



Effectiveness of Mindfulness-based Stress Reduction on Hypertension among Patients with Metabolic Syndrome

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Abstract

Background and Objective: Reducing stressors is an effective way to decrease blood pressure and its other associated symptoms. The present study aimed to investigate the effectiveness of mindfulness-based stress reduction (MBSR) on metabolic syndrome among patients with hypertension.

Materials and Methods: This experimental research was conducted based on a pretest-posttest control group design. A total number of 50 cardiovascular patients referring to Shahrekord Cohort Study, Shahrekord, Iran, in 2019 were selected using the convenience sampling method and randomly divided into experimental and control groups (n=25 each). Metabolic syndrome indices, including blood pressure, blood sugar, glucose triglyceride, high-density lipoprotein, and low-density lipoprotein, were used to collect the required data. All groups received the same standard medications under the supervision of an interventional cardiologist. In addition to the standard medical treatment, the experimental group received the intervention of MBSR (eight 90-minute sessions). The control group did not receive any non-pharmacological intervention. Data were analyzed using multivariate analysis of covariance.

Results: The results showed that MBSR was effective in improving metabolic syndrome symptoms in cardiovascular patients with hypertension ($P<0.05$).

Conclusions: The employment of MBSR along with medical and pharmacological treatments could help cardiovascular disease patients to improve the symptoms of metabolic syndrome.

Keywords: Cognitive, Heart disease, Metabolic syndrome, Mindfulness-based stress reduction, Stress

Background

Hypertension is considered an important cardiovascular risk factor throughout the world [1]. Several factors, such as diabetes, poor nutrition, smoking, hypertension, metabolic syndrome, psychological factors (e.g., stress and depression), and lack of well-being, affect cardiovascular disease [2]. Among these factors, metabolic syndrome, which is a major public health issue, is a combination of risk factors, namely abdominal obesity, high triglyceride levels, high-density lipoprotein cholesterol levels, high blood pressure, and high fasting blood glucose levels. A person with three abnormalities regarding these five factors is diagnosed as a patient [3, 4]. The main treatment for metabolic syndrome is the change of lifestyle. These changes include maintaining a heart-healthy diet and a healthy weight, controlling stress, exercising regularly, and quitting smoking. Preventive behavioral interventions that target metabolic syndrome in particular, mainly concentrate on diet and exercise [5].

Psychological factors, such as stress, depression,

and social isolation, affect the disease course, and therefore, are important both as main and primary risk factors affecting the onset of the disease [6]. Despite all the mentioned facts, few studies have been conducted concerning the effects of stress reduction interventions, including mindfulness [7, 8]. Mindfulness is a concept rooted in the Buddhist tradition which represents awareness of all external and internal experiences at the moment [9]. According to Jon Kabat-Zinn, mindfulness is a kind of consciousness through paying attention in a certain way and in the present moment, and without having any judgment on the experiences of the moment [10]. Mindfulness encourages the person to observe all emotions through a detached point of view. Mindfulness has been practiced in Buddhism for centuries and used in therapeutic interventions for common psychological problems, such as stress, worry, anxiety, and depression, since the 1970s [11]. Mindfulness-based stress reduction (MBSR) therapy focuses on avoiding judgment, raising

consciousness, and focusing on the present moment. Through these three factors, it helps individuals process their cognitive, physiological, and behavioral activities [12]. The results of various pieces of research have indicated the effectiveness of this therapy on increasing the quality of life of cardiovascular patients, type two diabetes patients, patients with chronic low back pain, patients with multiple sclerosis, and women suffering from obesity [13-17].

Mindfulness is an active cognitive construct that is able to completely moderate the response of individuals to stressful and emotional situations. In this way, mindfulness, using conscious attention and flexible attention, causes the person to distance himself from emotional and habitual reactions and plan an appropriate response rather than reacting to the situation. Therefore, recognizing the effects of this type of intervention, especially mindfulness training based on stress reduction on psychological symptoms, is essential for mental health professionals [14]. The results of the studies have demonstrated that all diseases, especially cardiovascular disease and hypertension, have psychosomatic origins and are influenced by stress and stressful events. Accordingly, reducing stressors is an effective way to decrease blood pressure and its other associated symptoms [18]. Although having stress is inevitable and having enough stress promotes growth and development, high levels of stress or ineffective coping strategies are detrimental.

During MBSR therapy, people learn to develop acceptance and compassion instead of judging their experiences. They also learn to create present-moment awareness rather than spontaneous thinking and apply new ways of responding to situations. Based on the results of a study conducted by Zare et al. [19], MBSR had an effective role in reducing the symptoms of diabetes. In another research, Mohammadi Shirmahaleh et al. [20] showed that mindfulness training significantly reduced anxiety and blood sugar level in patients with diabetes.

