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ORIGINAL ARTICLE

Blood Pressure Response against Sedentary Lifestyle and Caffeine Ingestion in Population: A Cross Sectional Study

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ABSTRACT

Background: Coffee and tea mainly contain caffeine, and they are the most widely consumed beverages all over the world. The association between caffeine consumption and a sedentary lifestyle in the population is not homogeneous and remains inconsistent.

Aims and objects: The aims and objectives of the current study were to examine the association of caffeine and an inactive lifestyle with blood pressure in the population.

Study Design: The current study was a cross sectional study in which participants were chosen based on certain variables of interest.

Place and Duration: The present study was conducted in healthcare units and Ghurki Teaching Hospital, Lahore, from February to May 2023.

Methodology: In this study, a total of 200 male and female individuals with hypertension were selected and divided into different groups based on their caffeine intake and lifestyle. In Group-X, 59 male and female individuals consumed only tea in their daily meals and had an active lifestyle. In Group-Y, 51 male and female participants consumed only tea with a sedentary lifestyle. In Group-Z, 90 male and female individuals consumed both tea and coffee with a highly inactive lifestyle.

Practical Implications: This study emphasizes the need for public education and lifestyle changes to lessen the negative effects of coffee use and inactivity on blood pressure. People may actively manage their cardiovascular health by encouraging better behaviors and preventative actions, which will increase community well-being and lower the risk of problems from hypertension.

Results: There was a significant ($p \leq 0.05$) difference in blood pressure observed between individuals in Group-Z compared to individuals in Group-X and Group-Y. The findings of the current study concluded that high consumption of caffeine-containing food products elevated both systolic and diastolic blood pressure. The changes in systolic and diastolic blood pressure for each group are graphically presented in Fig-1, Fig-2, and Fig-3, respectively. The findings of the present study regarding the association between a sedentary lifestyle and systolic and diastolic blood pressure showed significant ($p \leq 0.05$) changes. The male and female individuals in Group-X, Group-Y, and Group-Z exhibited remarkable changes in their systolic and diastolic blood pressure due to their lifestyle: (29.12±0.01, 1.12±0.01), (28.12±0.01, 1.12±0.01), (09.12±0.04, 22.12±0.01), (07.12±0.04, 13.12±0.01), (2.12±0.01, 48.12±0.01), (8.12±0.01, 48.12±0.01).

Conclusion: The present study concluded that there were significant ($p \leq 0.05$) changes in blood pressure among individuals in Group-Z compared to individuals in Group-X and Group-Y due to high caffeine intake. The results of this study demonstrated that high consumption of caffeine-containing food products increased both systolic and diastolic blood pressure in the population.

Keywords: Systolic and diastolic blood pressure, Caffeine, Lifestyle, Coffee, hypertension

INTRODUCTION

Caffeine levels in coffee range from 95 to 200 milligrams, while in black tea it ranges from 14 to 70 milligrams. Green tea contains 24 to 45 milligrams of caffeine, while white tea contains 6 to 60 milligrams.[1] Hypertension is an established risk factor for various chronic diseases, including coronary artery disease, stroke, heart failure, and kidney disease. It can shorten life expectancy, and even a small decrease in blood pressure can have a significant effect on these health outcomes[2] . In Pakistan, approximately 1 in 3 adults (78 million) have hypertension, but only about 50% of patients have their blood pressure controlled. Coffee and caffeine consumption is one of the dietary and lifestyle factors that play a role in blood pressure control and hypertension prevention, and coffee is a popular beverage consumed in Pakistan and worldwide [3].

