



Effect of Alcohol Consumption on Serum Lipid Profile, Apolipoprotein B-100 and Cardiac Biomarkers (CK-MB and Troponin I)

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ABSTRACT

Background: Since the discovery of alcohol, alcoholic beverages and the problems they engender have been familiar in human societies. About 3.5% of the global burdens of disease are attributable to alcohol. Alcohol metabolism in the liver results in the generation of acetaldehyde and highly reactive oxygen-containing molecules known as ROS. This study was conducted to evaluate the effect of alcohol consumption on serum levels of lipid profile, apolipoprotein B-100 (Apo B-100) and serum cardiac biomarkers (Troponin I and Creatine kinase). This study was a case-control study carried out in Anambra State, Nigeria. A total of 200 men (aged 30 to 70 years) consisting of 105 alcoholics (test) and 95 non alcoholics (control) subjects were recruited for the study. Their mean ages were 52.59 ±13.00 and 53.00 ±10.90 respectively. Four (4ml) of blood was collected after overnight fasting of 12 hours. Their serum lipid profile (triglyceride, total cholesterol, high density lipoprotein cholesterol, & low density lipoprotein) and Apo B-100 were measured using standard methods. Student's t test was used to compare averages between groups of the study and data were presented as means ± SD. Level of significance was taken at P values <0.05. All lipid profile parameters except TG and Apo B-100 were significantly higher in alcoholics compared to non-alcoholics. There was no statistical significant difference in the mean levels of TG and Apo B-100 between the test and control subjects. Troponin and Creatine Kinase-MB were also significantly increased in the alcoholics when compared to non-alcoholics. In conclusion, significantly altered lipid profile and cardiac markers is found in alcoholics compared to non-alcoholics, which indicates that, the alcoholics have an increased risk of dyslipidaemia and cardiovascular diseases.

Keywords: Alcohol; Apolipoprotein B-100; Cardiac Biomarkers

INTRODUCTION

Alcohol is a generic name for large group of organic chemical compounds. They are derivatives of hydrocarbons in which one or more of the hydrogen atoms have been replaced by hydroxyl group (-OH). It is a clear volatile liquid that is soluble in water due to its (-OH) group. It is a colorless, volatile and flammable liquid, and is the intoxicating constituent of alcoholic beverages like wine, beer, spirit and other drinks produced by fermentation of yeast, sugar and starch (NIH, 2012).

The metabolism of alcohol takes place in the liver through the primary pathway which mainly involves alcohol dehydrogenase (ADH). The metabolism of ethanol by ADH, and the oxidation of ethanol to acetaldehyde results in the reduction of nicotinamide adenine dinucleotide (NAD⁺), producing large amount of its reducing equivalents (NADH). Large amount of NADH distorts the redox homeostasis, and consequently, serious metabolic disorders associated with different tissues and organs may occur (Lieber, 2005). Alcohol consumption is prevalent all over the world and is accompanied with numerous tissue and organ damage that may lead to coronary heart disease, alcohol liver disease and several other manifestations including neurological disorders for which therapeutic attempts are needed (Lee, 2006; Pramyothin *et al.*, 2006). According to Molina *et al.*, (2003), alcohol is the only psychoactive drug that provides energy (7.1 kcal/g). However, its calories are considered "empty," because alcohol ingestion does not provide vitamins and minerals. Lieber *et al.*, (1995),

said the use of alcohol may cause alterations to the nutritional state example, the lipid profile level of an individual. Lipid profile consists of a group of biochemical tests often used in predicting, diagnosing and treating lipid related disorders including atherosclerosis (Brites *et al.*, 1998). In order to identify an individual with risk factors for ischaemic heart disease (IHD) and peripheral vascular disease, the first step will be to define the lipoprotein pattern by chemical analysis of the plasma lipids and lipoproteins (Burtis *et al.*, 1996). There are numerous evidence which relate the concentrations of lipids (total cholesterol and triglycerides) and their associated blood transporting lipoproteins (HDL-C, LDL-C, and VLDL) with the occurrence of atherosclerosis in general and coronary artery disease (CAD) in particular (Cummins, 2003). Hepatocellular damage is also known to occur with long- term alcohol use therefore, changes in lipid profile can also be due to the liver dysfunction. Apolipoprotein B (Apo B) is a protein which is encoded in human by APOB gene. It is the primary apolipoprotein of all hepatic derived lipoproteins like VLDL, IDL, and LDL and is responsible for carrying lipids including cholesterol around the body to all cells within all tissues. Apo B on the LDL particle acts as a ligand for LDL receptors in the body so high levels of apo B when mostly associated with higher concentrations of LDL are major risk factors of atherosclerosis (Lim *et al.*, (2011).

