



# Effect of Carboxy Therapy Combined with High Intensity Training on Blood Pressure in Patients with Metabolic Syndrome

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**Published online:**

Dec 2022

**Abstract:**

**Background:** metabolic syndrome is a common and worldwide diseases affecting humans. It can be considered a major health problem throughout the world as it has a high prevalence, and it can lead to increased risk of cardiovascular and liver diseases.

**Aim of the Work:** to determine the efficacy of carboxy therapy combined with high intensity training on blood pressure in patients with metabolic syndrome.

**Patients and Methods:** Eighty female patients diagnosed as metabolic syndrome selected from Al

Shohadaa Central Hospital were selected in this study Their age determined from 50 to 60 years old. Patients were assigned to two groups equal in number :group A (study group), it consisted of 40 female patient, women in this group were interventioned by high intensity training (3 sessions per week) and carboxy therapy (2 times per week) for 4 weeks. Group B (control group): it consisted of 40 women, both groups were following ((low fat low calorie diet ) for 4 weeks . blood pressure was measured two times before and after 4 weeks at the end of the study .

**Results:** there was statistically significant decrease in systolic and diastolic blood pressure in both groups pre/post data ( $p < 0.05$ ), with statistically significant improvement in the group A more than in the group B in all outcome data.

**Conclusion:** carboxytherapy combined with High intensity interval training and low caloric low fat diet can improve blood pressure in women with metabolic syndrome.

**Keywords:** High Intensity Training and Carboxy Therapy, Cardiovascular, Metabolic Syndrome.

## 1.Introduction:

Metabolic syndrome is a group of several disorders, which can increase the risk of atherosclerotic cardiovascular diseases, insulin resistance, and diabetes mellitus, and vascular and neurological complications such as a cerebrovascular stroke (1).

There are many hypothesized mechanisms about the pathophysiology of MetS, and the most accepted of these is insulin resistance and fatty acid flux. Other accepted mechanisms are low-grade chronic inflammation and oxidative stress (2).

The high prevalence of metabolic disorders between elderly Egyptians and high prevalence of chronic diseases in Egypt can be explained by a nationao screening programs to detect MetS and means to face the epidemic of overweight and outcomes of metabolic syndrome, particularly cardiovascular diseases (3).

Some of exercise techniques done to make weight reduction have insured on regular exercise like walking and running at a non-severe intensity. In addition, these types of exercises have led to

small weight loss. Thus, exercise protocols that can be done by obese, inactive subject that more effectively decrease body weight are required. A strong evidence suggests that high-intensity interval exercise (HIIE) has the power to be an easy and effective exercise for decreasing fat of overweight individuals (4).

High-intensity intermittent training (HIIT), known as alternate small bursts of aggressive exercise and light exercise or passive rest periods, has been suggested to be an alternative and a cheap method to MICT. The strong evidence has showed that HIIT could make greater or comparable stomach and visceral fat mass loss and cardiopulmonary efficiency than MICT among obese adults and could more effectively decrease metabolic risk factors in type 2 diabetes, HIIT can be a higher modality to keep cardio metabolic health (5).

Heart rate reaction linked with the nature of the HIIE protocol, but it is significantly raised during exercise and decreases during the time between sprint and rest. the blood pressure show a sudden decrease after exercise and noticeable reduction in both systolic and diastolic BP as a chronic effect (6).

Carbon dioxide (CO<sub>2</sub>) therapy, can be called carboxytherapy, explained to be the usage of CO<sub>2</sub> with therapeutic uses. The idea begin in France in 1932, and the intervention was done intradermal (through the skin) by a heated carbonated water pool or the usage of water-saturated CO<sub>2</sub> on the skin of patients. The idea was used for both arterial problems and ulcer treatment. After the discovery of new knowledge, the application became not topical and was by passing the CO<sub>2</sub> to be injected directly into the skin, to improve the power of results (5).