Drinking two to three cups of coffee can raise both systolic and diastolic blood pressure by 3 to 24 millimeters of mercury (mmHg) due to the immediate impact of coffee consumption. Caffeine has been implicated in the blood pressure changes observed after acute coffee consumption[4]. Caffeine stimulates the release of norepinephrine, affects the renin-angiotensin system, and antagonizes the adenosine receptor, which may contribute to coffee-related acute hypertension. However, current evidence suggests that drinking coffee is not thought to increase the risk of developing hypertension[5]. Studies on the relationship between chronic coffee consumption and blood pressure have yielded conflicting results. Some studies have shown a lower risk of hypertension with higher coffee consumption, while others have linked increased coffee consumption to higher blood pressure, which may be influenced by factors such as smoking[6]. Chronic coffee and caffeine consumption's effects on the hemodynamic system require further investigation. Caffeine's cardiovascular effects may involve adenosine receptor blockade and phosphodiesterase inhibition[7].

Physical inactivity is a significant public health issue and a leading cause of mortality. It is strongly associated with coronary heart disease, type II diabetes, and hypertension. In 2022, 9% of premature deaths worldwide were attributed to physical inactivity. Socioeconomic disparities in inactivity have also been observed[8]. The World Health Organization (WHO) recommends that adults aged 18-64 engage in 150-300 minutes of moderate-intensity physical activity, 75-150 minutes of vigorous-intensity physical activity, or an equivalent combination of both throughout the week[9]. Epidemiological data demonstrate a dose-dependent association between physical exercise and high blood pressure[10].

Physical inactivity is a significant contributor to morbidity and mortality, posing a major public health challenge. Insufficient physical activity is responsible for a significant proportion of non-communicable diseases such as hypertension[11]. Several studies have shown a strong graded association between sedentary behavior and increased systolic and diastolic blood pressure, with the relationship depending on the amount of time spent in physical activity[12] . Reducing sedentary time can lead to improvements in blood pressure and a reduction in cardiovascular risk. Physical activity has a direct relationship with systolic and diastolic blood pressure [13]. Participants in studies were encouraged to recall and document any recent activities they engaged in, considering only those that lasted at least ten minutes [13]. Factors such as age, sex,

monthly income, body mass index (BMI), commute distance, high BMI, and alcohol consumption were taken into account as potential confounding variables. Physically inactive individuals had higher probabilities of developing hypertension compared to those who were regularly active[14].

MATERIALS AND METHODS

Study design: The current study was a cross sectional study in which participants were chosen based on certain variables of interest.

Place and Duration: The present study was conducted in health care units and Ghurki Teaching Hospital, Lahore, from February to May 2023.

Methodology: In this study, a total of 200 male and female individuals with hypertension were selected and divided into different groups based on their caffeine intake and lifestyle. In Group-X, 59 male and female individuals consumed only tea in their daily meals and had an active lifestyle. In Group-Y, 51 male and female participants consumed only tea with a sedentary lifestyle. In Group-Z, 90 male and female individuals consumed both tea and coffee with a highly inactive lifestyle.

Sample Collection Method: A Convenient diet and physical exercise plan will be provided to the selected individuals shown in Chart-A. Each individual will check their blood pressure twice daily using a digital or mercury sphygmomanometer.

Data Collection Procedure: Each individual will check their blood pressure levels twice daily using a digital or mercury sphygmomanometer and record the readings on the questionnaire Performa (Annexure A). Additionally, they will measure their body weight at regular intervals and record the measurements accordingly.

Exclusion Criterial: The study includes regular drinkers of caffeine-containing liquids such as coffee, tea, energy drinks, or soft drinks. Participants should not have a history of hypertension or be currently taking any antihypertensive drugs. Individuals with conditions such as diabetes, kidney disease, cardiovascular disease, or any other illness that could potentially affect blood pressure are excluded from participation.

Inclusion Criteria: The study included individuals aged 25 to 65, encompassing a range of age groups. Participants had diverse degrees of physical activity, including both sedentary and moderately active individuals. Both regular and infrequent drinkers of caffeinated beverages were included, as they consume caffeine. Individuals with a diagnosis of hypertension, regardless of whether or not they were taking medication, were also included in the study.

Bio- statistic: Raw data was analyzed by statistical version SPSS. All variables were expressed as frequency and percentage frequency with the applications of Mean and Standard Deviation. Significant (p≤0.05) for group comparisons was applied.

