



# The comparison of the effect of garlic and lemon juice on blood pressure and comfort in hypertensive patients

*La comparación del efecto del ajo y el jugo de limón sobre la presión arterial y la comodidad en pacientes hipertensos*

shahabeddin Bahrani, Seyed ; Abdulkarimi, Rahim; sabziyani, Zahra; Zahrakord; Agha Mohamadi, Maryam; Gomar, Erfan; kord, Zohre; Afshari, Sahar; Jame Bozorg, Mohadese

<sup>1</sup>MSc Student of Nursing, School of Nursing and Midwifery, Hamadan University of Medical Sciences, Hamadan, Iran.

<sup>2</sup>Department of Environment, Boukan Office, Boukan, West Azerbaijan Province, Iran

<sup>3</sup>Master of Medical-surgical Nursing education, Nursing and Midwifery school, Hamadan University of Medical Sciences, Hamadan, Iran

<sup>4</sup>Master Student of Nursing, Department of Nursing and Midwifery, Hamadan University of Medical Sciences, Hamadan, Iran

\*corresponding author: Zahra sabziyani, MSc Student of Nursing, School of Nursing and Midwifery, Hamadan University of Medical Sciences, Hamadan, Iran. Email: zahrasabzyani2013@gmail.com

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## Abstract

**H**igh blood pressure is one of the biggest causes of disease and mortality in the world and the prevalence of high blood pressure and people affected by it is increasing in the world. The use of non-pharmacological methods such as complementary medicine can play an important role in the process of controlling and modulating blood pressure in patients with high blood pressure. The aim of this study was to compare the effect of garlic and lemon juice on blood pressure levels and comfort of patients with hypertension. This study was performed as a three-group clinical trial by repeated measures in 101 patients with primary hypertension referred to Farshchian Heart Hospital in Hamadan in 1397 who met the inclusion criteria. Patients were selected by convenience sampling and randomly divided into one of three groups: lemon juice, garlic and control. First, patients' blood pressure and comfort level were measured in three groups: in the group of garlic, 10 grams of garlic daily after breakfast and 10 grams of garlic after dinner, and in the group of lemon juice, 10 cc of lemon juice daily after breakfast and 10 cc after dinner, eat for 20 days and then rest for a week.

During this week, the patient's blood pressure and comfort were measured, and this was repeated for another 20 days, and the patients' blood pressure and comfort were measured again after 20 days. In the control group, only the usual treatment was received and their blood pressure and comfort were measured simultaneously with the other groups. Data were analyzed using SPSS 22 software and statistical tests such as Chi-square, ANOVA, ANCOVA and repeated measures ANOVA. The results of Repeated measures ANOVA test showed that there was a statistically significant difference between the mean systolic and diastolic blood pressure and the comfort of patients in the three groups in the three stages of the study (before, during and after) ( $P < 0.001$ ). Significance of garlic and lemon juice consumption leads to lowering blood pressure levels and increasing patient comfort, but no difference was observed between garlic and lemon juice groups. According to the results of the study, patients with hypertension can increase their comfort level by using lemon juice or garlic and have better control over their blood pressure levels.

**Keywords:** Garlic, Lemon juice, Hypertension, Comfort

La presión arterial alta es una de las principales causas de enfermedad y mortalidad en el mundo y la prevalencia de la presión arterial alta y las personas afectadas por esta está aumentando en el mundo. El uso de métodos no farmacológicos como la medicina complementaria puede desempeñar un papel importante en el proceso de control y modulación de la presión arterial en pacientes con presión arterial alta. El objetivo de este estudio fue comparar el efecto del ajo y el jugo de limón sobre los niveles de presión arterial y la comodidad de los pacientes con hipertensión. Este estudio se realizó como un ensayo clínico de tres grupos mediante medidas repetidas en 101 pacientes con hipertensión primaria remitidos al Hospital Farshchian Heart en Hamadan en 1397 que cumplieron con los criterios de inclusión. Los pacientes fueron seleccionados por muestreo de conveniencia y divididos aleatoriamente en uno de tres grupos: jugo de limón, ajo y control. Primero, la presión arterial y el nivel de comodidad de los pacientes se midieron en tres grupos: en el grupo de ajo, 10 gramos de ajo al día después del desayuno y 10 gramos de ajo después de la cena, y en el grupo de jugo de limón, 10 cc de jugo de limón al día después del desayuno y 10 cc después de la cena, coma durante 20 días y luego descansa durante una semana. Durante esta semana, se midieron la presión arterial y la comodidad del paciente, y esto se repitió durante otros 20 días, y la presión arterial y la comodidad de los pacientes se midieron nuevamente después de 20 días. En el grupo de control, solo se recibió el tratamiento habitual y su presión arterial y comodidad se midieron simultáneamente con los otros grupos. Los datos se analizaron utilizando el software SPSS 22 y pruebas estadísticas como Chi-cuadrado, ANOVA, ANCOVA y medidas repetidas ANOVA. Los resultados de la prueba ANOVA de medidas repetidas mostraron que había una diferencia estadísticamente significativa entre la presión arterial sistólica y diastólica media y la comodidad de los pacientes en los tres grupos en las tres etapas del estudio (antes, durante y después) ( $P < 0.001$ ) La importancia del consumo de ajo y jugo de limón reduce los niveles de presión arterial y aumenta la comodidad del paciente, pero no se observaron diferencias entre los grupos de ajo y jugo de limón. Según los resultados del estudio, los pacientes con hipertensión pueden aumentar su nivel de comodidad al usar jugo de limón o ajo y tener un mejor control sobre sus niveles de presión arterial.

