parameters post exercises ($p > 0.05$). Also, there was no significant difference between the three groups in respiratory rate post exercise ($p > 0.05$).

Premenopausal women have lower blood pressure than age-matched men, Also, They have higher rates of hypertension than men as they age. These findings suggest that gender or sex hormones have a prominent role in hypertension. Determining the role of sex hormones in the pathogenesis or progression of hypertension is complex given the effects of aging on the cardiovascular system and its relationship to other powerful risk factors such as body weight and cholesterol level (Buford., 2016).

The results of the current study revealed a significant increase in heart rate, respiratory rate, systolic and diastolic blood pressure in the three groups post exercise compared with that pre exercise ($p < 0.01$) this come in support with the results of Vyas, H. P (2015) who examined the effect of core muscle stability exercise on different cardiovascular parameters that showed a significant increase in all cardiovascular parameters after Lumbar core stability exercise, so it should be administered with the caution in the patients with cardiac problems.

Also the results of this study come in agreement with Sudhan (2018) who evaluated the cardiovascular response to abdominal muscle strengthening exercise in healthy young students and found the potential effect in increasing the cardiovascular parameters .

The results of the this study revealed significant increase in blood pressure, heart rate and respiratory rate for all groups (A, B&C) after the training session of abdominal exercises, this come in agreement with the result of Cunha, (2014) who examined the effect of low to moderate abdominal muscle exercises on the response of cardiovascular system and concluded that abdominal exercises performed this intensity resulted in relatively small increases in SBP, HR, and the RMSSD index. Although the subjects' SBP response increased significantly during the exercises, the response was expected given the increased hemodynamic demand caused by the exercise. During the recovery, the values returned to baseline values. The DBP did not change throughout the different conditions of the study.

The results of the current study also come in support with the result of Rao, (1993) who found significant increase in systolic and diastolic blood pressure and pulse rate following to trunk curl exercise and leg raising exercise in the examined females indicating the need for strict supervision during sessions, especially for the hypertensive patients.

## CONCLUSION:

In healthy premenopausal women, abdominal muscle exercises influenced the cardiovascular parameters after the end of the training session with more effect of lying hip flexion position.

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