Many studies showed the effect of the carboxytherapy treatment of subcutaneous fats; demonstrated good improvements in wide regions of the abdomen, legs ,arms; and showed histological evidence of the effect of carboxy, suggested its possible antifat effects (7). there has been demonstrated a statistically significant reduction in adipocyte girth during whole time of intervention with CO<sub>2</sub> compared to use of others (8).

New idea has suggested the association between the origin and prevention of metabolic disorders and changing lifestyle habits, especially diet and analysis of the good effects of many dietary regimes on MetS inflammatory factors. About the prevention of MetS (9).

## 2. Patients and Methods:

### 2.1. Study participants and recruitment criteria:

Eighty female patients diagnosed as metabolic syndrome selected from Al Shohadaa central Eighty female patients diagnosed as metabolic syndrome

selected from Al Shohadaa Central Hospital were included in this study. Age determined from 50 to 60 years old. Patients were assigned to two groups equal in number : (a) group A (study group), it consisted of 40 women, they were intervened by high intensity intermittent training (3 sessions per week) combined with carboxylic therapy (2 times per week) for a month. (b) Group B (control group): it consisted of 40 women, both groups were following ((low calorie low fat diet) for 4 weeks. Blood pressure was measured before and after 4 weeks at the end of the study.

**Inclusion Criteria:** All patients were female diagnosed with metabolic syndrome with age range from (50-60) years old, Fasting triglyceride (TG) level range from (151-200) mg/dl ,Waist circumference range from (105-120) cm, Blood pressure range from (131/149/86-89) mmhg, Fasting high density lipoprotein (HDL) range from (35-49) mg/dl., Fasting glucose of range from (101-125) mg/dL, Body mass index range from (30-35), Medically stable and psychologically stable, and Medically stable and psychologically stable.

**Exclusion Criteria:** Patient with recent abdominal surgery, skin disease at abdominal area, developing cancer, Smoking patients, renal failure, epileptic seizures and isolated cardiovascular disease.

### 2.2. Design of the study

This is two groups pre- test post-test design:

Group A (study group) consisted of 40 women; they were treated by high intensity interval training (3 times per week) combined with carboxy therapy (2 times per week) for 4 weeks and Group B (Study group) consisted of 40 women, both groups were following ((low caloric- low fat diet) for 4 weeks.

### 2.3. Evaluation procedures

#### A. weight and height measurement to detect BMI:

Patient weighted in light clothing and bare feet ,fasting and with an empty bladder. patients stood with feet together and head in vertical position. weight and height was taking 3 times and average was taken, MI was calculated and recorded.

#### B. Submaximal exercise test :

Treadmill exercise stress test protocol start at very low intensity and progressively rise to higher

speeds each 2-3 minutes until fatigue (modified Bruce protocol). The submaximal exercise test was determined when any of the following was met:

- 1) Heart rate reached/exceeded upper limits of test.
- 2) Cadence cannot be maintained.

Additional indications to stop the test include the following: drop in systolic blood pressure of 10 mm or failure of blood pressure to rise, failure of heart rate to increase with increase in exercise intensity, patients request to stop, signs of poor perfusion and abnormal shortness of breath.

### C. Blood pressure measurement :

Patients were instructed not to smoke, drink or exercise 30 min before measuring blood pressure. Patients were asked to wear short sleeve and to relax for at least 5 minutes. Blood pressure was measured 3 times and average was taken.

## 2.4. Treatment procedure:

### High intensity interval training

All patients in the first group attended the training program as follow:

Equipment: an electrical treadmill (LSG, SN321125, 2014, Taiwan) with adjustable speed 1-18km/h and inclination from 0-15%.

Intensity = was 4\*4 minutes at (85-90% max HR), and 3 minutes in between at (65-70% of max HR).

Maximum Heart rate was measured by incremental treadmill test using pulse oximeter (Modified Bruce protocol). Frequency = 3 times per week.

