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Original Research

The Effects of Dietary Interventions on Cardiovascular Indexes among Individuals with Cold and Hot Temperaments Based on Persian Medicine

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Abstract

This study aimed to explore potential relationships between dietary patterns aligned with cold or hot temperaments and cardiovascular parameters among healthy individuals. This randomized clinical trial was conducted in 2020 with 65 healthy volunteers. Participants were categorized into two groups, specifically as hot or cold temperaments. In the initial phase, we measured body temperature, systolic and diastolic blood pressure, and conducted the Heart Rate Variability (HRV) test. Subsequently, participants received a three-day diet plan with a similar nature to their body temperament (second phase). The same measurements were repeated after three days. Following this, participants returned to a normal daily diet for three days. In the third phase, they received a diet plan of the opposite nature to their temperament for another three days, and the same battery of tests was conducted at the study's conclusion. In both the cold temperament group during the second phase and the hot temperament group during the third phase, mean body temperature, heart rate, systolic and diastolic blood pressure were significantly lower than in other phases ($P < 0.05$). Additionally, HRV indexes, including RMSSD, SDNNInd, and QT, were significantly higher during the second phase for the cold temperament group and the third phase for the hot temperament group compared to other phases ($P < 0.05$). Irrespective of individual body temperament, the consumption of a cold-natured diet led to a significant decrease in mean body temperature, heart rate, systolic and diastolic blood pressure. This effect may be attributed to the activation of the parasympathetic nervous system.

Keywords: Temperament; Mizaj; Persian medicine; Autonomic nervous system; Diet; Heart rate variability

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Introduction

Temperament is a fundamental concept in traditional medicines worldwide. In Persian medicine, the principles of prevention and treatment revolve around the notion of temperament [1]. According to this paradigm, both the human body and foods possess a quality known as temperament, which is characterized primarily by the cold-hot axis and secondarily by the dry-moist axis. The central objective of this medical tradition is to maintain the body's equilibrium, thereby preventing diseases and preserving health [2]. Despite the growing popularity of these traditional methodologies, our understanding of their definitions and mechanisms remains limited. Despite advancements in various scientific domains, traditional medical treatments continue to rely on experiential knowledge, trial and error, and references to ancient texts [3,4]. Research into temperament is still in its infancy, and critical elements, such as the utilization of standardized questionnaires and consistent methodology for identifying temperament types, have yet to be fully integrated, potentially impacting research outcomes [5].

In traditional Persian medicine, body temperament is classified into nine groups: cold, hot, wet, dry (single temperaments), cold and wet, cold and dry, hot and wet, hot and dry (combined temperaments), and balanced. From this perspective, individuals can be broadly categorized into two groups: those with cold temperaments (including cold, cold-wet, and cold-dry temperaments) and those with hot temperaments (including hot, hot-wet, and hot-dry temperaments) [6,7].

Individuals with hot temperaments tend to be lively, active, extroverted, and readily display their emotions. They typically exhibit a fast pulse rate and have prominent, visible veins. While their bodies easily warm up in cold weather during physical activity, cooling down in hot weather proves challenging for them. In contrast, individuals with cold temperaments often experience low energy levels, cold extremities, slow and sluggish behavior, and physical movements. Their bodies resist warming in cold weather, and the cold lingers within them for an extended duration [7,8].

The relationship between temperament and biological systems has fascinated researchers since ancient times and remains a compelling area of study [9,10]. The autonomic nervous system, through the coordinated activity of its sympathetic and parasympathetic branches, plays a pivotal role in maintaining homeostasis. Key functions such as blood pressure regulation, heart rate modulation, gastrointestinal responses to food, bladder function, body temperature regulation, and pupil responses fall within the purview of the autonomic nervous system's homeostatic control. The regulation of autonomic function, particularly in the heart, is central to cardiovascular health. Previous research has indicated that individuals with hot temperaments exhibit higher peripheral sympathetic nervous system activity, adrenal sympathetic activity, adrenal corticosteroid activity, and lower parasympathetic nervous system activity compared to those with cold temperaments [11]. Additional studies have shown that individuals with hot temperaments tend to have higher systolic and diastolic blood pressure and elevated heart rates [12,13].