**Palabras clave:** ajo, jugo de limón, hipertensión, comodidad

Hypertension is one of the major causes of disease and mortality in the world and the prevalence of hypertension and people affected by it is increasing worldwide<sup>1</sup>. Hypertension is called a “silent killer” because it often has no warning signs or symptoms and many people do not know that they have hypertension<sup>2</sup>. Normal systolic blood pressure is below 120 mmHg and diastolic below 80 mmHg. Elevated blood pressure is systolic between 120 to 129 mmHg and diastolic below 80 mmHg, stage one hypertension means systolic blood pressure 130 to 139 mmHg or diastolic between 80 to 90 mmHg, and ultimately the definition of hypertension stage two blood pressure is systolic equivalent to or greater than 140 mmHg or diastolic equivalent to or greater than 90 mmHg<sup>3</sup>. The number of people with hypertension in Iran has increased from 4 million in the year 1975 to more than 9.7 million in the year 2015, that is largely due to the increased life expectancy and aging in the society<sup>4</sup>. One in three adults worldwide one person has hypertension<sup>5</sup>, and hypertension is the reason of 51% of deaths from stroke and 45% of deaths from cardiovascular disease<sup>5</sup>. Low adherence to antihypertensive drugs is very common and is the most important modifiable factor preventing hypertensive control and its adverse consequences<sup>6</sup>. Many patients prefer herbal remedies to conventional medications, while the use of natural ingredients can play a good complementary role in controlling and modulating blood pressure and increasing the comfort of hypertensive patients<sup>6</sup>. Nursing is one of the first professions to use complementary and alternative medicine. Complementary medicine is used as an intervention for many nursing diagnoses and is therefore referred to the classification of nursing interventions. Treatment with herbal remedies is one of the main components of complementary medicine<sup>7</sup>. Garlic and lemon juice are among the foods that can reduce inflammation and ultimately cardiovascular disease<sup>8</sup>. Garlic, scientifically called *Allium Sativum*, is one of the most widely used herbal supplements. Allicin in the garlic inhibits the activity of a protein called angiotensin-2, which is responsible for high blood pressure, and also contains substances called polysulfides that convert red blood cells to a gas called hydrogen sulfide, which dilates blood vessels and by this mechanism it helps to lower blood pressure<sup>9</sup>. The scientific name for lemons is *Citrus Latifolia*, and lemon juice contains flavonoids, carotenoids, and ascorbic acid, which reduce inflammation and stress. Lemon essence has antioxidant activity such as citral, limonene, linalool and thus prevents LDL oxidation from forming plaque in the artery wall, thereby preventing cardiovascular disease and hypertension<sup>10</sup>. Considering that the prevalence of hypertension and its consequences has increased in recent years, a study has not been conducted yet to investigate the impact of non-pharmacological methods on comfort

(relief, physical superiority, mental and environmental, and or social dimensions that can be strengthened<sup>11</sup> of patients with hypertension. The aim of this study was to compare the effect of garlic and lemon juice on blood pressure and comfort level in patients with hypertension.

**T**his study was done as a triple-blind clinical trial in patients with primary hypertension referred to Farshchian Heart Hospital Clinic in Hamedan in 1397. This study was conducted after obtaining permission from the Ethics Committee of Hamedan University of Medical Sciences under the specific ID IR.UMSHA.REC.1397.406 and registered with the Clinical Trial Center under code IRCT20160110025929N14. Patients who were included in the study were selected by convenience sampling and were randomly divided into three groups of lemon juice, garlic and control groups.