According to the findings of a study performed by Daubenmier et al. [21], mindfulness intervention may lead to long-term maintenance of fasting glucose levels and improved atherogenic lipid profiles. The results of a study carried out by Guyot et al. [22] were indicative of the existence of an association of higher mindfulness with lower odds of developing a metabolic syndrome, a lower waist circumference, higher high-density lipoprotein (HDL)-cholesterol, and lower level of fasting blood glucose among individuals with depressive symptomatology. Based on the findings of a study

performed by Monin et al. [23], engagement in MBSR as a couple to address symptoms of metabolic syndrome was well-received and feasible, and preliminary effects suggested more benefits for wives than husbands in terms of physical functioning and relational well-being.

The innovation of the present study was to evaluate the effectiveness of MBSR and cognitive therapy on hypertension in patients with metabolic syndrome.

Objectives

According to the mentioned cases, due to the prevalence of symptoms of metabolic syndrome among patients with hypertension, and the importance of such interventions along with drug interventions, the present study aimed to investigate the effectiveness of MBSR on the metabolic syndrome components in cardiovascular patients with hypertension.

Materials and Methods

This experimental research was conducted based on a pretest-posttest control group design. The statistical population included all cardiovascular patients referring to Shahrekord Cohort Study, Shahrekord, Iran, in 2019, who were clinically examined by a cardiologist. The samples ($n=50$) were selected using the convenience sampling method and randomly divided into experimental and control groups ($n=25$ each). The inclusion criteria were being diagnosed with hypertension and symptoms of metabolic syndrome by a cardiologist, being in the age range of 25-65 years, having secondary education, having the ability to participate in training sessions, providing informed consent to participate in the research. On the other hand, the patients who had psychiatric disorders and took medication, simultaneously participated in another psychological and therapeutic program, and were absent in more than two treatment sessions were excluded from the study.

Before the intervention, all the medical test samples related to metabolic syndrome and the blood pressure of patients were taken. After the intervention, laboratory monitoring was executed and blood pressure was taken again. In this regard, blood pressure levels higher than 140.90 mm Hg and 150.80 mm Hg were considered hypertensive for individuals under and over 60 years old, respectively [24].

Moreover, to apply the maximum control, a cardiologist provided a checklist that included the factors that might affect the process of taking blood pressure. Moreover, the physician considered the clinical examination while checking

the blood pressure. After selecting the eligible samples and randomly assigning them to the experimental and control groups, all groups received the same standard medications under the supervision of an interventional cardiologist. In addition to the standard medical treatment, the experimental group received MBSR intervention (eight 90-minute sessions); however, the control group did not receive any non-pharmacological intervention. After the last training session, test samples of metabolic syndrome and blood pressure levels of patients in both groups were gathered again under the same conditions. Regarding the ethical considerations, the participants were informed of the right to leave the study at any time. Moreover, all participants were assured of confidentiality in this study. Moreover, the participants' rights were observed in this study.

Research instruments

Measuring the blood pressure and metabolic syndrome: systolic and diastolic blood pressure were measured and recorded by an interventional cardiologist using a standard sphygmomanometer in patients. Metabolic syndrome parameters, including fasting blood glucose (sugar) level, triglyceride, HDL, and low-density lipoprotein were measured. These parameters were measured through testing the blood sample of patients (after 10-12 h of fasting) by the medical laboratory during 8-9 am and after the prescription of the interventional cardiologist. The test results were observed and interpreted by the interventional cardiologist.

Intervention program

The intervention program consisted of eight 90-minute sessions of MBSR intervention [25]. Table 1 presents the summary of the sessions.

Statistical analyses

After collecting data in the present study, in descriptive statistics, mean, standard deviation, minimum, and maximum scores were used. Inferential statistics section: Analysis of covariance (ANCOVA) was utilized to analyze the data. To investigate the assumptions of the inferential test, Leven's test (to investigate the equality of variances) and Shapiro-Wilk test (to examine the distribution normality of pre-test and post-test scores) were used. The results showed that the distribution of data was normal. The above statistical analysis was performed using SPSS.24 software.

Results

The participants included 50 cardiovascular patients with hypertension, aged between 25 and 65 years old. In the experimental group, 48% and 52% of the participants were female and male with the mean age of 38.52 and 42.38 years, respectively. In the control group, 40% and 60% of the participants were female and male with the mean age of 42.31 and 40.20 years, respectively. Table 2 presents the mean and standard deviation (SD) of the pre-test and post-test scores of components of metabolic syndrome for the experimental and control groups. The data were tested by the ANCOVA to investigate the effects of the intervention program on metabolic syndrome in cardiovascular patients with hypertension. Before the ANCOVA, its primary and essential assumptions were examined. According to the Shapiro-Wilk test results, the distribution of group scores in metabolic syndrome was normal before and after the intervention. The results of Levene's test also confirmed the equality of error variances in the groups (Table 3). The same assumptions were also made about the regression line slope and the equality of error variances in the groups.