This study aims to explore a fraction of the potential underlying mechanisms involving the autonomic nervous system in this theory. We also seek to evaluate the effects of diets with cold and hot natures on the autonomic system and temperament. Given the current dearth of empirical evidence supporting this theory and its pathophysiology, this study contributes to our comprehension of the scientific basis of this theory. Moreover, as the influence of nutrition on the autonomic system remains relatively uncharted territory in conventional medicine and nutrition, the findings of this study have the potential to shed light on the intersection of temperament and nutrition, potentially aiding in the prevention and treatment of individuals afflicted by autonomic disorders.

Materials and Methods

This clinical trial was conducted in 2020 at Chamran Hospital in Isfahan, Iran (Trial registration number: IRCT20200428047232N2). The study population comprised 65 healthy volunteers selected through convenient sampling methods. Ethical approval for the study protocol was obtained from the Research Committee of Isfahan University of Medical Sciences, with confirmation from the Ethics Committee.

Inclusion criteria encompassed physical and mental well-being, determined via medical history and physical examinations, an age range of 18-40 years, a body mass index (BMI) falling within 19-25 kg/m^2, and, for female participants, inclusion during days 17 to 27 of their menstrual cycle in the context of a regular 30-day cycle. All participants provided written informed consent.

Exclusion criteria consisted of a history of cardiovascular disease, hypertension, neurological disorders, liver and kidney ailments, diabetes, thyroid dysfunction, alcohol consumption, rheumatic conditions, autoimmunity, immunodeficiency, malignancy, or amyloidosis. Additionally, individuals who had recently followed any specific diet (including vegetarian or weight-loss diets), taken medications or supplements within the preceding four weeks, engaged in recent travel, or experienced severe stressful events were excluded. Participants experiencing adverse events or those unable to tolerate the prescribed diet were free to discontinue their participation at any point.

Demographic data, including age, gender, weight, and height, were collected from all participants initially. Subsequently, each candidate completed a temperament questionnaire [14] and was categorized into two groups, namely, cold and hot temperaments. The Salmannejad questionnaire, known for its higher sensitivity and lower specificity, was chosen as the preferred tool for temperament screening in this research [15].

In the initial stage, participants underwent autonomous nervous system tests within a quiet environment, maintained at a stable temperature of 21-26 °C. Participants refrained from consuming tea, coffee, or cigarettes for four hours before the tests and avoided strenuous physical activities for 24 hours prior. Measurements included mean body temperature, heart rate, systolic and diastolic blood pressure. Heart Rate Variability (HRV) tests were conducted in a quiet room, with participants resting in a supine position for five minutes while equipped with Holter monitoring devices. Subsequently, the data were transferred to software for HRV parameter calculation and interpretation. During Holter monitoring, we also measured the Root Mean Square of the Successive Differences (RMSSD), Standard Deviation of NN intervals (SDNN), SDNN Index (SDNNInd), and Standard Deviation of the Average NN intervals (SDANN). It is noteworthy that, based on prior research, activation of the parasympathetic nervous system could lead to a decrease in heart rate while potentially increasing HRV, resulting in elevated SDNN, SDANN, RMSSD, and SDNNInd. However, these changes may be subtle and dependent on individual characteristics.

Following the initial assessments, participants were provided with diets of a similar nature to their respective temperaments for 3 days. Those with cold temperaments were instructed to eat only the foods listed in the cold-natured diet and to avoiding the foods listed as hot natured, while participants with hot temperaments were asked to only consume foods that are listed under hot-natured diet refraining to eat foods listed on the cold nature list. During this period, participants were monitored via phone to ensure adherence to the prescribed regimen. Participants were not provided with specific calorie calculations or food quantity recommendations; instead, they were allowed to consume food freely, provided they adhered to the prescribed list of foods corresponding to their temperament. After the three-day diet period, participants returned to the clinic, and autonomic function tests were repeated, yielding data for the second stage of analysis.

Subsequently, participants resumed their normal daily diets for three days before receiving a diet plan of opposite nature to their temperament. A comprehensive list of hot and cold foods was provided (as listed in table 1), instructing participants not to consume foods aligned with their body temperaments for three days, effectively adhering to a contra-temperament diet. During this period, participants were monitored via phone to ensure adherence to the prescribed regimen. Participants were not provided with specific calorie calculations or food quantity recommendations during different stages of this study; instead, they were allowed to consume food freely, provided they adhered to the prescribed list of foods corresponding to contra-temperament. After these prescribed periods, participants returned to the clinic, and autonomic function tests were once again administered, constituting the data for the third stage of analysis.

