ORIGINAL RESEARCH ARTICLE

The effects of caffeine ingestion on blood pressure levels in athletic and non-athletic women

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Abstract

Caffeine is one of the most widely consumed pharmacological substances globally, and is known for its potential ergogenic effects. This study examined the impact of caffeine on the blood pressure in athletic and non-athletic women. Caffeine, a CNS stimulant, enhances athletic performance by boosting stamina, alertness, and cognitive speed. The aim of this study was to assess the impact of caffeine on heart rate and blood pressure in both athletic and non-athletic women, and to inform both groups about its effects. The study was conducted in the Kingdom of Saudi Arabia and involved 30 volunteers aged 18–30 years. Participants were equally divided into three groups: athletes who consumed caffeine, non-athletes who consumed caffeine, and a control group (given a placebo). After caffeine ingestion, there were no significant differences in diastolic blood pressure (DBP), systolic blood pressure (SBP), or heart rate between athletes and non-athletes. These findings suggest that caffeine consumption does not significantly affect blood pressure in either athletic or non-athletic women. However, if it raises blood pressure in both groups, it could pose risks, prompting athletes to consider alternative hydration options such as Gatorade. *(Afr J Reprod Health 2024; 28 [5]: 84-89)*

Keywords: Hypertension, systolic blood pressure, diastolic blood pressure, heart rate, coffee, athletes

Résumé

La caféine est l'une des substances pharmacologiques les plus largement consommées dans le monde, et est connue pour ses effets ergogéniques potentiels. Cette étude a examiné l'impact de la caféine sur la pression artérielle des femmes athlètes et non athlètes. La caféine, un stimulant du système nerveux central, améliore les performances des athlètes en augmentant l'endurance, la vigilance et la vitesse cognitive. L'objectif de cette étude était d'évaluer l'impact de la caféine sur la fréquence cardiaque et la pression artérielle chez les femmes athlètes et non athlètes, et d'informer les deux groupes de ses effets. L'étude a été menée au Royaume d'Arabie saoudite et a impliqué 30 volontaires âgés de 18 à 30 ans. Les participants ont été répartis également en trois groupes : des athlètes qui ont consommé de la caféine, des non-athlètes qui ont consommé de la caféine, et un groupe témoin (ayant reçu un placebo). Après l'ingestion de caféine, il n'y avait pas de différences significatives dans la pression artérielle diastolique (PAD), la pression artérielle systolique (PAS) ou la fréquence cardiaque entre les athlètes et les non-athlètes. Ces résultats suggèrent que la consommation de caféine n'affecte pas significativement la pression artérielle chez les femmes, qu'elles soient athlètes ou non. Cependant, si elle augmente la pression artérielle dans les deux groupes, cela pourrait présenter des risques, incitant les athlètes à envisager des options d'hydratation alternatives, telles que le Gatorade. *(Afr J Reprod Health 2024; 28 [5]: 84-89).*

Mots-clés: Hypertension, pression artérielle systolique, pression artérielle diastolique, fréquence cardiaque, café, athlètes

Introduction

Caffeine is the most commonly used pharmacological substance[1]. Food sources include coffee, tea, soft drinks, chocolates, energy drinks, and medications[2-4]. Coffee contains the highest number of caffeinated products[3]. There was 65-120 mg caffeine in 230 ml of coffee[1]. Healthy people can drink four cups of coffee daily (400 mg of caffeine)[1]. Recent phytochemical research has shown the benefits of coffee consumption to human health, as its benefits outweigh its negative effects[5]. Coffee contains components that may contribute to its vital benefits, such as antioxidant substances, including phenol chlorogenic acid (CA) and tocopherols (TCP)[6]. In recent years, coffee consumption has been associated with a reduced risk of chronic diseases including type 2 diabetes[10,27], Parkinson's disease[9], hepatocellular carcinoma[11], endometrial cancer[32], and Alzheimer's disease[12].

Coffee consumption is associated with a lower frequency of liver disease and blocked toxin-induced cirrhosis[1]. Coffee consumption has a positive protective effect on liver histology and enzyme levels in patients with non-alcoholic fatty liver disease (NAFLD) and non-alcoholic steatohepatitis (NASH)[7]. One study found that the consumption of two cups of coffee per day decreased the risk of liver cancer by 43%[8]. Clinical research has shown that single doses of caffeine <450 mg do not increase the severity of arrhythmia in healthy individuals[5].

Elevated caffeine consumption does not increase the risk of incident atrial fibrillation (AF) in healthy women. In contrast, low caffeine consumption may protect against AF[28]. According to the International Olympic Committee, caffeine positively affects performance[18]. Caffeine is a central nervous system stimulant that is now being used to enhance performance in sports[38]. Athletes are now using caffeine supplements to improve their workouts and performances in competitions[39]. Moderate doses of caffeine provide an effective ergogenic aid during endurance-type exercise and sports[29.30].