MATERIALS AND METHOD

This was a hospital based; case-control study carried out in St. Joseph Hospital, Adazi- Nnukwu in Anambra State, Nigeria. A total of 200 men (aged between 30 to 70 years) consisting of 105 alcoholics (test) and 95 non alcoholics (control) were recruited for the study. Blood was collected after an overnight fast under aseptic conditions. Blood samples (4ml) were drawn from ante-cubital vein and dispensed into plain tube. The collected blood was allowed to clot for 30 minutes, and then centrifuged at 2000 g for 15 minutes for clear separation of serum. Concentration of serum lipid profile and Apo B-100 were assayed. High density lipoprotein (HDL), triglyceride (TG) and total cholesterol (TC) were assayed using 2012 Shenzhen mindray semi-auto Chemistry Analyzer, model BA-88A, with their respective reagent kits, following the manufacturer's instruction(s). LDL-C was calculated by using Friedewald's calculation. Apo B-100 was assayed by enzyme linked immunosorbent assay (ELISA) method using a mindray microplate reader, model MR96A. The test analysis was carried out in Dr. Joe Nwiloh Heart Center Diagnostic laboratory at St. Joseph hospital, Adazi-Nnukwu, Anambra State.

RESULT

Table 1 results showed the mean concentration of the lipid profile and cardiac biomarkers of the alcoholics and non-alcoholics. Their lipid profile mean levels were TC (6.33 ± 2.55 & 5.26 ± 1.73), TG (1.27 ± 0.71 & 1.16 ± 0.60), HDL-C (1.61 ± 0.79 & 1.30 ± 0.62), LDL-C (4.16 ± 2.40 & 3.42 ± 1.47) and Apo B-100 (65.06 ± 50.22 & 58.76 ± 38.60) respectively, and their Troponin & CK-MB mean levels were Troponin (0.68 ± 0.53 & 0.56 ± 0.29) and CK-MB (14.30 ± 8.41 & 12.13 ± 8.26) respectively. The results showed that TC was significantly increased in the alcoholics when compared to non-alcoholics ($P = 0.001$). HDL- C was also seen to be significantly increased in the alcoholics when compared to the non-alcoholics ($P = 0.003$), same also with the LDL-C ($P = 0.011$). There was no statistical significant difference in the mean levels of TG and Apo B-100 between the groups ($P > 0.05$).

The result also showed that Troponin and CK-MB were significantly increased in the alcoholics when compared to non-alcoholics ($P < 0.05$).

Table 1: Biochemical characteristics of alcoholics and non-alcoholics

Parameters	Alcoholics (Test) N= 105	Non Alcoholics (Control) N= 95	P-value
TC (mmol/L)	6.33 ± 2.55	5.26 ± 1.73	0.001***
TG (mmol/L)	1.27 ± 0.71	1.16 ± 0.60	0.237
HDL-C(mmol/L)	1.61 ± 0.79	1.30 ± 0.62	0.003***
LDL-C(mmol/L)	4.16 ± 2.40	3.42 ± 1.47	0.011***
APO B ($\mu\text{g/ml}$)	65.06 ± 50.22	58.76 ± 38.60	0.325
AIP	-0.09 ± 0.35	-0.08 ± 0.03	0.771
Troponin I (ng/ml)	0.68 ± 0.53	0.56 ± 0.29	0.040*
CK-MB(units/L)	14.30 ± 8.41	12.13 ± 8.26	0.046