Duration = session duration was 30 minutes (5 minutes warming up + 21 minutes exercise time + 3 minute cooling down), the whole study duration is 4 weeks.

### Carboxy injection:

Equipment: Carbo-5000, Daeyang, SN2012009, 2001, Korea

Application;

Abdomen is divided into lines parallel to umbilicus each line consist of points 5cm apart Co2 is injected vertically, 1-2 cm depth, 5cc in each point with 30G syringe. The whole dose: is 150 cc in each session

Frequency: - two sessions per week for 4 weeks (Brandt et al., 2001).

## 3. Statistical Analysis:

The comparison between two independent groups with quantitative data and parametric distribution was done by using Independent t test.

The comparison of changes within each group was done by paired t- test .

P value of less than 0.05 is considered statistically signify Analysis.

## 4. Results:

The purpose of this study was to investigate the effect of high intensity interval training combined with abdominal carboxy therapy regarding blood pressure in patients with metabolic syndrome.

### General Characteristics of the Subjects

Data were collected from fifty female patients diagnosed as metabolic syndrome, as shown in table (1); Group (A) consisted of 40 women and Group (B) consisted of 40 women their mean age, weight, height and BMI of group A and B were (54.2±2.67) and (55±2.86) years, (87.63±5.01) and (88±7.02) kg, (165.03±4.12) and (165.90±5.05) cm and (32.08± 0.98) and (31.89±0.88) kg/m<sup>2</sup> respectively.

**Table (1):** General Characteristics of women of both groups

		Patient group No.= 40	Control Group No.= 40	Test value	P-value	Sig .
Age	Mean	54.20±	55.00±	1.29 2	0.200	NS
	± SD	2.67	2.86			
	Range	50– 60	50– 59			
Weight	Mean	87.63±	88.00±	0.27 5	0.784	NS
	± SD	5.01	7.02			
	Range	78.5 – 98	75– 99			
Height	Mean	165.03±	165.90±	0.84 9	0.398	NS
	± SD	4.12	5.05			
	Range	157–171	157–172			
BMI	Mean	32.08±	31.89±	-	0.358	NS
	± SD	0.98	0.88			
	Range	30– 34	30.4–33.5			

**P-value >0.05: Non-significant(NS); P-value <0.05:**

**Significant(S);**

**P-value< 0.01: highly significant(HS) •: Independent t-test**

### The effect of treatment blood pressure:

#### Systolic blood pressure:

##### A- Pre-study between groups:

As demonstrated in table (2), the means ± SD of SBP for females in the two groups A and B pre-study were (142.3±5.1) and (142.2±5.73) mmHg respectively. There was no statistically significant difference in pre-study mean values of SBP between the two groups (P=0.967).

##### B- Post-study between groups:

As demonstrated in table (2), The means ± SD of SBP for Patients in the two groups A and B poststudy were (123.75±4.63) and (136±3.04) mmHg respectively. There was statistically significant decrease in post-study mean values of SBP between the two groups (P=<0.001).

### C- Pre and post-study within groups:

As demonstrated in table (2), There was statistically significant decrease between pre, and post-study mean values of SBP within each groups were ( $<0.001$ ).

**Table (2):** Comparison between group (A) and group (B) Regarding SBP

SBP		Group (A)	Group (B)	Test value	P-value	Sig.
		No.= 40	No.= 40			
Pre	Mean	142.3	142.20	-0.041•	0.967	NS
	± SD	±5.1	±5.73			
Post	Mean	123.75	136.00	13.982•	$<0.001\#$	S
	± SD	± 4.63	± 3.04			
Test value		25.517*	9.293*			
P-value		$<0.001^*$	$<0.001^*$	–	–	–
Sig.		S	S			

**P-value  $>0.05$ : Non-significant (NS); P-value  $<0.05$ : Significant(S\*); Paired T-test, •: Independent t-test SPB: Systolic Blood Pressure. Data are shown as mean  $\pm$ SD. #:significant P value ( $<0.05$ ) based on unpaired t-test. \*: significant P value ( $<0.05$ ) based on paired t-test.**