Caffeine has been found to boost stamina, and alertness, quicken the speed it takes to process information and logic, and also reduce the amount of effort perceived to be done in an intense exercise period – in doing this, the athlete will feel less fatigued[38,40]. In addition, caffeine enhances endurance in some activities that last for more than 30 min, possibly because it stimulates the secretion of adrenaline[19] or delays fatigue within the nervous system by blocking or inhibiting adenosine receptors, thus reversing the inhibitory effects of adenosine, such as decreasing the synthesis of DA (a neurotransmitter) associated with an excess of 5-HT, and thus delaying fatigue[17].

In a previous study, caffeine did not increase SBP or DBP when maximal exercise was performed in physically active females[13]. Another study found that caffeine consumption (4 mg/kg) did not affect the cardiovascular system after exercise[14]. In two studies, caffeine consumption significantly increased Post-exercise SBP[15,16]. It is anticipated that 29% of adults living in developing nations (1.56 billion) will have hypertension by 2025[21]. Therefore, to avoid and reduce the risk of morbidity and mortality due to cardiovascular disease, blood pressure monitoring is necessary to maintain appropriate blood pressure levels[44]. Therefore, digital blood pressure monitors have received increasing attention as alternatives to aneroid and mercury manometers because they require qualified healthcare workers to use them[45]. Some studies recommend the use of digital blood pressure monitors[46,47].

In one study, blood pressure increased after caffeine ingestion (200-300 mg) in hypertensive patients 60 min after ingestion[20]. Additionally, they discovered in another study that healthy older normotensive women who consumed caffeine experienced a substantial rise in systolic and diastolic blood pressure (DBP) that persisted for 90 minutes[31]. In another study, they found that in a hypertensive older population, habitual coffee ingestion of >3 cups/day was associated with uncontrolled BP[22]. In two other studies, neither caffeinated nor decaffeinated coffee was linked to higher blood pressure in the long term[23,24]. Coffee consumers have a higher risk of developing hypertension than non-coffee drinkers[24]. The effect of caffeine on blood pressure is due to its ability to inhibit adenosine receptors in the blood vessels, which causing vasoconstriction[25.26]. The level of physical activity and variation in DBP after caffeine ingestion were inversely correlated in one study, indicating that younger women who engaged in less physical activity experienced an increase in DBP after caffeine ingestion[31,33].

The purpose of our study was to determine the effects of caffeine consumption on both athletic and non-athletic females. We wanted to determine whether caffeine raised blood pressure in both types and determine if it had a greater effect on one, so that we could inform the population about caffeine in their lifestyle.

If it was known that caffeine raised high blood pressure in a non-trained individual, and at the same time, the same effects were shown in an athlete, it could be considered dangerous for the non-athlete. This would be the same if caffeine had no effect on the athlete at all, and the athlete may want to reconsider consuming the product, considering that there are no effects from the caffeine shown on the blood pressure, and would be better off with regular Gatorade[41-43].

Methods

This study was conducted on 30 volunteers with ages ranging–18-30 years. Participants with hypertension or cardiovascular disease were excluded. Participants were requested to avoid consuming any source of caffeine, including medications, one day before the experiment (including medications).

The participants were divided equally into 3 groups:
(i)- Athletes who ingested caffeine
(ii) Non-athletes (normal) who ingested caffeine.
(ii) Control (placebo)

Information such as (weight - height - range of daily caffeine intake) was recorded for all participants before the experiment began. Groups (i) and (ii) ingested 250-300 ml of coffee (average 80–120 mg of caffeine), and group (iii) ingested 250-300 ml of water. SBP, DBP, and heart rate were measured for all groups before and after ingestion (–45-90 minutes after ingestion because within 45 min after oral ingestion, caffeine is completely absorbed in the small intestine and stomach; it reaches its highest concentration in the plasma within 20-30 min after ingestion[1]. Measurements were performed in a left-handed resting position using an automatic "digital" blood pressure monitor (CITIZEN, CH-657).

Results

Analysis of variance (ANOVA) was conducted using the SPSS software. Data were evaluated using descriptive statistical analyses and paired t-tests. All data processing was done at a probability value $p<0.05$. The average age of participants was 22.40±3.41 and weight was 59.93±9.24.