The number of samples needed for this study was calculated using mean and variance of the variables in the two control and experimental groups according to the original study<sup>10</sup> and according to the sample size formula the mean comparison between the two groups<sup>12</sup> and at 95% confidence level and with 90% statistical power, at least 33 patients were estimated for each group and a total of 101 patients were evaluated.

Inclusion criteria included age between 40-65 years, lack of suffering other diseases such as other heart disease, kidney, pulmonary, thyroid disorders, digestive, rheumatoid arthritis, hepatitis, fatty liver, no pregnancy and lactation, no smoking, lack of rapid weight change in the last two months and no use of effective drugs on blood sugar, blood lipids, anti-inflammatory and hypersensitivity to garlic and lemon juice, the patient's blood pressure should be greater than 140/90 mm Hg. Exclusion criteria included death of the patient, withdrawal from co-operation for any reason, reduced level of consciousness, allergy or gastrointestinal problems such as ulcers during the study, changes in medication effective on blood pressure during the study, and the occurrence of any the most common annoyance due to garlic or lemon juice.

After obtaining written consent to participate in the study and measuring patients' blood pressure and comfort at baseline, the garlic consumer group received 10 g of garlic daily for breakfast and 10 g garlic for 20 days and then one week of rest was given, during this one week the patient's blood pressure and comfort were measured, and again 20 days later 10 g of garlic after breakfast and 10 g of garlic after dinner was used. Blood pressure and comfort were measured again. In the lemon juice group, 10 cc lemon juice was given daily for breakfast for 10 days and 10 cc for dinner for 20 days and then one week of rest was conducted, during which one week rested blood

pressure and patient comfort were measured again and, the next 20 days they consumed 10 cc of lemon juice after breakfast and 10 cc after dinner. The patient's blood pressure and comfort were measured again, and the results were compared before, during, and after using garlic and lemon juice<sup>13</sup>. The control group received only routine treatment and their blood pressure and comfort were measured simultaneously with the other groups. Both intervention groups received medication prescribed by the physician in addition to garlic or lemon juice. The lemon juice provided to the patients was fresh with no additives and the garlic cloves were given to the garlic group.

Demographic and clinical characteristics questionnaire containing 29 questions was used for data collection and patient convenience was assessed using Visual Analog Scale (VAS). This scale was self-report and one line and what is used in this study was a vertical 10 cm line with numbers from 0 to 10. On this scale, number 10 represents the lowest comfort state and number zero indicates complete comfort. The participant was asked to rate their comfort using a pencil on the scale. Data were entered into SPSS 22 software after collecting and mean systolic and diastolic blood pressure levels patients' convenience in three stages (before intervention, during and after intervention) (mean, standard deviation, frequency, percentage) (chi-square, Anova, Ancova and Repeated Measures Anova) were examined and analyzed statistically by descriptive statistical and analytical tests and the level of significance was considered less than 0.05.

## Results

**A** total of 101 patients were studied in this study, 33 of them were in garlic group, 33 in lemon juice group and 35 in control group. According to the results, there were no significant differences between the three groups in terms of age, sex, education, marital status, occupation, living area, BMI, daily activity, type of food, type of meat consumed and type of drug used ( $p > 0.05$ ). However, there was a significant difference between the three groups in terms of salt intake in daily diet ( $p = 0.001$ ) and dietary fat intake ( $p = 0.048$ ) (Table 1). None of the three study groups had a history of diabetes and were not currently smoking (cigarette and opium).