RESULTS

Blood pressure levels raised with caffeine consumption were measured in all group with considering lifestyle of each individual respectively. The significant (p≤0.05) criteria was applied in each group.

Table-1: General demographics of participants

Variables	Units	Mean ± SD	(p≤0.05)
Age	Years	52.21±0.01	0.01
Gender (n)	Male	118.01±0.01	0.01
	Female	82.01±0.01	0.01
Smoking	Number	72.01±0.04	0.04
Alcohol	Number	22.01±0.02	0.02
BMI	kg/m^2	29.01±0.03	0.03

Table-2: Group-X male individuals (n=30)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	28.01±0.02	0.02
Tea	Cup/day	2.12±0.01	0.01
Coffee	Cup/day	2.12±0.01	0.01
Soft drinks	Drinks/ day	01.12±0.01	0.01
Lifestyle	Active	29.12±0.01	0.01
	Non Active	1.12± 0.01	0.01

Table-3 Group-X male individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	135.01±0.02	0.02
Diastolic BP	mm Hg	85.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	132.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	81.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	130.01±0.02	0.02
Diastolic BP After 2 Month	mm Hg	89.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	135.10±0.01	0.01
Diastolic BP After 3 Month	mm Hg	88.12±0.01	0.01

Table-4: Group-X female individuals (n=29)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	29.01±0.02	0.02
Tea	Cup/day	2.12±0.01	0.01
Coffee	Cup/day	2.12±0.01	0.01
Soft drinks	Drinks/ day	01.12±0.01	0.01
Lifestyle	Active	28.12±0.01	0.01
	Non Active	1.12± 0.01	0.01

Table-5: Group-X female individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	136.01±0.02	0.02
Diastolic BP	mm Hg	88.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	135.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	81.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	130.01±0.02	0.02
Diastolic BP After 2 Month	mm Hg	89.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	137.10±0.01	0.01
Diastolic BP After 3 Month	mm Hg	87.12±0.01	0.01

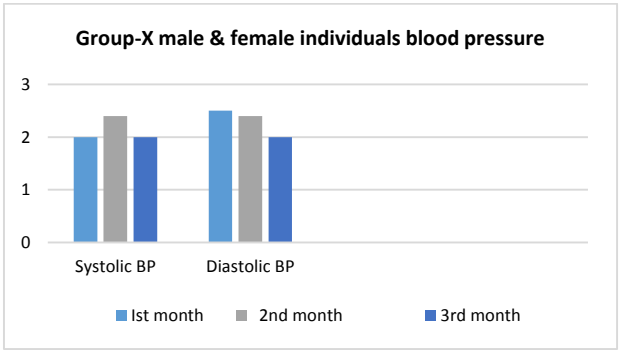

Fig-1: Graphical presentation of blood pressure in Group-X (M/F)

Table6: Group-Y male individuals (n=31)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	30.01±0.01	0.01
Tea	Cup/day	5.12±0.02	0.02
Coffee	Cup/day	2.12±0.01	0.01
Soft drinks	Drinks/ day	02.12±0.03	0.03
Lifestyle	Active	09.12±0.04	0.04
	Non Active	22.12± 0.01	0.01

Table-7: Group-Y male individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	140.01±0.02	0.02
Diastolic BP	mm Hg	90.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	142.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	91.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	140.01±0.02	0.02
Diastolic BP After 2 Month	mm Hg	95.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	145.10±0.01	0.01
Diastolic BP After 3 Month	mm Hg	98.12±0.02	0.02

Table-8: Group-Y female individuals blood pressure (n=20)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	30.01±0.01	0.01
Tea	Cup/day	5.12±0.02	0.02
Coffee	Cup/day	2.12±0.01	0.01
Soft drinks	Drinks/ day	02.12±0.03	0.03
Lifestyle	Active	07.12±0.04	0.04
	Non Active	13.12± 0.01	0.01

Table-9: Group-Y female individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	139.01±0.02	0.02
Diastolic BP	mm Hg	90.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	142.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	91.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	142.01±0.02	0.02
Diastolic BP After 2 Month	mm Hg	95.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	144.10±0.01	0.01
Diastolic BP After 3 Month	mm Hg	97.12±0.02	0.02