Table 1: Demographic data for participants' included standard deviation and average values

	N	Mean	Std. Deviation
Age	30	22.40	3.41
Weight	30	59.93	9.24
Height	30	156.03	5.17
No. of coffee cups per day	30	1.27	0.98
Valid N (listwise)	30		

Table 1 shows the demographic data of the participants, including standard deviation and average values. Table 2 displays the findings following the use of the paired t-test to compare variations in SBP, DBP, and heart rate between athletes, non-athletes, and controls after ingestion of caffeine and placebo. The results of the paired samples test are summarized in Table 3 as the mean values of SBP, DBP, and Pulse in athletes and non-athletes after caffeine ingestion and in the control group.

Table 2: The standard deviation and mean of the variables are shown in the overview of the paired t-test between athletes, non-athletes, and control

VAR00010	N	Mean	Std. Deviation
SYS_ Normal (After)	10	113.30	6.83
SYS_ athletes (After)	10	116.10	11.43
SYS_control (After)	10	116.70	8.62
DIA_ Normal (After)	10	83.30	8.03
DIA_ athletes (After)	10	85.80	9.27
DIA_ control (After)	10	84.60	7.62
Pulse_ Normal (After)	10	98.90	13.44
Pulse_ athletes (After)	10	86.80	17.54
Pulse_ control (After)	10	86.70	6.70

The average SBP difference of non-athletes after drinking a coffee was 2.80 ± 5.20 ($t = 1.702$, $p = 0.123 > 0.05$), and of athletes it was -2.5±10.92 ($t=-0.724$, $p=0.487 > 0.05$). The average DBP variation or difference of non-athletes after consuming coffee was 1.30 ± 6.07 ($t=0.677$, $p=0.516 > 0.05$) and of athletes it was -4.7 ± 7.2 ($t = -2.065$, $p = 0.069>0.05$). The typical heart rate difference of non-athletes after consumption of coffee was -1.90 ± 13.55 ($t = -0.443$, $p = 0.668>0.05$), and that of athletes was 0.8 ± 12.32 ($t=0.205$, $p=0.842 > 0.05$). Consequently, we concluded that there was no difference in DBP, SBP, or heart rate between athletes and non-athletes after caffeine ingestion. (Table 3) There was a slight increase in SBP and DBP in athletic women after caffeine consumption.

Discussion

In our study, we found that caffeine ingestion had no effect on blood pressure in both athletic and non-athletic women. This result was supported by some studies, in two of them they found that moderate or habitual caffeine intake (>3 cups\day or 440 mg of caffeine\day) was not associated with the risk of hypertension[36,34]. A systematic review found that moderate caffeine consumption was inversely associated with the risk of cardiovascular disease (CVD), whereas high coffee consumption was not associated with a higher risk of CVD[37]. A meta-analysis of 21 prospective cohort studies found that moderate caffeine consumption was associated with a lower risk of coronary heart disease (CHD) in women[35]. Our study has some limitations.

Table 3: BP and heart rates test results

Paired Differences and Samples Test		Mean	Std. Deviation	t	df	Sig
Samples of Normal (with caffeine)	SYS (Before) -SYS (After)	2.80	5.20	1.702	9	.123
	DIA (Before) - DIA (After)	1.30	6.07	.677	9	.516
	Pulse (Before) - Pulse (After)	-1.90	13.55	-.443	9	.668
Samples of athletes (with caffeine)	SYS (Before) -SYS (After)	-2.5	10.92	-.724	9	.487
	DIA (Before) - DIA (After)	-4.7	7.2	-2.065	9	.069
	Pulse (Before) - Pulse (After)	0.8	12.32	.205	9	.842
Control	SYS (Before) -SYS (After)	0.7	6.11	.362	9	.726
	DIA (Before) - DIA (After)	1.3	4.62	.890	9	.397
	Pulse (Before) - Pulse (After)	1.4	9.63	.460	9	.657

The sample size was small, may be considered non-representative, and the study time was short. We recommend further investigation of the impact of caffeine on human health and blood pressure in long-term large-scale studies.

In summary, the results of this study indicate that there is no relationship between caffeine ingestion and blood pressure in both athletic and non-athletic women. However, if it raises blood pressure in both groups, it could pose risks, prompting athletes to consider alternative hydration options such as Gatorade.

Conclusion

Author contributions

Daniyah Al-Shebel performed the investigation, resources, methodology, validation, data curation, formal analysis, and preparation of the original draft. Al-Shebel conducted the resources, data curation, and formal analysis.
Noorah Al-Sowayan conceptualized the methodology, validation, writing—review and editing, visualization, supervision, and project administration.
All authors have read and agreed to the published version of the manuscript.

Consent form

A meeting was held with the volunteers and the experiment was explained to them. We obtained their consent and signed an informed consent form. They were informed that they could leave the experiment at any time.

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Data availability statement

Data is contained within the article.

Conflicts of interest

The authors declare no conflicts of interest.

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