Data were meticulously collected, verified, and entered into SPSS software (version 25, IBM Corporation, Armonk, NY). Descriptive statistics, such as frequency distribution tables, were employed to report epidemiological and clinical characteristics. Quantitative variables were described using means and standard deviations, while qualitative variables were presented as percentages. To analyze quantitative variables, normality was assessed using histogram diagrams and the Kolmogorov-Smirnov test. Means were compared using t-tests and analysis of variance (ANOVA), while qualitative variables were compared using the chi-square test. All data analyses were conducted at a significance level of 5%.

Results

A total of 70 volunteers initially enrolled in the study, meeting the inclusion criteria. However, five participants were subsequently excluded: two due to cardiovascular disease, one due to diabetes, and two due to inadequate cooperation with phone calls during the diet plan recommendation phase. Consequently, data from 65 participants were included for analysis. Figure 1 illustrates the CONSORT flowchart for this study. Demographic characteristics of the subjects are presented in table 2.

Table 3 displays the determination and comparison of mean values for the variables at three stages (study initiation, post-pro-temperament diet, and post-contra-temperament diet). As indicated in table 3, the mean body temperature, heart rate, systolic and diastolic blood pressure during the second stage for the cold temperament group (following a cold diet) and during the third stage (following a cold diet) for the hot temperament group were significantly lower compared to other stages ($P < 0.05$). Furthermore, based on the results, the mean values of SDNNInd, QT, and RMSDD variables during the second stage for

Table 1. List of foods with hot and cold nature recommended to participants

Study group	Pro-temperament diet	Break	Contra-temperament diet
Individuals with cold temperament	3 Days of diet with a cold nature	3 Days of routine diet	3 Days of diet with a hot nature
Individuals for hot temperament	3 Days of diet with a hot nature	3 Days of routine diet	3 Days of diet with a cold nature

List of foods with hot nature: Figs, grapes, peanuts, sweet almonds, mountain almonds, melon seeds, melons, carrots, apples, turnips, sesame, mangoes, paper almonds, eggplants, pistachios, oregano, onions, horseradish, leeks, parsley, tea, Mustard, cinnamon, basil, turmeric, saffron, ginger, cumin, cumin, garlic, fenugreek, pepper, hazelnut, celery, black currant (raisin), walnut, cod liver oil, shallot, beeswax, coconut, chickpea, mint, Orange juice, cardamom, orange juice, dates, watercress, watercress, sugar, turnip, fenugreek, dill, tarragon, coconut, water peas, broth, turkey meat, mutton, duck, pigeon, sparrow, partridge, shrimp, Quail meat, liver, eggplant stew, lunar cabbage, salty foods, egg yolk, chicken meat, camel meat, chicken ostrich meat, pigeon meat, kohan, camel, table salt, cloves, cardamom, cumin, honey, garlic, walnut, basil, mint, cabbage, dill, leek, ginger, ginger jam, shaqal jam, Fennel and lemon juice, grilled meats, black seeds, thyme, saffron, sheep liver.

List of foods with cold nature: Spinach, plum, pomegranate, beans, okra, purslane, cheese, cucumber, buttermilk, pumpkin, cucumber and watermelon seeds and squash, pumpkin, peach, watermelon, Indian stamp, barley, corn, rhubarb, barberry, vinegar, elderberry, king Oak, cilantro, cherry, Amani lemon, sour lemon, sweet lemon, mung bean, orange, pumpkin, barley, barley, spinach, vinegar, lemon juice, watercress, pickle, lettuce, cucumber, tomato, purslane, orange, sakanjabin, gourd, jujube , strawberries, kiwi, citrus fruits, plums, oranges, grapefruit, raspberries, blueberries, sumac, string beans, yogurt, buttermilk, curd, beef, mung bean, dairy products, turnips, Bukhara plums, coriander, barberry , rice, lentils, yogurt, syrup, milk, chicory, fish, milk, egg whites, lettuce salad, mushrooms, potatoes, tomatoes, green beans.