Table 1. Demographic Characteristics of Patients in Three Groups				
Variable	Intervention Groups			P-value
	garlic (n=33)	Lemon juice (n=33)	Control (n=35)	
Age, (mean ± sd)	56.30 ± 7.55	55.81 ± 9.60	54.31 ± 8.27	0.603
BMI, (mean ± sd)	28.05 ± 2.79	27.52 ± 3.82	29.52 ± 4.13	0.067
Sex, n (%)				
Male	14 (42.4)	14 (42.4)	16 (45.7)	0.951
Female	19 (57.6)	19 (57.6)	19 (54.3)	
Education, n (%)				
Illiterate	11 (33.3)	11 (33.3)	7 (20)	0.489
Elementary	4 (12.1)	7 (21.2)	9 (25.7)	
High school	9 (27.3)	6 (18.2)	5 (14.3)	
Diploma	8 (24.2)	6 (18.2)	9 (25.7)	
Higher than diploma	1 (3)	3 (9.1)	5 (14.3)	
Marital status, n (%)				
Single	1 (3)	2 (6.1)	3 (8.6)	0.627
Married	32 (97)	31 (93.9)	32 (91.4)	
Occupation, n (%)				
Employee	3 (9.1)	2 (6.1)	5 (14.3)	0.556
Retired	3 (9.1)	8 (24.2)	6 (17.1)	
Housewife	18 (54.5)	18 (54.5)	18 (51.4)	
Self-employed	9 (27.3)	5 (15.2)	6 (17.1)	
Accommodation, n (%)				
City	32 (97)	29 (87.9)	34 (97.1)	0.187
Village	1 (3)	4 (12.1)	1 (2.9)	
Physical activity, n (%)				
5-10 per day	8 (24.2)	7 (21.2)	10 (28.6)	0.152
10-15	6 (18.2)	2 (6.1)	4 (11.9)	
15-20	0	7 (21.2)	5 (11.9)	
Non	19 (57.6)	17 (51.5)	16 (51.5)	
Diet Fat Consumption				
Low fat	18 (54.5)	18 (56.2)	19 (54.3)	0.048
Medium	15 (45.5)	10 (31.2)	16 (45.7)	
Fatty	0	4 (12.5)	0	
Daily salt intake n (%)				
$\frac{1}{4}$ Tea spoon	9 (27.3)	21 (63.6)	10 (28.6)	0.001
$\frac{1}{2}$ tea spoon	23 (69.7)	7 (21.2)	21 (60)	
one tea spoon	1 (3)	5 (15.2)	4 (11.4)	
Type of food consumed n (%)				
Fried	19 (57.6)	16 (48.5)	20 (57.1)	0.595
Herbal	0	2 (6.1)	2 (5.7)	
Boiled	14 (42.4)	13 (39.4)	12 (34.3)	
Grilled	0	2 (6.1)	1 (2.9)	
Type of meat consumed n (%)				
Red meat (beef and lamb)	11 (33.3)	18 (56.2)	15 (42.9)	0.175
White meat (chicken, fish, ostrich and quail)	22 (66.7)	14 (43.8)	20 (57.1)	

There was no significant difference between the three groups in regard to blood thinners, antihypertensive and diuretic medications ( $p > 0.05$ ) (Table 2).

Table 2 - Comparison of Frequency of Medications used in Patients in Three Groups				
medicines	Intervention Groups			P-value
	Garlic (n=33) n(%)	lemon juice (n=33) n(%)	Control (n=35) n(%)	
Blood dilutor				
Yes	17 (51.5)	17 (51.2)	21 (60)	0.544
No	16 (48.5)	16 (48.2)	14 (40)	
Antihypertensive				
Yes	33 (100)	33 (100)	34 (97.1)	0.386
No	0	0	1 (2.9)	
Diuretic				
Yes	5 (15.2)	1 (3)	3 (8.6)	0.224
No	28 (84.8)	32 (97)	32 (91.4)	

According to Table 3, the results of the Anova test showed no significant difference between the mean systolic blood pressure before the intervention ( $P=0.063$ ). Ancova test results showed that the mean systolic blood pressure in the intervention and the post-intervention phase was significantly different between the three groups by adjusting the effect of salt and fat in the diet ( $P<0.001$ ). The following Bonferroni test showed a significant difference between the garlic group and the control group in both stages ( $P<0.001$ ), but there was no significant difference between the garlic group and the control group during the intervention ( $P=0.974$ ) and after the intervention ( $P=0.125$ ).

Repeated Measures Anova test results showed that there was a statistically significant difference between mean systolic blood pressure in three stages of study in garlic group and lemon juice group ( $P<0.001$ ). There was a significant decrease in mean systolic blood pressure at each stage compared to the previous stage. But in lemon juice group there was a statistically significant difference between the mean before, during and after the mean ( $P<0.001$ ), but there was no significant difference between the mean during and after stages ( $P=1$ ). In the control group, there was no significant difference between mean systolic blood pressure in three stages ( $P=0.377$ ) (Table 3).

Based on Table 3 and Chart 1, the results of Repeated Measures Anova statistical test showed that by modifying the effect of pre-systolic blood pressure and salt and fat intake, there was a significant difference between the three groups in the mean effect of systolic blood pressure on the three groups (garlic, lemon juice and control group) in three stages of study (before, during and after the study) there was a statistical significant difference ( $P<0.001$ ) and the Bonferroni post hoc test showed a significant difference in mean systolic blood pressure between the two groups. There was no significant difference between garlic and lemon juice ( $P=0.793$ ) but there was a difference between garlic and control group ( $P<0.001$ ) and lemon juice with control ( $P<0.001$ ). There was statistically significant difference in the study in three stages.