Mean difference is significant when p is < 0.05 * = significant; *** = very significant N = No of subjects in the group; CK-MB = Creatine Kinase-MB; TC = Total cholesterol; TG = Triglyceride; HDL-C = High density lipoprotein cholesterol; LDL-C = Low density lipoprotein cholesterol; APO B = Apolipoprotein B; AIP = Atherogenic index of plasma

The results here in Table 2, showed that there was a significant positive correlation between troponin and total cholesterol (TC) ($r = 0.238$ & $p = 0.015$) and between troponin and triglyceride (TG) ($r = 0.274$ & $p = 0.005$) in alcoholics, but not in non-alcoholics. There was no significant statistical relationship ($p > 0.05$) between troponin and other parameters.

Table 2: Relationship between Troponin and lipid profile of the alcoholics and non-alcoholics

Parameters	Alcoholics		Non alcoholics	
	r	p-value	r	p-value
Troponin Vs TC	0.238	0.015**	-0.048	0.647
Troponin Vs TG	0.274	0.005**	-0.102	0.327
Troponin Vs HDL-C	0.146	0.137	-0.063	0.545
Troponin Vs LDL-C	0.147	0.076	-0.004	0.972
Troponin Vs APO B- 100	0.168	0.087	0.065	0.533

Correlation is significant when p is ≤ 0.05 **= significant TC = Total cholesterol (mmol/L); TG = Triglyceride (mmol/L); HDL-C = High density lipoprotein cholesterol (mmol/L); LDL-C = Low density lipoprotein cholesterol (mmo/L); APO B = Apolipoprotein B ($\mu\text{g/ml}$).

Table 3 shows the relationship between CK-MB, the lipid profile and Apo B-100 in the alcoholics and non-alcoholics. A significant positive correlation was observed between CK-MB and Apo B-100 in the alcoholics but not in non-alcoholics. No significant statistical relationship was observed between CK-MB and other parameters both in alcoholics and non-alcoholics.

Table 3: Relationship between CK-MB and lipid profile of the alcoholics and non-alcoholics

Parameters	Alcoholics		Non alcoholics	
	r	p-value	r	p-value
CK-MB Vs TC	0.101	0.305	-0.087	0.401
CK-MB Vs TG	0.009	0.942	-0.162	0.116
CK-MB Vs HDL-C	0.006	0.95	0.132	0.204
CK-MB Vs LDL-C	0.102	0.302	-0.133	0.198
CK-MB Vs APO B-100	0.209	0.032*	-0.042	0.687

Correlation is significant when p is < 0.05 *= significant CK-MB = Creatine Kinase- MB; TC = Total cholesterol (mmol/L); TG = Triglyceride (mmol/L); HDL-C = High density lipoprotein cholesterol (mmol/L); LDL-C = Low density lipoprotein cholesterol (mmo/L); APO B = Apolipoprotein B ($\mu\text{g/ml}$).

DISCUSSION

The interaction between alcohol and lipid metabolism is salient to the pathogenesis of alcoholic fatty liver, hyperlipidemia, and atherosclerosis. In this study, we evaluated the effect of alcohol consumption on the serum levels of lipid profile, Apo B-100, Troponin I and CK-MB.

