

Does Ingestion of Regular Coffee Influence Serum Lipid Profile in Dialysis Patients?

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We checked whether dialysis patients who drink coffee might have a serum lipid profile different from that of nondrinkers of coffee.

The study was performed in 30 patients (26 on peritoneal dialysis, 4 on hemodialysis). Group I included patients who drank 1 – 3 cups of coffee daily (140 – 420 mg caffeine) for at least 2 years before the study [n = 11; dialysis vintage: 29.1 months (range: 8.7 – 59.6 months); age: 56.0 ± 14.6 years]. Group II consisted of patients who said that they were nondrinkers of caffeinated coffee [n = 19; dialysis vintage: 15.2 months (range: 6.3 – 45.4 months); age: 56.3 ± 19.8 years]. Serum lipid profile, anthropometric and bioimpedance measurements, and laboratory indices of nutrition and inflammation status were examined.

Compared with group II, group I showed higher serum high-density lipoprotein (HDL) cholesterol (45.1 ± 12.8 mg/dL vs. 37.7 ± 6.6 mg/dL, p = 0.045) and lower low-density lipoprotein (LDL) cholesterol (104.7 ± 15.7 mg/dL vs. 139.0 ± 41.8 mg/dL, p = 0.007). Other examined parameters did not differ significantly between the groups, with the exception of serum albumin [4.0 g/dL (range: 3.1 – 4.3 g/dL) in group I vs. 3.3 g/dL (range: 2.9 – 4.4 g/dL) in group II, p = 0.020]. Adjustment for age and sex additionally showed differences in bioimpedance and anthropometric measurements. Compared with group II, group I showed lower waist and hip circumferences, a lower waist/height ratio, a lower fat body mass, and a higher lean body mass as a percentage of total body mass. When adjustments were made for age, sex, and fat body mass, differences in lipid profile were nonsignificant. In the overall group, a correlation

was seen between lean body mass and total cholesterol (r = -0.487, p = 0.006).

Lower LDL and higher HDL serum cholesterol may occur in dialyzed patients who drink coffee not only because of the direct influence of coffee ingredients on serum lipid profile, but mainly because of a more favorable body composition and better protein nutrition in coffee drinkers.

Key words

Coffee, dialysis, serum lipid profile, body composition

Introduction

Coffee is a chemical mixture reported to contain more than a thousand different molecular substances, including carbohydrates, lipids, nitrogenous and phenolic compounds, vitamins, minerals, and alkaloids. Caffeine, cafestol, kahweol, and chlorogenic acids are related to lipid metabolism and theoretically may influence serum lipid profile.

In humans, caffeine taken before planned exercise, when caffeine is not regularly consumed, increases the level of nonesterified fatty acids in serum because of a positive influence on hormone-sensitive lipase; it also increases the speed of oxidation of nonesterified fatty acids in muscle during relaxation preceding exercise (1). By contrast, in mice, after long-term (16 weeks') caffeine ingestion, the concentration of serum nonesterified fatty acids declined (2). In rats, caffeine reduces the transintestinal absorption of hydrophobic substances such as cholesterol and fatty acids (3).

The diterpenes cafestol and kahweol, present in coffee, have a cholesterol-raising effect because of their action as ligands for farnesoid X and pregnane X receptors in the liver (4). They lower the synthesis of cholesterol 7 α - and 12 α -hydroxylase, which are key enzymes in the biosynthesis of bile acids, being the main path for cholesterol excretion (5). Cafestol and

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kahweol also lower the synthesis of Na⁺-taurocholate co-transporting polypeptide, essential in the excretion of bile acids into the biliary tract (4). Secondly, cafestol and kahweol are ligands for pregnane X receptors on enterocytes. They increase the synthesis of intestinal bile acid-binding protein (4), responsible for transcellular transport between the apical and basolateral surfaces of enterocytes (6), increasing the speed of cholesterol recirculation through the enterohepatic circulation (6). A third cholesterol-raising effect of cafestol and kahweol is stimulation of enterocytes to secrete fibroblast growth factor 15, which lowers the synthesis of bile acids in hepatocytes (4). Finally, cafestol and kahweol inhibit lecithin-cholesterol acyltransferase, which results in a lowering of serum high-density lipoprotein (HDL) cholesterol (7).

By contrast, cafestol, kahweol, and (mainly) chlorogenic acids are involved in antioxidative activity. Cafestol and kahweol defend against radical-dependent peroxidation of lipids by inhibition of cytochrome P and stimulation of enzymes involved in the production of glutathione (8,9). Because of this action, they play an important role in lowering the level of low-density lipoprotein (LDL) oxidation (10). Chlorogenic acids have a structure similar to that of tocopherols. They have an ability to accumulate in LDLs and to lower the radical-dependent oxidation of those lipids (11). The whole activity of the antioxidants dissolved in coffee does not change the concentration of particular lipoproteins, but it does change the tendency of LDL to accumulate in atheromas, and it lowers the risk of atherosclerosis (12).

