Research Article

The Relationship between Habitual Coffee and Tea Consumption and Type 2 Diabetes Mellitus among Libyan Adults

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ABSTRACT

Libya has the highest prevalence of type 2 diabetes mellitus in North Africa. This disease is highly affected by patients Lifestyle such as habitual consumption of certain meals and beverages. Black and green tea and coffee are traditional beverages that are daily consumed by many Libyans. In this study we asked the question of is there any association between coffee or tea consumption and predisposing factors of developing type 2 diabetes such as fasting blood glucose, blood pressure, and obesity as calculated by Body Mass Index (BMI)?. In the literature, there are inconsistent results regarding this association. Our study included 396 Libyan diabetic patients (292 females and 104 males) with mean age of 49±17 years from Tripoli center of diabetes. This study performed during a period of seven months from Apr 2013 to Oct 2013. We also included control patients who were coffee or tea non consumer type2 diabetics. The results of this prospective study showed that coffee, green tea, and black tea consumption may help in reduce fasting blood glucose of type 2 male and female diabetics. In addition, green tea consumption strongly reduces blood cholesterol, blood pressure and BMI while black tea has weaker effect. In contrast, coffee consumption increases blood cholesterol, BMI and blood pressure in both male and female diabetics.

Keywords: Coffee, black tea, cholesterol, fasting blood glucose, green tea, obesity

Received 1 April 2015 Received in revised form 21 April 2015 Accepted 23 April 2015

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INTRODUCTION

Type 2 diabetes mellitus is chronic condition in which cells fail to use insulin properly, sometimes combined with insulin resistance. It is the most common endocrine disorder characterized by hyperglycemia [1]. WHO criteria for the diagnosis of diabetes is fasting blood glucose of more than 126 mg/dl or random blood glucose of more than 200 mg/dl [2]. Obesity and type 2 diabetes are tightly associated disease worldwide because obesity can lead to insulin resistance [3]. The proportions of people with these two health problems have recently reaching epi¬demic levels in Asia [4]. There is strong positive association between overall obesity as measured by Body Mass Index (BMI), blood cholesterol, blood pressure and diabetes [5]. The prevalence of diabetes in Libya is very high [6]. Patients Lifestyle such as habitual consumption of certain meals and beverages plays major role in the development of diabetes [7]. Since black and green tea and coffee are traditional beverages that are daily consumed by many Libyans and some studies suggest that these beverages can modulate many biochemical parameters in the blood such as cholesterol level and blood glucose [8,9] we investigated here the effects of daily consumption of tea and coffee on fasting blood glucose, blood cholesterol, blood pressure, and BMI of type 2 diabetic males and females.

Black tea and green tea are made from the leaves of the plant Camellia Sinesis [10]. Black tea is generally stronger in flavor and is more oxidized than green tea. Black tea beverage differs in composition from green tea in that most of the flavanols and the other phenolic materials are converted to the oxidized forms known as the aflavins and

the arubigins. Both are the main type of catechins in black tea and responsible for its dark colour and distinct taste [11]. Flavanols and catechines are a group of polyphenols called flavonoids [10]. It has been shown that tea's protective benefits is linked to the antioxidant property of this group of compounds. Green tea has the highest content of flavonoids compered to black tea. Epigallocatechingallate (EGCG) is found in the highest concentration in green tea and it is well researched catechins [12]. In addition, caffeine, aluminium and manganese have been reported to be present at small concentrations in both types of tea. The remaining compounds consist of partially soluble proteins, polysaccarids, lignin and sugars [10].

Habitual daily consumption of coffee is also very common in Libya. Many ingredients in coffee have been intensively studied and correlated to the health benefits of coffee drinking such as chlorogenic acid and caffeine [13].

MATERIALS AND METHODS

Study design: A random population sample of 396 diabetic patients, included 292 women and 104 men, mean age was 49± 14 years, took part in a screening study performed at the Tripoli center of Diabetes. We included only cases that habited to daily consume only one of the beverages since 2 years ago or more. Additional control sample of 100 diabetic patients was considered in our study, they were coffee and tea non-consumer diabetics. Type 1 diabetics are not included in this study.