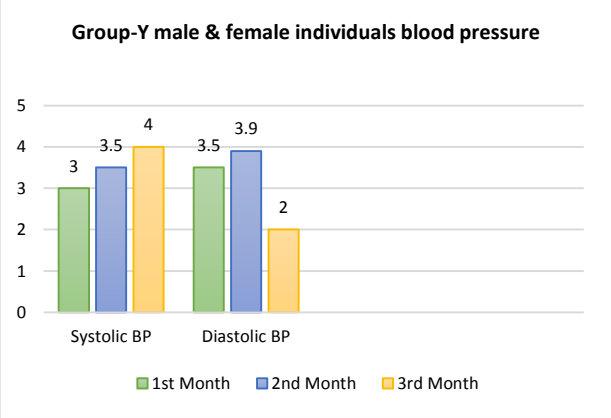

Fig-2: Group-Y male & female individuals blood pressure

Table10: Group-Z male individuals (n=50)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	28.01±0.02	0.02
Tea	Cup/day	4.12±0.01	0.01
Coffee	Cup/day	4.12±0.01	0.01
Soft drinks	Drinks/ day	2.12±0.01	0.01
Lifestyle	Active	2.12±0.01	0.01
	Non Active	48.12± 0.01	0.01

Table-11: Group-Z male individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	145.01±0.02	0.02
Diastolic BP	mm Hg	95.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	142.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	91.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	150.01±0.01	0.01
Diastolic BP After 2 Month	mm Hg	99.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	149.10±0.03	0.03
Diastolic BP After 3 Month	mm Hg	98.12±0.04	0.04

Table-12: Group-Z female individuals blood pressure (n=40)

Parameters	Units	Mean ± SD	(p≤0.05)
BMI	kg/m^2	35.01±0.01	0.01
Tea	Cup/day	4.12±0.01	0.01
Coffee	Cup/day	4.12±0.01	0.01
Soft drinks	Drinks/ day	2.12±0.01	0.01
Lifestyle	Active	8.12±0.01	0.01
	Non Active	40.12± 0.01	0.01

Table-13: Group-Z female individuals blood pressure

Parameters	Units	Mean ± SD	(p≤0.05)
Systolic BP	mm Hg	146.01±0.03	0.03
Diastolic BP	mm Hg	98.12±0.01	0.01
Systolic BP After 1 Month	mm Hg	145.10±0.01	0.01
Diastolic BP After 1 Month	mm Hg	101.12±0.01	0.01
Systolic BP After 2 Month	mm Hg	150.01±0.02	0.02
Diastolic BP After 2 Month	mm Hg	99.12±0.01	0.01
Systolic BP After 3 Month	mm Hg	147.10±0.01	0.01
Diastolic BP After 3 Month	mm Hg	97.12±0.01	0.01