Despite established associations between constituents of coffee and lipid metabolism, the influence of coffee consumption on serum lipid profile in humans is not clear. Several investigators found an epidemiologic association between coffee consumption and elevation of serum lipids: in the 1980s, the association was noted in people in Nordic countries (13–15), and in 2001–2002, it was noted in the Greek province of Attica (16). Filtered coffee, which is currently the type of brewed coffee most commonly consumed in many countries, did not affect serum lipid concentrations (17,18). Studies have also reported a decrease in LDL cholesterol and LDL oxidation susceptibility in coffee drinkers (19).

To our knowledge, the influence of coffee consumption on serum lipid profile has not been examined in dialysis patients. We decided to check whether

coffee-drinking dialysis patients might have a different serum lipid profile than do nondrinkers of coffee undergoing dialysis treatment.

Patients and methods

Uremic patients older than 18 years of age, treated with peritoneal dialysis (PD) or intermittent hemodialysis (HD), were qualified for the study. Patients that met at least one of the following conditions were excluded:

- Dialysis treatment for less than 6 months
- Recognized disease (except for diabetes mellitus) that was not a complication of dialysis treatment, but that could influence lipid metabolism (for example, unbalanced thyroid gland diseases, tumors)
- Implanted medical devices (for example, a pacemaker or infusion pump)
- Medication with drugs that influence lipid metabolism (for example, statins, fibrates, glucocorticosteroids) at the time of, or within 2 months before, the study examination
- Acute infection or inflammation during month preceding the study examination

There were 30 patients who fulfilled the aforementioned criteria and who agreed to participate in the study. Of these 30 patients, 26 were being treated with PD, and 4 with intermittent HD. All participants were asked about their usual (average) frequency of daily coffee consumption. All reported coffee types (instant, brewed, cappuccino, or filtered) were adjusted for 1 standard cup of coffee (250 mL). By self-report, none of the patients took medications (whether prescribed or over-the-counter) that contained caffeine. The study patients were allocated to two groups. Group I included dialysis patients who regularly drank 1–3 cups of caffeinated coffee daily [approximately 140–420 mg caffeine daily (20)] for at least 2 years before study initiation. Group II consisted of patients who said that they were nondrinkers of caffeinated coffee.

Group I consisted of 11 patients (5 women, 6 men) aged 56.0 ± 14.6 years, treated with HD ($n = 4$) or PD ($n = 7$). Their dialysis vintage was 29.1 months (range: 8.7–59.6 months). Group II consisted of 19 PD patients (13 women, 6 men) aged 56.3 ± 19.8 years. Their PD vintage was 15.2 months (range: 6.3–45.4 months).

The two groups showed no statistically significant differences in the causes of end-stage renal disease (Table I). Chronic tubulointerstitial nephritis and diabetic nephropathy were the most frequent causes in both groups. None of the coffee drinkers suffered from hypertensive nephropathy. Prevalence of heart diseases and cardiac insufficiency was similar in both groups. Arterial hypertension also occurred at a similar frequency in coffee drinkers and non-drinkers (Table II).

In PD patients, study measurements were performed with a “dry” peritoneal cavity after drainage of the dialysate, which was not replaced until completion of all study procedures. In HD patients, a blood sample was taken before the midweek HD session; other examinations were started at 30 minutes after the HD session.

Serum total cholesterol, HDL cholesterol, and triglycerides were determined by the enzymatic colorimetric method on an Itegra 400 Plus analyzer (Roche Diagnostics, Mannheim, Germany). The Friedewald equation was used to calculate LDL cholesterol. Other study parameters included routine laboratory measurements used in dialyzed patients. Additionally, anthropometric measurements and bioimpedance records of body composition were taken and compared between the two groups.

The distribution normality of variables was checked for each group separately using the Shapiro–Wilks test. Results are expressed as a mean \pm 1 standard deviation or as a median and range, as appropriate. Comparisons of nonadjusted results between the two study groups used the Student *t*-test for unpaired data if distribution in both groups was