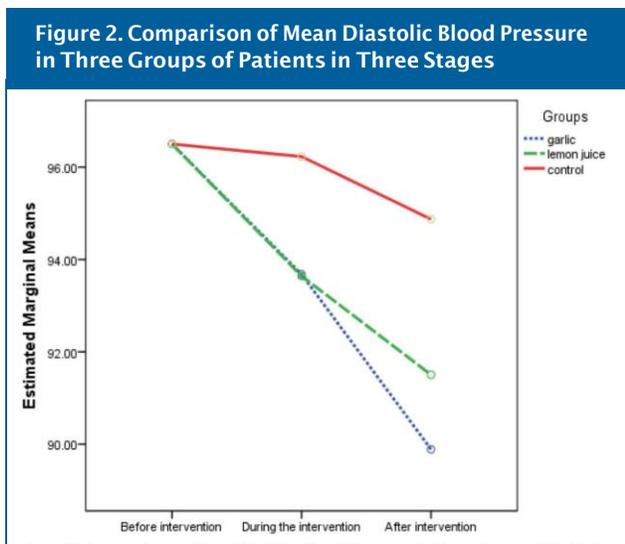
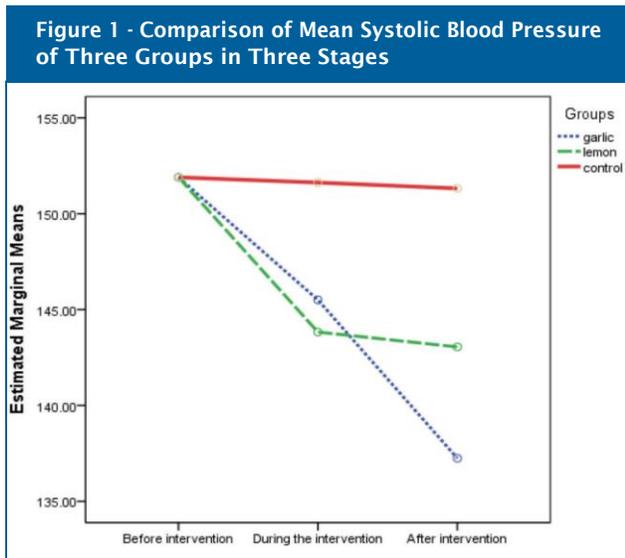
According to Table 4, the results of the Anova test showed no significant difference between the mean diastolic blood pressure before the intervention in the three groups ( $P=0.347$ ). Ancova test results showed that mean diastolic blood pressure during the intervention and after the intervention was significantly different between the three groups ( $P=0.018$ ) and result of Bonferroni post hoc test showed that there was no statistically significant difference between garlic and lemon juice ( $P=1$ ), but there was a significant difference in mean diastolic blood pressure during and after the intervention between garlic and control group, as well as between lemon and control group ( $P<0.05$ ).

Repeated Measures Anova test results showed that there was a significant difference between the mean diastolic blood pressure in three stages of study in each of the garlic and lemon juice groups ( $P<0.001$ ) and Bonferroni post hoc test showed a there was a significant decrease in diastolic blood pressure in all groups ( $P<0.05$ ). There was a statistically significant difference between mean before and during diastolic blood pressure ( $P=0.012$  and  $P<0.001$ , respectively) but no significant difference between mean before and during diastolic blood pressure ( $P=0.075$ ). There was no statistically significant difference between mean diastolic blood pressure in three stages in control group ( $P=0.354$ ) (Table 4).

Based on Table 4 and Chart 2, the results of Repeated Measures Anova test showed that there was a significant difference between the three groups in moderating the effect of pre-diastolic blood pressure and salt and fat consumption. There was a statistically significant difference ( $P=0.004$ ). Bonferroni post hoc test showed that there was no significant difference in mean diastolic blood pressure in three stages between two groups of garlic and lemon juice ( $P=1$ ), but there was a statistically significant difference between garlic and control group ( $P=0.002$ ) and lemon juice with control group ( $P=0.029$ ).