Table 2. Mean and standard deviation of the underlying variables of the subjects

Variable		Value
Age (years) (Mean± SD)		27.4± 7.4
Height (cm) (Mean± SD)		179.07± 26.09
Weight (kg) (Mean± SD)		68.8± 7.18
Gender (n (%))	Male	51 (78.5%)
	Female	14 (21.5%)

the cold temperament group and the third stage for the hot temperament group were significantly higher than in the other stages ($P < 0.05$). However, no significant differences were observed in the means of SDNN and SDANN variables across different stages ($P > 0.05$).
Insert Table 3.
Additionally, the group comparison results show that the mean QT variable in all three stages in the hot temperament group is significantly higher than in the cold temperament group.
In cases where group comparisons were significant, a post hoc test was employed to compare variable pairs at each stage and between the two groups. The table reveals that only for the QT variable, the comparison between groups was significant. According to the post hoc test results, the mean QT variable in the first and third stages in the hot temperament group was significantly higher than the mean in the first and third stages in the cold temperament group.

Discussion

This study aimed to investigate the effects of diets with hot or cold natures on the physiology and clinical characteristics of 65 individuals with either cold or hot temperaments. According to our data, the mean body temperature, heart rate, and systolic and diastolic blood pressure in the second stage for the cold temperament group (following a cold diet) and in the third stage for hot temperament individuals (following a cold diet) were lower than in other stages, respectively. Additionally, we observed that the mean values of SDNNInd, QT, and RMSDD variables in the second stage for the cold temperament group and the third stage for the hot temperament group were significantly higher than in the other stages. Furthermore, the mean QT variable in all three stages in the hot temperament