TABLE I Causes of end-stage renal disease in the dialysis patients studied

<i>Causes of end-stage renal disease</i>	<i>All patients (n=30)</i>	<i>Group I (n=11)</i>	<i>Group II (n=19)</i>	<i>p Value (I vs. II)</i>
Chronic tubulointerstitial nephritis	8 (26.7%)	3 (27.3%)	5 (26.3%)	0.7104
Diabetic nephropathy	7 (23.3%)	3 (27.3%)	4 (21.0%)	0.9524
Chronic glomerulonephritis	5 (16.7%)	1 (9.1%)	4 (21.0%)	0.7347
Polycystic kidney disease	4 (13.3%)	2 (18.2%)	2 (10.5%)	0.9704
Hypertensive nephropathy	1 (3.3%)	—	1 (5.3%)	0.7784
Obstructive nephropathy	1 (3.3%)	1 (9.1%)	—	0.7784
Unknown	4 (13.3%)	1 (9.1%)	3 (15.8%)	0.9704

TABLE II Prevalence of heart diseases and arterial hypertension in the dialysis patients studied

<i>Condition</i>	<i>All patients (n=30)</i>	<i>Group I (n=11)</i>	<i>Group II (n=19)</i>	<i>p Value (I vs. II)</i>
All heart diseases	15 (50.0%)	4 (36.4%)	11 (57.9%)	0.4486
Heart diseases				
Ischemic heart disease	11 (36.7%)	3 (27.3%)	8 (42.1%)	0.6750
Cardiac infarction	1 (3.3%)	—	1 (5.3%)	0.7784
Revascularization	1 (3.3%)	1 (9.1%)	—	0.7784
Atherosclerotic cardiomyopathy	2 (6.7%)	—	2 (10.5%)	0.7230
Persistent atrial fibrillation	1 (3.3%)	—	1 (5.3%)	0.7784
Paroxysmal atrial fibrillation	1 (3.3%)	1 (9.1%)	—	0.7784
Hypertrophic cardiomyopathy	1 (3.3%)	1 (9.1%)	—	0.7784
Mitral insufficiency	1 (3.3%)	—	1 (5.3%)	0.7784
Heart failure				
NYHA I–IV	13 (43.3%)	4 (36.4%)	9 (47.4%)	0.8384
NYHA I	1 (3.3%)	1 (9.1%)	—	0.7784
NYHA II	8 (26.7%)	2 (18.2%)	6 (31.6%)	0.7104
NYHA III	4 (13.3%)	1 (9.1%)	3 (15.8%)	0.9704
Arterial hypertension	26 (86.7%)	9 (81.8%)	17 (89.5%)	0.9704

NYHA = New York Heart Association

normal; otherwise, the Mann–Whitney test was used. Comparisons of results adjusted for sex, age, and fat body mass (FBM) used the analysis of covariance methodology. The Spearman correlation was performed between selected parameters. A *p* value less than 0.05 was judged to be significant. Statistical analyses were performed using Statistica PL 8.0 (StatSoft, Tulsa, OK, U.S.A.).

Results

The plasma concentration of HDL cholesterol (45.1 ± 12.8 mg/dL for group I vs. 37.7 ± 6.6 mg/dL for group II, $p = 0.045$) was significantly higher and the plasma concentration of LDL cholesterol (104.7 ± 15.7 mg/dL for group I vs. 139.0 ± 41.8 mg/dL for group II, $p = 0.007$) was significantly lower in coffee drinkers than in nondrinkers of coffee. As a percentage of total cholesterol, HDL cholesterol was higher in coffee drinkers ($22.3\% \pm 4.6\%$ for group I vs. $18.1\% \pm 4.2\%$ for group II, $p = 0.018$). Serum total cholesterol (204 ± 49 mg/dL for group I vs. 214 ± 46 mg/dL for group II) and serum triglycerides (168 ± 80 mg/dL for group I vs. 191 ± 92 mg/dL for group II) were not significantly different between the groups.

When the results were adjusted for age and sex, the difference for HDL cholesterol showed a *p* value of borderline significance ($p = 0.073$), but for LDL cholesterol, the value stayed significant ($p = 0.042$). Comparison of laboratory parameters showed a significantly higher serum albumin concentration in coffee drinkers than in nondrinkers of coffee [4.0 g/dL (range: $3.1 - 4.3$ g/dL) in group I vs. 3.3 g/dL (range: $2.9 - 4.4$ g/dL) in group II, $p = 0.020$]. Other routine laboratory parameters, such as indices of Ca–P balance, inflammatory markers, blood pH, and blood count were not significantly different between the two groups. The results of anthropometric measurements and bioimpedance records, adjusted for sex and age, showed that coffee drinkers had lower total body mass (TBM) and a better body composition as indicated by a lower waist/height ratio, lower FBM as a percentage of TBM, and a higher lean body mass (LBM) as a percentage of TBM (Table III). In the overall group, we observed a negative correlation between LBM and total cholesterol ($r = -0.487$, $p = 0.006$; Figure 1).