**Table (3):** Comparison between group (A) and group (B) Regarding DBP

DBP		Group (A)	Group (B)	Test value	P-value	Sig.
		No.= 40	No.= 40			
Pre	Mean	87.50	87.80	1.018•	0.312	NS
	± SD	± 1.6	± 1.49			
Post	Mean	77.9	83.90	9.022•	$<0.001\#$	S
	± SD	± 3.9	± 2.84			
Test value		22.282*	9.416*			
P-value		$<0.001^*$	$<0.001^*$	–	–	–
Sig.		S	S			

**P-value  $>0.05$ : Non-significant(NS); P-value  $<0.05^*$ : Paired T-test, •: Independent t-test DPB: Diastolic Blood Pressure . Data are shown as mean  $\pm$ SD. #:significant P value ( $<0.05$ ) based on unpaired t-test. \*: significant P value ( $<0.05$ ) based on paired t-test.**

## 5. DISCUSSION:

The goal of that trial was to know the effect of high intensity intermittent training combined with abdominal carboxy therapy regarding blood pressure in patients with metabolic syndrome. Eighty female patients diagnosed as metabolic syndrome were selected from al shohada central hospital as the prevalence of female was more than male at the time of this study, they were 50-60 years old (menopause) to exclude the effect of menstruation or pregnancy on

results , they were free from renal failure ,severe anemia ,cancer ,orthopedic or psychological problems not to interfere with results .they were assigned to two groups equal in number ;Group (A) study group consisted of 40 women and Group (B) control group consisted of 40 women their mean age, weight, height and BMI of group A and B were ( $54.2\pm 2.67$ ) and ( $55\pm 2.86$ ) years, ( $87.63\pm 5.01$ ) and ( $88\pm 7.02$ ) kg, ( $165.03\pm 4.12$ ) and ( $165.90\pm 5.05$ ) cm and ( $32.08\pm 0.98$ ) and ( $31.89\pm 0.88$ )  $\text{kg/m}^2$  respectively.

Major findings of this study were:

- HIIT combined with carboxytherapy, and low fat low caloric diet have induced a statistically significant improvements in blood pressure in female with metabolic syndrome .
- The improvement in the aforementioned outcomes was greater in the group (A) than in the group (B).

The results of the present study were supported by Olea et al.,(10) demonstrated that 12-weeks of HIIT (4  $\times$  4 min at 85–90%  $V_{O2\text{max}}$ , walking/running, 38 min total session) reduced 24-h SBP by 12mmHg.

Also, this trial came with the same line of Pedralli et al.. (11) who showed that after 24 interventions (2 months), with HIIT technique, all patients with high blood pressure showed a decrease in both measured diastolic and systolic BP with average 12 degree, which leader to improvement in their health as they became normal .

In addition, this study agreed with Schwing Hackl et al., (12) who described that who found that low-fat diet showed beneficial effects on systolic and diastolic BP management, and improved HDL and LDL levels in the short term compared to usual diet.

Furthermore, this thesis agreed with Pianez et al., (13) who reported that microcirculatory changes following CO<sub>2</sub> therapy leads to increase perfusion as measured by laser Doppler flow metry and increase oxygen tension as measured by transcutaneous oxygen tension. This is to be known from the Bohr effect on the oxygen dissociation curve, it was demonstrated a statistically significant reduction in blood pressure during the early and late phases of subjects treated with CO<sub>2</sub>.

On the other side , this thesis disagreed with Costa et al. (14) who showed that no exercise substrate metabolic outcomes were reported to demonstrate that HIIT could be considered an effective therapy against hypertension.

## CONCLUSION:

The present study demonstrated that HIIT combined with carboxy therapy and low fat low caloric diet can induce improvement in blood pressure in women with metabolic syndrome .

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