Measurement of BMI:

We recorded the weight (kg) and length (m2) to calculate BMI using the formula (BMI) = Weight (kg) / height (m^2). WHO criteria5 for diagnosis of obesity is BMI of more than 29 kg/m^2.

Measurement of fasting serum glucose:

Fasting serum glucose (FBG) was analysed with a standard glucokinase method using commercial reagent kits from Analyticon ® Biotechnologies AG [14]. Glucokinase catalyses the oxidation of glucose to gluconic acid with formation of hydrogen peroxide which detected using phenol-aminophenazone in the presence of peroxidase. The assay procedures performed according to kit instructions. Normal fasting serum glucose is 70-110 mg/dl [15].

Measurement of blood cholesterol

Fasting blood cholesterol was determined after enzymatic hydrolysis and oxidation according to the kit instructions from Randox Labs® UK at 500nm. Patients were asked to don't eat or drink anything other than water for 9 to 12 hours before the blood sample is taken [16].

Measurement of blood pressure:

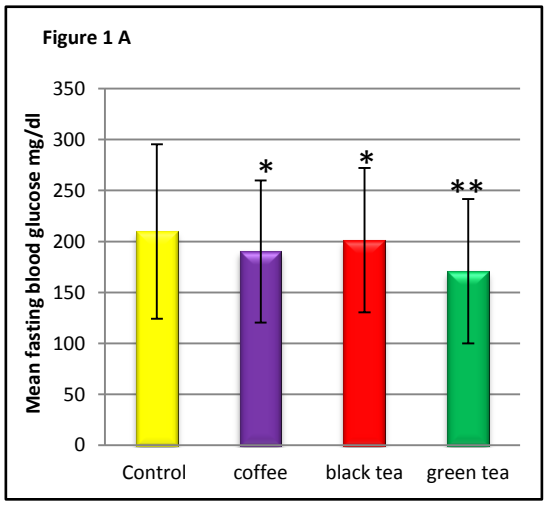
Blood pressure was measured twice on the left arm while the participants were in a supine position. The mean of the two blood pressure measurements was used in the analysis. The systolic and diastolic blood pressures were measured using a Boso Oscillomat (Bosch & Sohn, Jungingen, Germany).

Statistical analysis:

The data was represented as mean ± SD. To test the significance differences we compare the mean of each group of data with that of the mean obtained for the corresponding control sample of coffee or tea non-consumer diabetic patients. The data was analyzed statistically using paired student t test by Sigma Plot 2 Programm [17]. (*indicates a statistically significant difference where $P<0.05$, **indicates a statistically significant difference where $P<0.001$. (ns) means no significant difference is observed.

RESULTS

(**Figure 1A and Figure 1B**) show the levels of mean fasting blood glucose in male and female patients with relation to coffee, black tea, or green tea habitual daily intake. We observed a marked difference between blood glucose level of control diabetic females and control diabetic males who were coffee or tea non consumers. Control sample of females tended to report higher level of fasting blood glucose than control sample of males because we noticed that diabetic females show poor control of their blood glucose than females. Diabetic females who habitually consume coffee rather than green tea or black tea exhibit a significant lower level of fasting blood glucose. Diabetic males who habitually consume green tea appears to have a significant lower blood glucose level than their corresponding black tea or coffee drinkers.