Discussion

Among the many components of coffee, caffeine makes favorable changes in serum lipids at least in

mice (2); chlorogenic acids are also beneficial in this case (11). Cafestol and kahweol may raise serum cholesterol, but they also have an antioxidative effect (4,6–10). Intake of cafestol and kahweol can be reduced by drinking filtered coffee (21). Using filters reduces by $0.08 - 0.60$ mmol/L the total cholesterol increase caused by long-term ingestion of 4 cups of coffee daily (21). An increase in total cholesterol and LDL cholesterol (16,22,23) is more frequently reported than is a decrease in LDL cholesterol and LDL oxidation susceptibility (19).

In the present study, from a clinical viewpoint, serum lipid profile was better in dialyzed coffee drinkers than in nondrinkers of coffee on dialysis. Thus, our results are more compatible with those obtained by Yukawa *et al.* (19). However, it is unclear whether this beneficial effect is related to a direct effect of the coffee or to other differences between the groups, namely, better body composition and protein nutrition in the coffee drinkers.

Overweight and obesity are frequently associated with hyperlipidemia, and so the coffee drinkers examined in our study may benefit from a lower FBM in this case. Interestingly, the prevalence of obesity in women was significantly lower with increased coffee consumption (16). To exclude a possible relationship between FBM and serum lipid profile, we adjusted the statistical analysis not only for age and sex, but also for FBM. After these adjustments, differences in the plasma lipid profiles became insignificant. Moreover, in the overall group of study patients, we observed a negative correlation between LBM and total cholesterol. That finding also confirms a close association between body composition and serum lipid profile in dialyzed patients.

A question arises whether coffee-drinking contributes to lower body weight and more favorable body composition. The answer is “Yes, it does.” A randomized double-blind 12-week study showed an average loss of mass in overweight people of 5.4 kg and 1.7 kg respectively in groups consuming chlorogenic-acid-enriched and normal instant coffee (24). A prospective study showed that increases in caffeine intake may lead to a small reduction in long-term weight gain (25). Oral treatment of SKH1 mice with caffeine (0.1 mg/mL in drinking water), voluntary running-wheel exercise, or a combination of caffeine and exercise for 2 weeks reduced the weight of the parametrial fat pads by 35%, 62%, and 77%

TABLE III Selected results of anthropometric measurements and bioimpedance records in the dialysis patients studied

Parameter	Group I (coffee drinkers)	Group II (nondrinkers of coffee)	p Value
TBM [kg (range)]	66.5 (48.3–95.0)	72.0 (54.0–90.0)	0.038
Waist circumference (cm)	95.8±14.9	97.1±12.0	0.010
Waist/height ratio	0.58±0.10	0.59±0.09	0.009
Hip circumference (cm)	100.0±10.5	102.0±10.9	0.012
FBM (kg)	20.9±7.9	22.5±7.6	0.023
FBM as %TBM	28.7±8.6	30.9±8.8	0.001
LBM (kg)	54.9±12.6	49.7±9.1	0.001
LBM as %TBM	71.3±8.6	69.1±8.8	0.001
TBW (L)	40.2±8.0	38.1±7.5	0.000
TBW as %TBM	55.4±5.3	52.7±6.6	0.009

FBM = fat body mass; TBM = total body mass; LBM = lean body mass; TBW = total body water.

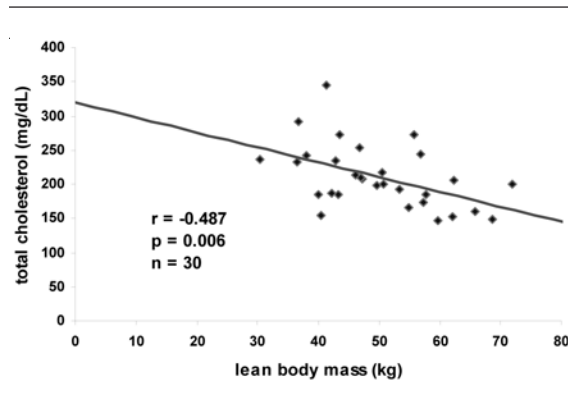


FIGURE 1 Correlation between lean body mass and serum total cholesterol in the dialysis patients studied.

respectively and reduced the thickness of the dermal fat layer by 38%, 42%, and 68% respectively. The plasma concentration of caffeine in mice ingesting caffeine (0.1 mg/mL in drinking water) is similar to the plasma concentration in most one-cup-daily coffee drinkers (26).

Conclusions

Lower plasma LDL and higher HDL cholesterol in dialyzed coffee drinkers as compared with nondrinkers of coffee may occur not only because of a direct influence of coffee ingredients on serum lipid profile, but mainly because of a more favorable body composition (lower FBM as a percentage of TBM and a lower waist/height ratio) and better protein nutrition (higher LBM as a percentage of TBM and higher serum albumin) in the coffee drinkers.

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