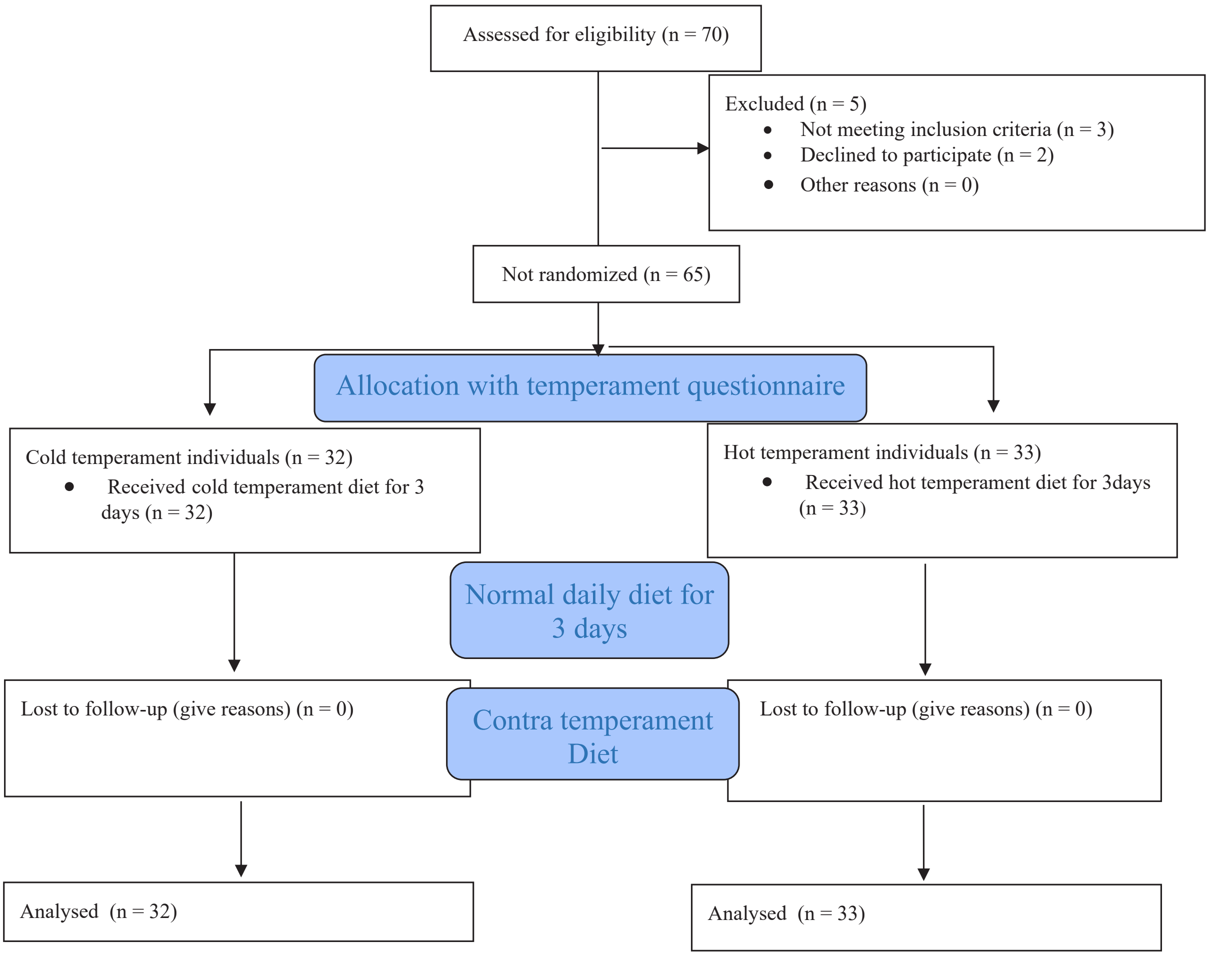

Figure 1. CONSORT flow chart of the participants

group was significantly higher than in the cold temperament group. We know that Increased QTV may be caused by sympathetic overactivity while a decrease in mean body temperature, heart rate, and systolic and diastolic blood pressure may represent activation of parasympathetic nervous system [16]. These findings suggest that the consumption of a cold nature diet can lead to a significant reduction in mean body temperature, heart rate, and systolic and diastolic blood pressure in participants, irrespective of the individual's temperament. Conversely, a cold diet was associated with an increase in the mean values of SDNNInd, QT, and RMSDD. These physiological changes in individuals may be attributed to the modulation of the sympathetic or parasympathetic nervous systems. We hypothesize that the consumption of a cold diet may activate the parasympathetic system, resulting in a reduction in mean body temperature, heart rate, and systolic and diastolic blood pressure, which is consistent with findings from other studies [17,18]. In 2010, Zygmunt and Stanczyk conducted a study demonstrating that different foods, nutrition, and diets can significantly impact the autonomic nervous system, subsequently leading to alterations in cardiovascular reflexes and body temperature [19]. Their research highlighted that activation of the parasympathetic nervous system can reduce heart rate while potentially increasing HRV, thereby leading to heightened SDNN, SDANN, RMSDD, and SDNNInd. However, these changes may vary in magnitude and depend on individual characteristics. In 2012, Toufan and colleagues assessed cardiovascular indices among 50 professional athletes and 50 healthy non-athletes. Their study results revealed that heart rate, blood pressure, HRV, and Holter monitoring indexes are highly influenced by both the level of physical activity and the autonomic nervous system. Furthermore, they noted that participants' diets and personality traits could significantly influence these variables [20]. Our data align with these findings, demonstrating significant changes in cardiovascular parameters, including heart rate, systolic and diastolic blood pressure, SDNNInd, QT, and RMSDD, following dietary changes in healthy individuals. These changes appear to be mediated through the activation or deactivation of the autonomic nervous system. Moreover, individual differences

Table 3. Comparison of the mean± standard deviation of the studied variables between groups and within groups

Variable		Cold temperament	Hot temperament	P-value*	P-value**
Temperature (°C)	First stage	0.32±37.15	0.26±37.15	0.001	0.87
	Second stage	0.2±36.95	0.22±37.23		
	Third stage	0.22±37.22	0.2±36.96		
QT(ms)	First stage	11.7±341.7	21.08±357.9	0.001	0.004
	Second stage	28.05±352.1	19.25±356.7		
	Third stage	15.3±343.4	23.5±362.1		
Heart rate(bpm)	First stage	8.1±86.4	11.09±82	0.001	0.18
	Second stage	7.2±81.3	11.04±82.6		
	Third stage	8.5±84.9	11.4±78.8		
RMSDD(ms)	First stage	9.3±29.56	21.5±39.1	0.01	0.051
	Second stage	14.6±37.1	25.07±43.06		
	Third stage	12.2±32.1	23.4±43.2		
SDNN(ms)	First stage	13.7±51.6	22.2±56.83	0.08	0.4
	Second stage	16.9±58.7	27.2±660.19		
	Third stage	16.5±52.5	23.4±58.2		
SDNNInd(ms)	First stage	17.9±46.9	22.7±52.2	0.02	0.21
	Second stage	16.6±50.7	22.4±54.09		
	Third stage	16.8±45.7	20.5±53.14		
SDANN(ms)	First stage	8.5±16.6	9.4±16.4	0.2	0.99
	Second stage	7.7±16.1	10.01±14.35		
	Third stage	8.08±14.1	9.3±16.1		
Systolic blood pressure (mmHg)	First stage	18.2±127	21.2±130	0.001	0.24
	Second stage	14.3±114.1	13.09±127.7		
	Third stage	12.2±124	16.1±120		
Diastolic blood pressure(mmHg)	First stage	8.6±81.33	16.2±80.3	0.001	0.86
	Second stage	5.6±74	5.8±80.49		
	Third stage	5.5±80.3	9.6±75.4		