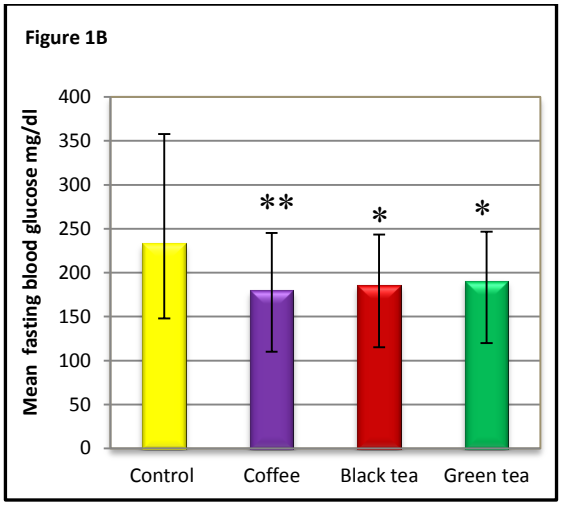
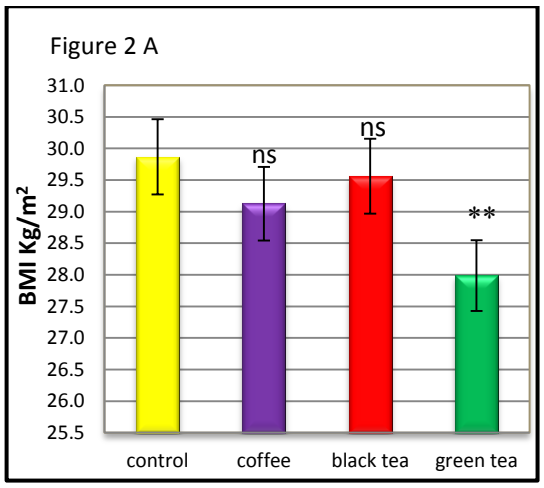


Figure 1: The effects of coffee or tea daily intake on fasting blood glucose

Figure 1A for male patients and figure 1 B for female patients**.** Mean FBG of control diabetic patients who do not habitually consume tea or coffee is represented by yellow column. The violet column represents the mean FBG of diabetic patients who habitually consume only coffee. The red column represents the mean FBG of diabetics who habitually consume only red tea. The green column represents mean FBG of diabetics who habitually consume only green tea.

The effects of coffee or tea consumption on BMI of diabetic Libyan males and females appear in (**Figure 2 A and Figure 2B**) respectively. We observed that diabetic females who are included in this study have a significant higher BMI than diabetic males. Daily intake of green tea rather than black tea was associated with powerful BMI reducing effect in males while coffee intake produce a significant BMI reducing effect in females.



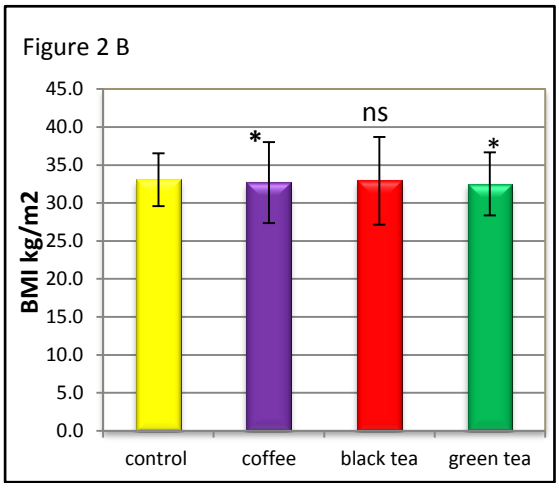


Figure 2: The effects of coffee or tea daily consumption on BMI

(A) in male diabetic patients. (B) in female diabetic patients. BMI of control diabetics who do not habitually consume tea or coffee is represented by yellow column. The violet column represents the BMI of diabetics who habitually consume only coffee. The red column represents the BMI of diabetics who habitually consume only red tea. The green column represents the BMI of diabetics who habitually consume only green tea.

(**Figure 3 A and figure 3 B**) represent the relationship between blood cholesterol and habitual daily consumption of coffee or tea in diabetic males and females respectively. Coffee intake was positively associated with higher blood cholesterol level in both females and males, whereas, green tea or black tea intake reduces blood cholesterol. Green tea has a stronger reducing effect on blood cholesterol of females.