This present study showed a significantly increased total cholesterol concentration in alcoholics ($p = 0.001$) when compared to non-alcoholics. This increase could be due to inhibition of fatty acid β -oxidation as a result of accumulation of NADH. During the metabolism of ethanol in the liver through alcohol dehydrogenase, large amount of NADH is generated. Increased NADH distorts the redox homeostasis, and consequently, led to serious metabolic disorders associated with different tissues and organs (Lieber, 2005). This increase in total cholesterol could also be due to negative control mechanism effect of the metabolite of ethanol metabolism (acetate). The acetate released into the plasma is said to inhibit lipolysis in peripheral tissues thus allowing lipids to accumulate (Siler *et al.*, 1999). Increase in HDL-C level of alcoholics was highly significant ($p = 0.003$) compared to control. Alcohol increases HDL-C by raising the transport rate of apolipoproteins of HDL-C i.e apo A-I and apo A-II. Apo A-I takes up cellular cholesterol thereby removing much tissue cholesterol, initiating reverse cholesterol transport (De Oliveria *et al.*, 2000). The cardioprotective effect of HDL-C is greatly attributed to its role in reverse cholesterol transport (Hannuksela *et al.*, 2002). LDL-C was also seen to be significantly increased in alcoholics when compared to control (non-alcoholics). Studies comparing alcohol consumption and LDL-C are inconclusive as some show a strong positive effect of alcohol on LDL-C (Le-Djoussé *et al.*, 2009) while others indicate that genetic factor may be at play (Hopkins *et al.* 2011 and Shah *et al.* 2012). However, this present work agrees with the work done by Lichtenstien *et al.*, (2006), which reported high plasma level of LDL- C, but disagrees, with the result in the work done in Benin by Moutawakilou *et al.*, (2013) where there was no significant difference in the mean levels of LDL-C of the alcoholics when compared to the non-alcoholics. Elevation in TG and ApoB-100 was not significant between the groups. According to Baheiraei *et al.*, (2013), although alcohol increases lipid peroxidation as well as the modification of proteins, it is not always clear if these changes are the causes rather than consequences of alcohol-induced tissue injury. Also, metabolism of ethanol is said to induce cytochrome P450 in the microsomal ethanol-oxidizing system, causing oxidative stress due to production of free radicals that affect the antioxidant system (Zima *et al.*, 2001). In this study, we also found that Troponin was significantly increased in alcoholics when compared to non-alcoholics. Cardiac troponin I (cTnI) is a sensitive and specific marker for myocardial injury (Keller *et al.*, 2011). Long-term alcohol consumption can induce dilated cardiomyopathy through the accumulation of its metabolites and disturbances in cardiac energy metabolism thus reducing oxygen supply to the cardiac muscle (Piano *et al.*, 2014). Acetaldehyde is a potent oxidant and, as such, increases oxidative stress, leading to the

formation of oxygen radicals, with subsequent endothelia and tissue dysfunction. This metabolite may also result to impairment of mitochondrial phosphorylation and since mitochondria play a vital role in cellular metabolism, disruption to their function can have serious effect on the entire cell (Laurent *et al.*, 2014). Therefore the increase in troponin in this study could be the effect of alcohol on the cardiac muscle. Also in this study, CK-MB was found to be significantly higher in alcoholics when compared to non-alcoholics. Just like troponin, CK-MB is also present in the heart muscle and is seen in higher concentration in the blood following myocardial damage. The increased CK-MB in this present work could mean that the cardiac muscle of the alcoholics is greatly affected especially where there is concomitant increase in troponin a more specific and sensitive cardiac biomarker.

When troponin was correlated with lipid profile and Apo B-100 (table 2), the result showed a significant positive correlation with TC and TG in alcoholics when compared with non-alcoholics. Alcohol and hypercholesterolemia are risk factors for atherosclerosis aside other factors. These risk factors for atherosclerosis increase the risk of the production of reactive oxygen species (ROS) which could result to endothelia cell damage, muscle damage, and cell death in the absence of antioxidant. By these mechanisms, the heart muscle could be damaged, leading to leakage of CK-MB and Troponin I into plasma, giving a high concentration of these parameters in plasma as seen in this present study.

When CK-MB was correlated with lipid profile and Apo B-100 of both alcoholics and non-alcoholics, the result only showed a significant positive correlation with Apo B-100 in alcoholics when compared with non-alcoholics. Apo B-100 is atherogenic and its measurement is a determinant of the number of atherogenic particles (lipoproteins) in circulation, than the cholesterol content of LDL only, and studies in men have demonstrated that Apo B-100 can be a valuable predictor for CAD (Rader *et al.*, 1994). However, there are situations where both CK-MB and troponin can be elevated in an individual without the presence of any form of myocardial damage.