**Table 3. Comparison of Mean Systolic Blood Pressure of the Three Groups**

Groups	Before intervention	During the intervention	After intervention	Repeated Mesures Anova in each group	Repeated Mesures Anova
	Mean (SD)	Mean (SD)	Mean (SD)		
<b>garlic</b>	153.78 (9.43)	146.81 (8.27)	138.33 (10.94)	F=61.82 df=2 p-value<0.001	F=14.48 df=2 p-value<0.001*
<b>lemon juice</b>	153.48 (13.07)	144.03 (12.71)	143.18 (12.48)	F=18.29 df=2 p-value<0.001	
<b>Control</b>	148.71 (6.10)	150.08 (6.17)	150.08 (8.92)	F=0.96 df=2 p-value=0.377	
Anova & Ancova	F=2.83 df=2 p-value=0.063	F=15.77 df=2 p-value<0.001*	F=22.31 df=2 p-value<0.001*		



According to Table 5, the results of the Anova test showed no significant difference between the patients' pre-intervention comfort in the three groups ( $P=0.501$ ). Ancova test results showed that patients' mean comfort at each stage during and after the intervention was significantly different between the three groups ( $P<0.001$ ) and Bonferroni post hoc test results showed that there was a statistically significant difference between the garlic and lemon juice groups during the intervention ( $P=0.001$ ) and  $P<0.001$ , respectively), but there was no significant difference between the garlic and lemon juice groups ( $P=1$ ). There was no significant difference between garlic and lemon juice after intervention ( $P=0.186$ ), but between lemon juice with control ( $P<0.001$ ) and garlic group with control ( $P<0.001$ ) there is a statistically significant difference.

Repeated Measures Anova test results showed that there was a statistically significant difference between patients' comfort in three stages of study in each of the garlic and lemon juice groups ( $P<0.001$ ) and Bonferroni post hoc test showed a significant difference between all stages in both two groups ( $P<0.001$ ). But there was no statistically significant difference between the patients' mean comfort in the three stages of the study in the control group ( $P=0.076$ ) (Table 5).

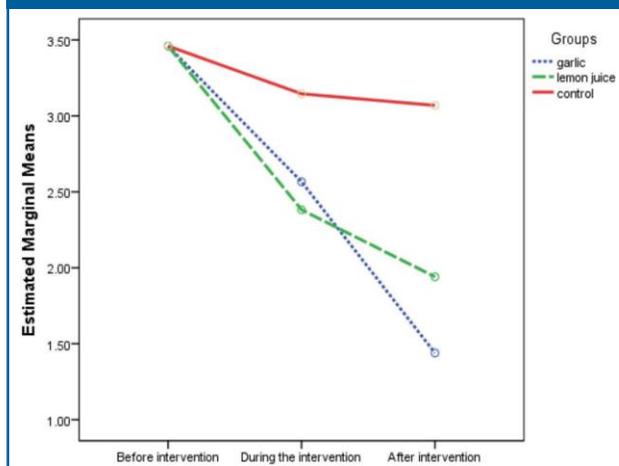
Based on Table 5 and Chart 3, the results of Repeated Measures Anova test showed that by moderating the effect of pre-comfort and salt and fat intake in the three groups, the effect of the groups was significant and there was a statistically significant difference between the mean comfort of the patients in the three study phases. There was a significant difference ( $P<0.001$ ) and the results of Bonferroni post hoc test showed that there was no statistically significant difference between the two groups of garlic and lemon juice ( $P=1$ ). But there was a statistically significant difference between garlic with control group and lemon juice with control ( $P<0.001$ ).

Groups	Before intervention	During the intervention	After intervention	Repeated Mesures Anova in each group	Repeated Mesures Anova
	Mean (SD)	Mean (SD)	Mean (SD)		
garlic	97.27 (6.74)	94.24 (6.74)	90.30 (6.72)	F=19.19 df=2 p-value<0.001	F=3.97 df=2 p-value=0.004*
lemon juice	96.96 (6.36)	93.81 (7.01)	91.51 (5.79)	F=13.90 df=2 p-value<0.001	
Control	95.28 (4.99)	95.42 (5.73)	94.42 (6.03)	F=1.05 df=2 p-value=0.354	
Anova & Ancova	F=1.07 df=2 p-value=0.347	F=4.19 df=2 p-value=0.018*	F=8.73 df=2 p-value<0.001*		