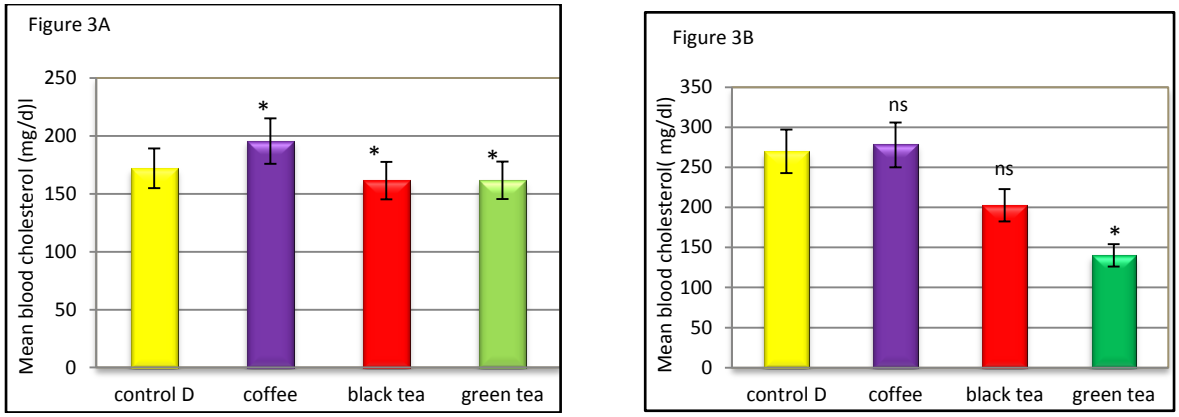


Figure 3: The effects of coffee or tea intake on blood cholesterol

(A) in male diabetics and (B) in female diabetics. Blood cholesterol of control diabetics who do not habitually consume tea or coffee is represented by yellow column. The violet column represents the blood cholesterol of diabetics who habitually consume only coffee. The red column represents the blood cholesterol of diabetics who habitually consume only red tea. The green column represents the blood cholesterol of diabetic patients who habitually consume only green tea.

The associations between blood pressure and coffee or tea consumption are seen in (**Figure 4A**) for males and (**Figure 4B**) for females. There was a significant positive effect of coffee intake on systolic blood pressure in both males and females and a significant negative effect of green tea intake on systolic blood pressure of both females and males. We observed no significant effects of these drinks on diastolic pressure. We also found no significant effect of black tea daily intake on blood pressure neither in females nor in males.