Table 1. Summary of the mindfulness-based stress reduction sessions

Sessions	Content
First	Introducing cardiovascular disease and risk factors. Being familiar with the effect of stress on cardiovascular diseases, blood pressure, blood sugar, and blood lipids. Teaching meditation and body examination.
Second	Continuing the exploration of physical feelings. Learning meditation through awareness of breathing. Practicing and meditating as homework.
Third	Teaching soft mental yoga moves to lighten the global symptoms of stress and become aware of delicate body movements. Practicing pregnancy exercises, including checking physical feelings, and soft yoga.
Forth	Teaching and practicing meditation emphasizing the perception of physical feelings. Determining home practice, including soft yoga, meditation for a long time, awareness of stress knowledge.
Fifth	Practicing the sitting meditation focusing on stress and ways of coping with it in certain situations. Determining home practice to check physical feelings. Performing yoga and Meditation.
Sixth	Performing physical meditation. Checking physical feelings. Performing yoga and meditation.
Seventh	Talking. Performing more physical exercises. Applying mindfulness-based stress reduction in everyday life. Determining home practices, including physical feeling check, yoga, and meditation.
Eighth	Overviewing the past sessions. Continuing the practice. Meditating and practicing choiceless awareness. Emphasizing continuing the practices after the sessions. Asking for feedback from participants about mindfulness and planned training.

Table 2. Descriptive data of dependent variables in experimental and control groups in pre-test and post-test (n=50)

Dependent variables	Group	Phase	Mean	SD	Min.	Max.
Systolic blood pressure	Experimental	Pre-test	133.58	9.55	124	144
		Post-test	126.16	5.63	121	132
	Control	Pre-test	135.54	8.77	126	144
		Post-test	134.53	8.26	126	143
Diastolic blood pressure	Experimental	Pre-test	87.98	8.71	80	94
		Post-test	79.03	4.44	75	84
	Control	Pre-test	88.93	7.48	81	95
		Post-test	88.69	7.84	80	94
Fasting blood sugar	Experimental	Pre-test	121.15	23.88	78	165
		Post-test	106.54	22.46	79	160
	Control	Pre-test	125.14	28.55	80	163
		Post-test	123.83	26.56	80	160
Triglycerides	Experimental	Pre-test	175.34	61.27	102	230
		Post-test	141.19	30.81	103	181
	Control	Pre-test	181.11	62.76	104	219
		Post-test	178.07	58.21	105	231
High-density lipoprotein	Experimental	Pre-test	47.10	13.63	35	64
		Post-test	52.97	12.14	35	71
	Control	Pre-test	45.70	12.65	36	62
		Post-test	47.07	10.21	39	65
Low-density lipoprotein	Experimental	Pre-test	117.10	35.63	63	142
		Post-test	101.92	25.14	59	123
	Control	Pre-test	115.70	32.65	70	140
		Post-test	112.14	27.59	71	136

Table 3. Results of Levene's test

Variables	F	df1	df2	P
Systolic blood pressure	1.95	2	54	0.15
Diastolic blood pressure	1.41	2	54	0.25
Fasting blood sugar	2.07	2	54	0.13
Triglycerides	1.97	2	54	0.15
High-density lipoprotein	3.03	2	54	0.06
Low-density lipoprotein	2.80	2	54	0.09

df: Degrees of freedom

Table 4 presents the results of multivariate analysis of covariance. Accordingly, all four relevant multivariate statistics (i.e., Pillai's trace, Wilk's lambda effect, Hotelling's trace, and Roy's largest root) were significant for the components of metabolic syndrome. There was a significant difference between the experimental and control groups regarding at least one of the components ($P < 0.01$). The amount of this effect was equal to 0.23 and the power of test was equal to 0.93.

Subsequently, the effect of the independent variable on each component was separately evaluated using the one-way ANCOVA.

The result of the univariate test was significant for all the dependent variables ($P < 0.05$). Regarding this, it was concluded that the independent variable separately affects each of the dependent variables. This finding demonstrated that there was a significant difference between the MBSR group and the control group (Table 5).