* Test results for group comparison. ** Test results for intergroup comparison

represented as temperament classification in Persian medicine seems to play a role in the autonomic system regulation. Based on our results, individuals with a cold temperament exhibit lower mean body temperature and heart rate, as well as lower systolic and diastolic blood pressure, and higher SDNNInd, QT, and RMSDD values. These values underwent significant changes following the consumption of a cold-nature diet. In accordance with Persian medicine concepts, individuals with cold body temperaments are advised to limit the consumption of foods with cold temperaments. According to this perspective, the consumption of cold nature foods further exacerbates the temperament's coldness and may lead to cold dys-temperaments and related illnesses.

In 2014, Farsani and colleagues investigated the relationship between hot and cold temperaments and basal metabolic rate, as well as the activity of the sympathetic-parasympathetic system. They emphasized the strong connection between people's temperaments and the autonomic nervous system. Consequently, changes in diet that align with or contradict their temperaments might lead to alterations in basal metabolic rate and the autonomic nervous system [21]. Our study results support this concept, as the consumption of a cold-nature diet was associated with the activation of the parasympathetic system, resulting in the reduction of body temperature, heart rate, and blood pressure in individuals.

Another study, conducted by Masoumzadeh in 2018, examined the effects of both cold and hot-natured diets on the levels of thyroid hormones, epinephrine, norepinephrine, cortisol, testosterone, and luteinizing hormone (LH). A total of 60 students with an average age of 20 years participated in the study and underwent dietary interventions for three weeks. Ultimately, the study reported that consuming a diet of moderate nature, hot nature or cold nature foods for three weeks, had no significant effects on thyroid hormones, cortisol, testosterone, LH, cortisol, VMA, and Normetanephrine levels. The study also noted that dietary interventions could influence the autonomic nervous system but found no effects of diet on the hormonal system [22].

In summary, our study suggests that the consumption of a cold nature diet can lead to a significant reduction in mean body temperature, heart rate, and systolic and diastolic blood pressure in individuals, regardless of their temperament. These changes are likely mediated through the activation of the parasympathetic system, which aligns with previous research.

It is crucial to acknowledge the limitations of our study, which primarily stem from several factors. Firstly, we provided participants with diets of hot and cold natures for only a brief duration of three days. This limited timeframe may not have been sufficient to induce significant changes in their inherent temperaments, as temperamental alterations can often require more extended periods of dietary adherence for observable shifts to occur.

Additionally, it is essential to consider that temperament is a complex and multifaceted trait influenced by various factors beyond dietary intake. Variables such as sleep patterns, physical activity levels, and mental activity can all play pivotal roles in shaping an individual's temperament. Unfortunately, in our study, we faced challenges in controlling these external factors, which could have influenced our participants' temperaments independently of their dietary choices.

Given these limitations, it becomes apparent that the short duration of dietary interventions and the inability to regulate various external factors may have contributed to our inability to detect significant changes in temperament based solely on food consumption. Future research endeavors with longer intervention periods and more comprehensive control over external variables may yield a deeper understanding of the interplay between diet and temperament.

Conclusion

The consumption of a cold nature diet is associated with a significant reduction in mean body temperature, heart rate, and systolic and diastolic blood pressure in individuals, regardless of their temperament. These changes are mediated through the activation of the parasympathetic system.

Ethical approval

This study protocol was approved by Research Committee of Isfahan University of Medical Sciences. (Code number IR.MUI.MED.REC.1398.402)

Conflict of Interests

The authors declare no conflict of interest.

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