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TEA AND COFFEE CONSUMPTION IN RELATION TO C-REACTIVE PROTEIN INFLAMMATORY MARKER AMONG HEALTHY SUDANESE POPULATION

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ABSTRACT

In recent years, clinical and observational studies reported that coffee and tea consumption were associated with cardiac arrhythmia, heart rate, serum cholesterol, blood pressure, and consequently cardiovascular risk (Mesas, *et al*, 2011). Still, no metabolic study investigated the effects of both tea and coffee consumption on inflammatory markers in healthy Sudanese population. Therefore this study is intended to confirm the relation between inflammation, coffee and tea consumption, with the outcome being a stronger public health message. This was a case control study which involved caffeine consumers of both genders and they were all recruited from different areas of the Sudanese community. The study included 90 subjects (aged from 16 to 50 years), of them 60 were caffeine consumers (tea and/or coffee), and 30 were non caffeine consumer (controls). All samples were analyzed by Mindray machine to determine C reactive protein level and the procedure was performed in Al-Ribat Hospital. The results revealed a significant elevation in the CRP level of caffeine consumer (14.1±13.1), when compared to non-consumers (6.6 ±8.3). This study concluded that high consumption of caffeine could increase proinflammatory marker (CRP) level, which might lead to heart diseases. More studies are

much needed to confirm our findings, with the outcome being a stronger public health message.

KEYWORDS: cardiac arrhythmia, heart rate, serum cholesterol, blood pressure, and consequently cardiovascular risk.

INTRODUCTION

Caffeine is a central nervous system (CNS) stimulant of the methylxanthine class (Nehlig, *et al*, 1992). It is the world's most widely consumed psychoactive drug, but unlike many other psychoactive substances it is legal and unregulated in nearly all parts of the world. There are several known mechanisms of action to explain the effects of caffeine (Echeverri, *et al*, 2010; Nehlig, *et al*, 1992). The most prominent is that it reversibly blocks the action of adenosine on its receptor and consequently prevents the onset of drowsiness induced by adenosine. Caffeine also stimulates certain portions of the autonomic nervous system (Zahn, *et al*, 1987). Coffee is slightly acidic and can have a stimulating effect on humans because of its caffeine content. The majority of recent researches suggest that moderate coffee consumption is benign or mildly beneficial in healthy adults (Higdon and Frei, 2006). On the other hand high intake of caffeine suppresses antibody production in the body. Caffeine blocks the T cells and B cells in the body to attack foreign bodies to fight infection. The caffeine found in coffee increases catecholamines, the stress hormones. The stress response elicit cortisol and increases insulin hormone which lead to increase in the inflammation process (Hyman, 2012). A relation exist between moderate to high coffee and tea consumption and increase inflammation process (Telma, *et al*, 2013; Zampelas, *et al*, 2004; Hammer, *et al*, 2006; Koloverou, *et al*, 2002).

Previous studies revealed that people who consumed coffee and had higher interleukin-6, higher serum amyloid-A, higher tumor necrosis factor, higher white blood cell count, and higher C-reactive protein level (Yamashita, *et al*, 2012; Zampelas, *et al*, 2004). C-reactive protein (CRP) is an acute-phase protein that serves as an early marker of inflammation or infection. The protein is synthesized in liver and is normally found at concentrations of less than 10 mg/L in the blood. During infectious or inflammatory states, CRP levels rise rapidly within the first 6 to 8 hours and peak at levels of up to 350-400 mg/L after 48 hours (Young, *et al*, 1991; Gewurz, *et al*, 1982; Palosuo, *et al*, 1986).

Coffee and tea has effect of the body's platelet by decreasing their ability to stick together (Lundin, 2016) and lead to reduction in hemoglobin concentration, PCV and red blood cell and increase in total white blood cell (Ladokun, *et al*, 2015).

MATERIALS AND METHODS

This was a retrospective case control study which included 90 regular coffee and tea consumers (>2 cups/day) of both genders and among the age of 16-50 years old, and all were recruited from different areas from Sudanese community. 60 samples were selected randomly from coffee and tea consumers and the rest 30 were selected from people who don't use any caffeine beverages. Data were excluded from participants who were obese, diabetics, pregnant ladies, smokers and those who are suffering from cardiovascular disease or any inflammatory diseases.

Furthermore, an interview-administered data collection sheet was completed before sample collection by all participants. Data on demographic, lifestyle characteristics and medical history was collected. Informed consent was obtained from all participants.

Serum preparation

Five ml of venous blood was collected from each participant. After collection of the whole blood it was allowed to clot by leaving it undisturbed at room temperature for 15-30 minutes. Following centrifugation at 1500 rpm (for 5-10 min) liquid component (serum) was transferred into a clean plain container using a Pasteur pipette. The samples were maintained at 2-8 C while handling.

C-reactive protein analysis

All samples were analyzed by (Mindray machine BS-200); to estimate C-reactive protein by (turbidimetry method).

Test principle

Anti-human CRP antibody + CRP --------- immune-complex (agglutination).

The concentration of CRP was determined through photometric measurement of immune complex between antibodies of CRP and CRP present in the sample and the absorbency increase is directly proportional to the concentration of CRP.