Table 5 - Comparison of Mean Comfort of Patients in the Three Groups

Groups	Before intervention	During the intervention	After intervention	Repeated Mesures Anova in each group	Repeated Mesures Anova
	Mean (SD)	Mean (SD)	Mean (SD)		
garlic	3.63 (0.92)	2.69 (0.91)	1.54 (1.09)	F=122.23 df=2 p-value<0.001	F=19.28 df=2 p-value<0.001*
lemon juice	3.42 (1.17)	2.30 (0.88)	1.84 (0.97)	F=36.63 df=2 p-value<0.001	
Control	3.28 (1.50)	3.02 (1.50)	3 (1.51)	F=2.81 df=2 p-value=0.076	
Anova & Ancova	F=0.69 df=2 p-value=0.501	F=11.01 df=2 p-value<0.001*	F=22.65 df=2 p-value<0.001*		

Figure 3. Comparison of the Mean Comfort of Patients in Three Groups in Three Stages



## Discussion

The aim of this study was to compare the effect of garlic and lemon juice on blood pressure and comfort level in patients with hypertension which total of 101 people (garlic intake 33 patients, lemon juice intake 33 patients and control group 35 patients) were studied. The results of this study showed that there was a statistically significant difference between the three groups only in terms of daily salt intake and dietary fat intake and their effect was moderated.

Based on the results, lemon juice was effective in reducing systolic and diastolic blood pressure of the patients studied and garlic consumption was also effective in reducing systolic and diastolic blood pressure of the studied patients, but there was no difference between the effect of garlic on systolic and diastolic blood pressure. There is no effect of lemon juice on systolic and diastolic blood pressure. If you write it like this, it is contradictory to what was stated above. Does it have an effect?. In general, garlic consumption resulted in a decrease in patients' blood pressure, which was observed at both systolic and

diastolic blood pressure levels during the first 20 days of the intervention, and continued garlic consumption in the second phase of the intervention (the second 20 days after the rest period) it has led to a further decrease in blood pressure in patients, and also short-term consumption of lemon juice can have a positive and significant effect on lowering blood pressure in patients (systolic and diastolic), and its longer consumption significantly does not reduce blood pressure in patients.

In a study by Karin et al<sup>14</sup> they also found that garlic supplements have the potential to lower blood pressure in people with hypertension and that garlic intake could be considered as a complementary treatment option for hypertension.

Also in a study by Wang et al<sup>15</sup>, which meta-analyzed 17 clinical studies on the effect of garlic on blood pressure, they found that garlic consumption significantly reduced systolic and diastolic blood.

In several other meta-analysis studies conducted in this field, all studies investigating the effect of garlic consumption on blood pressure in healthy individuals and patients have been included in the meta-analysis, and the results of these studies show that garlic consumption leads to lower blood pressure in healthy people and patients with hypertension<sup>16-18</sup>.

Contrary to the results of the present study, Tohidi et al<sup>19</sup> studied the effect of garlic powder consumption on blood pressure and serum lipid and lipoprotein levels in healthy subjects. They found that serum level of lipid and lipoproteins decreased significantly after intervention but they did not find a significant decrease in blood pressure. This study may be different from the present study in the population, as only healthy individuals were studied in the Tohidi's study, but the present study was conducted on individuals with hypertension.

Consistent with the results of our study, Kato et al<sup>20</sup> examined the effect of daily consumption of lemons and walking on lowering blood pressure in women with high blood pressure and concluded that daily consumption of lemons and the steps a person takes daily have a significant effect on lowering blood pressure in patients<sup>20</sup>.

Also, in a study by Pratt et al<sup>21</sup> the effect of lemon juice on blood pressure in pregnant mothers found that using lemon juice significantly reduced systolic and diastolic blood pressure in pregnant women.

In a study by Edway et al<sup>22</sup> found that people who consumed garlic in their diet had lower blood pressure than others, but this relationship was statistically significant only for systolic blood pressure and contrary to the results of the study, in the present study there was no significant reduction in diastolic blood pressure by garlic consumption.

Consistent with the results of our study, the results of a review and meta-analysis of Anders Ruhner et al<sup>23</sup> showed that nine meta-clinical trials (study interval between 6 and 26 weeks) entered this meta-analysis and all these studies examined the effect of consumption garlic reduced blood pressure in patients with hypertension compared to control group, significantly lowering systolic and diastolic blood pressure in patients consuming garlic compared to control group.

In a study conducted by Kawak et al<sup>24</sup> aimed at investigating the effect of garlic powder consumption on cardiovascular risk factors, they meta-analyzed randomized clinical trials studies, of which 9 articles were searched for impact of garlic powder had been used on systolic blood pressure and 10 articles were about on diastolic blood pressure, evidence of lowering systolic blood pressure  $-4.34$  mmHg ( $-0.29$  to  $-8.28$ ) and lowering diastolic blood pressure  $-2.36$  ( $-0.15$  to  $-4.56$ ) mmHg has been reported.