CONCLUSION

In conclusion, significantly altered lipid profile, CK-MB and Troponin was found in alcoholics compared to non-alcoholics, which indicates that, the alcoholics have an increased risk of cardiovascular diseases. Apo B was also significantly increased in alcoholics compared to non-alcoholics. Elevated levels of apolipoproteins (Apo B) are associated with increased cardiovascular risk. We therefore encourage the use of apolipoprotein B measurements in clinical practice to identify patients at high risk in different situations. Although AIP was not altered, alcoholism should be discouraged as this may lead to cardiac pathology.

REFERENCES

- [1] A Baheiraei; Z Hamzehgardeshi; MR Mohammad; N Saharmz; M Eesa. *Iran Red Crescent Med J*, **2013**, 5(3), 212-217.
- [2] FD Brites; CD Bonavita; M Cloes; M Yael. *Int J Clin Chem*, **1998**, 269, 107-124.
- [3] CA Burtis, ER Ashwood. *Lipids, Apolipoproteins and Lipoproteins*. Tietz Fundamentals of Clinical Chemistry. 4th edition. Philadelphia, Pa: WB Saunders, **1996**, 375-386.
- [4] KC Cummings. *Clin Chem* 47, 407-409.
- [5] ER De Oliveria e Silva; D Foster; MM Harper; CE Seidman. *Circulation*, **2000**, 102, 2347-2352.
- [6] MI Hannuksela; MK Liisanant; MJ Savolainen. *Crc Cr Rev Cl Lab Sc*, **2002**, 39, 225-283.
- [7] PN Hopkins; PP Toth; CM Balantyne; DJ Rader. *J Clin Lipidol*, **2011**, 5(3Suppl), S9-17.
- [8] T Keller; T Zeller; F Ojeda; S Tzikas; L Lillpopp; C Sinning; P Wild. *J Am Med Assoc*, 306(24), 2684-2693.
- [9] D Laurent; JE Mathew; M Mitry; M Taft; A Force; JG Edwards. *Alcohol*, **2014**, 49(4), 381-389.
- [10] IM Le-Djoussé; EB Lee; GM Julie. *Circulation*, **2009**, 120, 237-244.
- [11] JS Lee. *Clinica Chimica Acta*, **2006**, 347, 121-128.
- [12] AH Lichtennstien; LJ Appel; M Brands; M Carnethon; S Daniels; HA Franch; B Franklin; P Kris- Etherton; WS Harris; B Howard; N Karanja; M Lefever; L Rudel; F Sacks; L Van Horn; M Winston; J Wylie-Rosett. *Arterioscl Throm Vas*, **2006**, 26, 2186-2191.
- [13] CS Lieber. *Clin Liver Dis*, **2005**, 9, 1-35.
- [14] CS Lieber. *New Engl J Med*, **1995**, 333(16), 1058-1065.
- [15] JS Lim; DH Lee; JY Park; SH Jin; DR Jacobs. *J Clin Lipidol*, **2011**, 5(4), 264-272.
- [16] PE Molina; JB Hoek; S Nelson; DM Guidot; CH Lang; JR Wands; JM Crawford. *Alcohol Clin Exp Res*, **2003**, 27(3), 563-575.
- [17] M Gominaa; GES Ahlonsoub; B Awedec; A Laleved; SA Akponae. *Basic Appl Res*, 2307-4531.
- [18] National Institute of Health. *Ann Internal Med*, **2012**, 157(9), 645-654.
- [19] MR Piano; SA Phillips. *Cardiovasc Toxicol*, 14(4), 291-308.
- [20] P Pramyothin; P Samosorn; S Pounghompo; C Chaichantipyuth. *J Ethnopharmacol*, **2006**, 107, 361-364.
- [21] DJ Rader; JM Hoeg; HB Brewer Jr. *Ann Internal Med*, **1994**, 120, 1012-1025.

- [22] S Shah; JP Casas; TR Gaunt; J Cooper; F Drenos; D Zabaneh. *Eur Heart J*, **2012**, 34(13), 949-950.
- [23] SQ Siler; RA Neese; MK Hellerstein. *Am J Clin Nutr*, 70, 928-936.
- [24] T Zima; L Fialova; O Mestek; M Janebova; J Crkovska; I Malbohan. *J Biomed Sci*, **2001**, 8, 59-70.