Calculation of the results

The analyzer calculated the CRP concentration of each sample automatically after calibration.

Conversion factor: mg/dL x 0.1= mg/L

Normal range of CRP ≤ 5.0 mg/L

Data analysis

Statistical analysis was carried out using statistical package for social study (SPSS) computer program. Frequencies and percentages was performed using cross tabulation (TSI) square test, the mean was calculated using T test (Anova).

RESULTS

A group of 90 subjects were included in this study, 60 were caffeine consumer while 30 were control group. Among the study groups 35 were males and 25 females. This study revealed that most of the participants lie between the age group of 21 and 25 years old, and an overall view shows that most of them (61%) think that caffeine in tea and caffeine is addiction except those among the age group of 31-35 years old. It was also noticed that the intake of tea and coffee is nearly the same in each age group.

All of coffee consumers were detected to be having an elevation in the CRP level, but the participants who consumed more than 4 cups/day had the highest level of CRP, representing (14.1± 13.1) while the participants who consumed 1-2 cups/day had the lowest level of CRP (3.7± 4.6), table 1.

Table 1: the relation between the number coffee cups consumed/day and CRP level.

Number of cup of coffee/ day	Percent	C-reactive protein level (S.D)
Non consumer	100%	0.8 ± 1.0
1-2 cup/ day	43.3%	3.7 ± 4.6
3-4 cup/ day	26.6%	4.8 ± 4.9
More than 4/ day	6.6%	13.1 ± 14.1

CRP analysis for tea consumers indicated that the mean S.D for participants was at its higher point among those who drink more than 4 cups/day, showing 6.6 ± 8.3 g/dl. CRP level of people who drink 1-2 their results was within the upper limit representing 4.7 ± 5.1 g/dl, table 2.

Table 2: The association between the amount of tea consumed/ day and CRP level.

Number of cup of tea/ day	Percent	C-reactive protein level (S.D)
Non consumer	100%	0.8 ± 1.0
1-2 cup/ day	46.6%	4.7 ± 5.1
3-4 cup/ day	23.3%	3.7 ± 3.8
More than 4/ day	13.3	6.6 ± 8.3

One to one interview with the participants showed that headache was the most experienced symptom when compared to other symptoms, in which 100% of the participants among the age groups of 16-20 and 41-45 feel headache when they do not drink their daily amount of caffeine. The second most experienced symptom was irritation followed by fatigue. On the other hand a marked number of participants pointed to the fact that the feel nothing when they do not consume their average amount of caffeine/day, table 3.

Table 3: symptoms experienced by the study groups when caffeine is not consume according to their age.

Age group	Feeling experienced when caffeine is not taken			
	Headache	**Fatigue**	**Irritated**	**Nothing**
16 – 20	100%	20.0%	20.0%	0%
21 – 25	61.5%	0%	15.4%	23.1%
26 – 30	60.0%	10.0%	50.0%	10.0%
31 – 35	66.7%	0%	0%	33.3%
36 – 40	66.7%	0%	33.3%	16.7%
41 – 45	100%	0%	25.0%	0%
46 – 50	33.3%	0%	33.3%	0%

DISCUSSION

Caffeine could be the most frequently ingested pharmacologically active substance globally (Echeverri, *et al*, 2010). Because of its wide consumption at different amounts by most segments of the population, elevation of the effect of coffee consumption on various cardiovascular markers could be of great importance from a public health prospective (Telma, *et al*, 2013).

This study indicated that coffee consumption rate was significantly higher in males (58%) than in females (41%). This result agrees with a previous survey conducted in 1189 young people, done by (Demura, *et al*, 2013) who aimed to examine gender differences in coffee consumption and demonstrated a quite close result.

The study indicated that the highest mean CRP levels (14.1±13.1, 6.6 ±8.3 in both coffee and tea drinkers) were detected among those who consume the most amount of caffeine/ day (> cups/day). More ever, (Zampelas, *et al*, 2004) as well showed that there is a relation between coffee consumption and inflammatory marker, and indicated that coffee increases IL-6 synthesis, which then affects CRP production in the liver. In addition, (David, *et al*, 1989) suggested that IL-6 can stimulate synthesis of all acute-phase protein involved in the inflammatory response namely, CRP, SAA, fibrinogen, and others.

Consequently the research overall demonstrated a significantly elevated CRP in individuals who consume caffeine when compared to non-caffeine consumers. These results have been confirmed by many researches namely, (Yamashita, *et al*, 2012; Hammer, *et al*, 2006; Young, *et al*, 1991).

The study also revealed that 69%, 25.2% and 11.8% of the participant were experiencing headaches, irritations, and fatigue respectively, when they do not consume their daily caffeine dose. (Bond, 2015) explained these symptoms by pointing to the effect of caffeine on the body in general and particularly in the central nervous system in which it suppresses the energy metabolism, which lead to adrenal fatigue. Furthermore, (Daly, 2007) also pointed to the same fact by explaining that the counteracting adenosine and caffeine also significantly reduces blood flow to the brain which leads to headache. In contrast, (Glade, 2010) suggested that moderate consumption of caffeine increases the energy availability and decreases fatigue.

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