In the study of Reed et al<sup>25</sup> mean blood pressure in the group consuming 2 capsules of garlic for 12 weeks and group 4 capsules for 8 weeks of mean systolic blood pressure significantly decreased compared to the control group, but there was no statistically significant difference in decreasing diastolic and consumers of first capsule.

Contrary to the results of the present study, in the study that Ozonal et al<sup>26</sup> aimed to investigate the effect of lemon juice on hypertension of patients with hypertension was given to lemon juice intervention group and to normal control group and patients' blood pressure level 5 minutes, 15 Minutes and 30 minutes after intervention were measured. In both groups, systolic and diastolic blood pressure levels decreased and no statistically significant difference was observed between the two groups. The reasons given in this study for the lack of a significant relationship between abdominal blood pressure in patients, the presence of a doctor, the relaxation and the quiet environment were noted. This has led to a decrease in blood pressure in both groups.

Also in a study by Hashemipour et al<sup>27</sup> it was concluded that consumption of lemon juice in overweight and obese people decreased systolic and diastolic blood pressure in the intervention group before and after treatment but this difference was not significant compared with the control group.

The difference between the present study and that of Hashemi Pour, who concluded that lemon juice consumption did not significantly decrease the blood pressure of the subjects studied, may be due to the different target group of these studies and it can be concluded that lemon juice in individuals with hypertension will reduce more effectively systolic and diastolic blood pressure levels.

Studies investigating the effect of garlic consumption compared with lemon juice to reduce blood pressure in patients are very limited, and the only study available in this area is the study of Aslan et al<sup>11</sup> which studies the effect of consumption a mixture of garlic and lemon juice on fasting blood sugar, blood pressure and BMI in hyperlipidemia patients, with 120 patients aged 30-65 years newly diagnosed with hyperlipidemia who were randomly divided into 4 equal groups. Consumption of garlic and lemon juice after 8 weeks was able to significantly reduce systolic and diastolic blood pressure and BMI compared to lemon juice and control group, but this reduction was not significant compared to garlic group. Also, the combination of garlic and lemon juice had no significant effect on fasting blood sugar. And the final result of this study was that mixing garlic with lemon juice could not have a better effect than garlic consumption alone.

As the results of the present study and other studies have shown, garlic and lemon juice consumption results in a decrease in blood pressure in patients with hypertension, and studies on the effect of garlic consumption on blood pressure levels are far greater than studies of the effect of lemon juice on blood pressure. Aysel et al<sup>28</sup> also conducted a study aimed at examining the acute and chronic effects of lemon juice on patients' blood pressure, concluding that whether lemon juice lead to acute complications or not, they declared that further studies are needed to investigate the effect of lemon juice on blood pressure.

According to the results of the present study, garlic consumption has effectively increased the patients' comfort level (mean decrease in VAS score) and lemon juice has also increased patients' comfort level (mean decrease of VAS score), but there is no difference between effect of garlic on increasing comfort or the effect of lemon juice on increasing comfort.

No studies have been performed to evaluate the effect of lemon juice or garlic on the comfort of hypertensive patients. But based on the results of the study, it can be concluded that patients' blood pressure increased as their level of comfort increased and during and after the procedure, according to the previous results, no difference was observed in the blood pressure of patients with garlic group on blood pressure. The effect of garlic and lemon juice on the patients' comfort was not significantly different between the two groups, but each of the garlic and lemon juice groups compared to the control group led to a decrease in blood pressure and an increase in the comfort level of patients with hypertension. The results obtained in this section can be the basis for future studies in assessing patients' comfort level.



The results of the present study show that even in the short 20-day period of consumption of garlic and lemon juice, we see a decrease in blood pressure and an increase in patients' comfort level. Although there was no statistically significant difference between garlic intake and lemon juice at different stages of intervention, according to the obtained averages, lemon juice was more effective in the short term (during the intervention), however after completing the study, in for a longer period of time, we have seen a greater reduction in blood pressure and an increased level of comfort for patients, and the effect of garlic consumption on blood pressure is more noticeable. In short, it can be concluded that the short-term effects of lemon juice are greater than those of garlic and the long-term effects of garlic consumption are greater than those of lemon juice, but these results can be very useful for hypertensive patients who can benefit from these substances and eat more in their diet and thus have better control over their blood pressure and increase their comfort level, while patients themselves are also more likely to use a vegetarian diet to control their blood pressure.

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