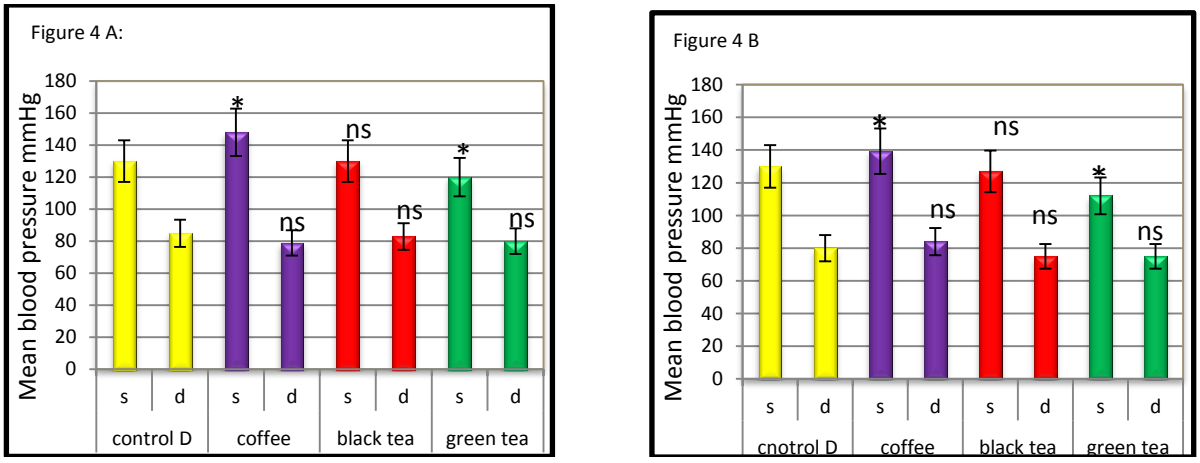


Figure 4: Blood pressure and coffee or tea daily intake

(A) Blood pressure of male diabetic patients. (B) blood pressure of female patients. Blood pressure of control diabetic patients who do not habitually consume tea or coffee is represented by yellow bar, (s) denotes systolic blood pressure and (d) denotes diastolic blood pressure . The violet column represents the blood pressure of diabetic patients who habitually consume only coffee. The red column represents the blood pressure of diabetics who habitually consume only red tea. The green column represents the blood pressure of diabetic patients who habitually consume only green tea.

From the literature it appears that the majority of diabetic cases could be prevented by changes in lifestyle and diet [7,18]. Both coffee and tea are very good source of caffeine which may affect glucose tolerance [19]. Although conflicting results have been reported regarding the effect of coffee or tea consumption on blood glucose [6,18-24], our results are in line with those found a decline of blood glucose level in diabetic patients by habitual drink of coffee or tea [20]. We found no significant difference between the amount of decrease in fasting blood glucose due to consuming

of coffee, black tea, or green tea neither in males nor in females (**Figure 1 A and Figure 1B**). We noticed a significant difference in fasting blood glucose of control sample between females and males. This could be due to the high BMI calculated for females as compared tothat males. The blood glucose lowering effect of coffee seen in type 2 diabetics might be due to the fact that chlorogenic acid in coffee reduces glucose absorption, and inhibits hydrolysis of glucose-6-phosphate and thus reduce glucose output in the liver [21]. Moreover, coffee is rich in magnesium, which improves insulin sensitivity and secretion [22]. The effects of green tea and black tea on blood glucose level is not clear. Black tea and green tea extracts have found to produce no effects on blood glucose in type 2 obese diabetics [23].

Obesity and type 2 diabetes are closely linked metabolic diseases. The patients of our study were randomly selected, however, it was noticed that the majority of females included in this study suffer from obesity and the majority of male patients belong to the category overweight as measured by BMI according to WHO classification of body weight [5]. This could be due to the differences in lifestyle between males and females in Libya since many females have no chance for sport and physical activity outdoors. Its known that elevated blood lipids enhances insulin resistance in obese patients [24,25]. Interestingly, green tea catechins could inhibit key enzymes involved in lipid biosynthesis resulting in the reduction of body weight [26]. In addition, Theaflavin-3-gallate, a theaflavin derivative found in tea has been shown to reduce cholesterol absorption [27,28]. Consistently, our results show that diabetic patients who habitually drink green tea have lower BMI and blood cholesterol as compared to those who habitually drink coffee (**Figure 2 and Figure 3**).

We found that blood cholesterol of diabetic patients who daily consume coffee is higher than control patients (**Figure 3A and Figure 3B**). Coffee contain the diterpenes cafestol and kahweol and both might be responsible for the cholesterol-raising properties of coffee [29]. Moreover, we observed a marked increase in the systolic blood pressure in those patient consuming coffee daily (**Figure 4A, Figure 4B**). Elevated blood pressure may predates type 2 diabetes [30,31]. The increase in blood pressure due to coffee consumption might be due to its high content of caffeine which has been found to increase blood pressure and heart rate [32,33].

CONCLUSION

From these results we can conclude that daily consumption of coffee or tea may be helpful in lowering fasting blood glucose level in diabetic patients but in contrast to green tea, coffee consumption increases blood cholesterol and blood pressure in diabetic patients. Black tea seems to be weaker than green tea in redusing blood glucose, BMI, blood cholesterol, and blood pressure in males and females.

ACKNOWLEDGEMENT

Our gratitude goes to Tripoli center for diabetes in Tripoli-Libya for giving us an opportunity to conduct this study.

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