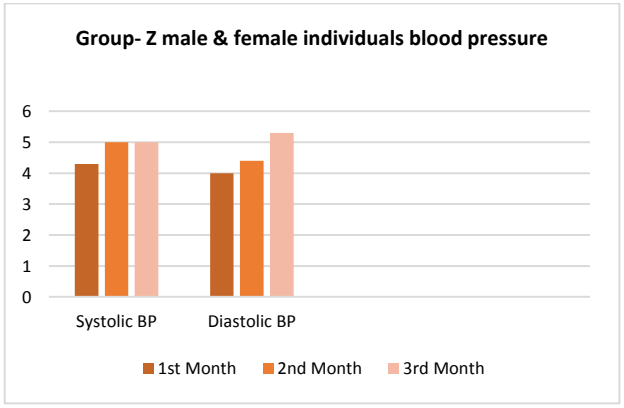

Fig-3: Group-Z male & female individuals blood pressure

The consumption of tea, coffee, and soft drinks, whether in the short or long term, can raise blood pressure. Caffeine, the main active ingredient in these beverages, is responsible for this effect. In the current study, it was observed that a high quantity of caffeine likely contributed to increased systolic and diastolic blood pressure. The male and female individuals in Group-Z had higher BMI and led a sedentary lifestyle, consuming excessive amounts of tea, coffee, and other caffeine-containing soft drinks compared to individuals in Group-X and Group-Y. The systolic and diastolic blood pressure measurements of Group-Z individuals (145.01±0.02, 95.12±0.01) were recorded after the 1st, 2nd, and 3rd month as follows: (142.10±0.01, 91.12±0.01), (150.01±0.01, 99.12±0.01), (149.10±0.03, 98.12±0.04), (146.01±0.03, 98.12±0.01), (145.10±0.01, 101.12±0.01), (150.01±0.02, 99.12±0.01), (147.10±0.01, 97.12±0.01) respectively.

Significant (p≤0.05) differences in blood pressure were observed between individuals in Group-Z compared to those in Group-X and Group-Y. Based on the findings of the current study, it was concluded that the high consumption of caffeine-containing food products contributed to increased systolic and diastolic blood pressure. The changes in systolic and diastolic blood pressure for each group are graphically presented in Fig-1, Fig-2, and Fig-3.

Regarding the relationship between sedentary lifestyle and systolic and diastolic blood pressure, the findings of the present study showed significant (p≤0.05) changes. Both male and female individuals in Group-X, Group-Y, and Group-Z exhibited remarkable changes in their systolic and diastolic blood pressure due to their respective lifestyles, as follows: (29.12±0.01, 1.12±0.01), (28.12±0.01, 1.12±0.01), (09.12±0.04, 22.12±0.01), (07.12±0.04, 13.12±0.01), (2.12±0.01, 48.12±0.01), (8.12±0.01, 48.12±0.01).

DISCUSSION

According to this analysis, the intake of coffee containing 200 to 300 mg of caffeine caused a significant rise in blood pressure in hypertensive patients[15]. This increase was observed within the first 60 minutes of consumption and lasted for up to 180 minutes[16]. However, drinking coffee for two weeks did not seem to increase blood pressure. Previous research has shown conflicting findings regarding the relationship between blood pressure and coffee and

caffeine consumption[17]. Randomized controlled trials have indicated that short-term consumption of caffeine or coffee leads to an immediate elevation of 2/1 mm Hg in systolic and diastolic blood pressure compared to decaffeinated coffee or abstention[18]. However, long-term use has been associated with a significant increase in both systolic and diastolic blood pressure. In Pakistan, the majority of caffeine consumed by adults comes from beverages, with coffee being the most common source[19].

These findings provide hypertensive individuals with evidence of the impact of coffee on their blood pressure[20]. A comprehensive evaluation of caffeine's acute effects on normotensive individuals revealed an increase of 20 to 42 mm Hg in systolic blood pressure and 23 to 41 mm Hg in diastolic blood pressure[21]. It is concluded that regular coffee consumption may harm certain individuals who are prone to hypertension. Numerous studies have demonstrated the hemodynamic effects of chronic coffee and caffeine consumption, indicating that caffeine can have adverse cardiovascular effects by blocking adenosine receptors and inhibiting phosphodiesterase[22].

Physical inactivity is indeed a significant public health issue and a leading cause of morbidity and mortality[23]. Insufficient physical activity is a major contributor to non-communicable diseases such as hypertension, coronary heart disease, and type II diabetes[24]. A cross-sectional survey conducted in the Colombo District of Sri Lanka involving senior officers and management assistants aged 30 to 60, employed in public administration institutions, provided evidence supporting the fact that physical inactivity is a primary cause of death and plays a role in the development of various chronic conditions[25].

CONCLUSION

Based on the findings of the present study, it was concluded that there were significant ($p \leq 0.05$) changes in blood pressure among individuals in Group-Z compared to those in Group-X and Group-Y due to their high intake of caffeine. The results indicate that consuming food products containing high levels of caffeine raised both systolic and diastolic blood pressure in the population.

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