Table 4. Results of multivariate analysis of covariance

Tests	Value	df	Error df	F	P	Effect size	Statistical power
Pillai's trace	0.47	12	88	2.26	0.010	0.23	0.93
Wilk's lambda	0.53	12	86	2.65	0.004	0.27	0.96
Hotelling's trace	0.86	12	84	3.04	0.001	0.30	0.98
Roy's largest root	0.85	6	44	6.29	0.001	0.46	0.99

df: Degrees of freedom

Table 5. Results of one-way analysis of covariance

Variables	SS	df	MS	F	P
Systolic blood pressure	26.36	2	13.18	3.22	0.05
Diastolic blood pressure	15.20	2	7.60	3.12	0.05
Fasting blood sugar	258.09	2	129.04	4.32	0.02
Triglycerides	701.62	2	350.81	3.13	0.05
High-density lipoprotein	49.00	2	24.50	3.81	0.03
Low-density lipoprotein	228.15	2	114.07	3.62	0.04

SS: Sum of squares; df: Degrees of freedom; MS: Mean square; F: F-distribution

Discussion

The present study aimed to investigate the effectiveness of MBSR on the metabolic syndrome components among cardiovascular patients with hypertension. The findings demonstrated that the MBSR therapy was effective on each component of the metabolic syndrome among cardiovascular patients with hypertension. This finding is consistent with the results of studies performed by Márquez et al. [3], Guyot et al. [4], Geiger et al. [7], and Kharatzadeh et al. [13].

Stress is one of the factors that alone or in combination with other factors play a major role in high blood pressure. During stressful and threatening situations, the arteries of the visceral organs constrict, during which, the pulse beats rapidly and blood pressure rises [26]. There are various reasons according to which MBSR interventions can beneficially affect the biomarkers of metabolic syndrome. First, from a cerebral point of view, mindfulness presents two ways for stress resilience that are increasing the activity and functional connectivity in the stress-regulating parts of the prefrontal cortex and reducing activity and functional connectivity in parts that control the stress alarm system of the brain. It is expected that resilience modulates the responses of the peripheral sympathetic nervous system and hypothalamic-pituitary-adrenal axis to external stressors [27]. Second, mindfulness interventions affect health behaviors related to stress. Moreover, they probably influence biomarkers [28]. Third, this intervention affects the regulation of emotion, self-awareness, attention control, and concentration through psychological mechanisms [29].

Hypertension is by far the most prevalent individual component among those of the metabolic syndrome and is found in 50%-76% of patients. Both obesity and insulin resistance are known to be associated with increased blood pressure; nevertheless, the etiology of hypertension is likely multifactorial. The compensatory hyperinsulinemia may induce hypertension by a number of mechanisms, including chronic stimulation of the sympathetic and vascular tone [30, 31].

A raft of clinical and experimental evidence emphasizes the role of stress in obesity and metabolic syndrome, with the resultant degree and pattern of sympathetic activation influencing the development of obesity-related illnesses, including hypertension; insulin resistance; and renal, cardiac, and vascular impairment [32]. Mindfulness helps people deal better with stress, pain, and illness. This method improves the state of mindfulness in

individuals and ameliorates patients' health behaviors by reducing rumination and emotional avoidance and increasing self-regulatory behaviors [9]. Moreover, mindfulness training makes patients less judgmental regarding issues and events, be more patient, and consider the upcoming events and issues as if they were facing them for the first time. In other words, the patients try to perceive the events in a new way each time rather than ignoring them or reacting with excessive emotions that are based on past experiences. Judgment causes stress in hypertension patients in many situations. Consequently, the employment of ineffective coping strategies increases the experience of negative feelings and stress. This vicious cycle can lead to an increase in diseases, disorders, and symptoms.

Considering that the treatment of the metabolic syndrome and prevention of its symptoms are highly dependent on how the individual performs self-care behaviors, improvement in the patient's level of mindfulness in this regard will lead to a rise in controlling the symptoms and adhering to self-care behaviors. Consequently, the symptoms of metabolic syndrome in patients with hypertension will improve using this type of intervention. A noteworthy point in the results of this research was the significant levels of difference between the experimental and control groups, which was on the borderline regarding many indicators. This statistical finding clinically indicated that since patients in both groups were being treated by a specialist physician and were taking medications, improvement in symptoms was evident in both groups.

Regarding that this research was conducted on patients with hypertension, who underwent treatment, the achieved results should be cautiously generalized to other individuals and groups of society. Moreover, as the participants of all groups voluntarily participated in learning sessions, the motivating factor should be considered in the improvement of individuals. Due to the limitations of patients, accomplishing the follow-up phase was not feasible in this study.

Conclusions

Therefore, it is suggested that the follow-up stage be performed in future studies to investigate the effect of treatment on patients' recovery process. It is also recommended to conduct the study using gender-disaggregated data.

Ethical considerations

The study was approved by the Ethical Committee of Islamic Azad University, Karaj Branch, Karaj, Iran (IR.IAU.K.REC.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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