

The prevalence of alcohol consumption and its association with selected biological risk factors for cardiovascular disease

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ABSTRACT

Cardiovascular diseases (CVDs) are the leading cause of global mortality and a major contributor to morbidity. The aim of the study was to investigate the prevalence of alcohol consumption and its association with selected biological risk factors related to cardiovascular disease. A total number of 622 young adults (306 males and 316 females) aged 21 to 30 years participated in the study. Anthropometric and biochemical measurements were recorded. Alcohol consumption questionnaires were administered. A linear regression model was utilised for the analysis of data. The prevalence of alcohol consumption was found to be 33.3% (38.6% in males and 28.0% in females). A strong positive association between alcohol consumption and raised triglycerides (β ranged from 4.088 to 2.393, $p < 0.001$), was observed. The results further showed a significant negative association between alcohol consumption and high-density lipoprotein cholesterol (β ranged from -0.087 to -0.071, $p < 0.030$). Participants who consumed alcohol were more likely to be linked with an increased low-density lipoprotein cholesterol (OR ranged from 1.50 to 1.62, $p < 0.002$). Our findings suggested that alcohol consumption was associated with increased selected biological risk factors for cardiovascular diseases. Health policies should be set to prevent the burden of alcohol related CVD nationally and worldwide.

Key words: alcohol consumption, risk factors, cardiovascular diseases, South Africa, rural populations

INTRODUCTION

Alcohol consumption has a negative impact on health, economy, and social well-being in many countries¹. In 2016, 2.8 million deaths reported globally, were due to alcohol consumption². Alcohol use was the seventh leading risk factor for both

deaths and disability adjusted life years (DALYs) in 2016². According to the World Health Organisation report, alcohol use resulted in 132.6 million DALYs in 2016³. The use of alcohol seems to rise in the low and middle-income countries, while decreases in wealthy countries⁴. Alcohol is one of the major causes of many disease

categories, such as infectious diseases, neuropsychiatric illnesses, cardiovascular diseases (CVDs), hepatobiliary diseases and injuries⁵. Cardiovascular diseases may include hypertensive diseases, ischemic heart diseases and cerebrovascular disorders³.

It has been reported that both the type of drink consumed namely: beer, wine, and liquid spirits, as well as drinking patterns may have contributing effects on cardiovascular diseases⁶. Previous epidemiological studies have reported stronger association between alcohol consumption and hypertension in a dose-dependent relationship on both genders in different ages^{7,8}. Some studies have established a close relationship between alcohol consumption and high-density lipoprotein cholesterol levels in both sexes, lowering the risk of cardiovascular disease^{9,10}. However, alcohol consumption has also been shown to be significantly associated with increased level of high-density lipoproteins cholesterol^{9,10,11,12}. The relationship is modified by several factors such as drinking pattern, type of beverage, gender, food intake/diet, smoking and the level of physical activity^{13,14}. Increased triglyceride concentration levels in the blood have been related to arteriosclerosis, increased risk of CVDs and stroke development¹⁵.

The preliminary results of the Ellisras Longitudinal Study (ELS) showed an increase in the prevalence of hypertension, overweight and obesity in children over time¹⁶. However, there is limited information available on the impact of alcohol consumption with selected biological risk factors for CVDs amongst rural South African population. Hence, the aim of the study was to investigate the prevalence alcohol consultation and its association with selected biological risk

factors of cardiovascular diseases in the rural black populations.

MATERIALS AND METHODS

Geographical Area

The study was conducted in rural villages of Lephalale region, previously known as Ellisras, and situated in the Limpopo Province, South Africa. This area is located approximately 70km from the Lephalale town (23° 40S 27° 44E) and is adjacent to the Botswana border¹⁷.

Sampling and study design

The Ellisras Longitudinal Study (ELS) followed a multiple longitudinal study design suggesting that repeated measurements were carried out in more than one cohort with overlapping ages.¹⁸ The Ellisras Longitudinal Study (ELS) began in the year 1996, and followed a cluster sampling method¹⁹. The study was undertaken at 22 schools (10 pre-schools and 12 primary schools). The selection was undertaken randomly from 68 schools within the area. Birth records were obtained from the principals of each school. Only those records that were verified against health clinic records were used to determine the age of each potential participant. Each of the 22 selected schools were assigned a grade with the expectation that most of the children in a particular age category (e.g. 3-10 years old) would be found in a specific grade. The attrition rate for the ELS ranges from 2.4 to 70.3% due to migration to urban and farm areas, illness, pregnancy, and death. These participants re-joined the measurements session when they were available in the area. However, the attrition rate of ELS subjects based on permanent loss due to death ranged between 0.71 and 3.73% for boys and 0.75 and 4.89% for girls²⁰.

In total, 622 young adults (306 males and 316 females), aged between 21 to 30 years, of the ELS sample were recruited. The ethical approval was granted by Turfloop Research Ethics Committee of the University of Limpopo, and the reference number is “Project Identification ID: TREC/112/2018: PG”. Permission to carry out the study was also sought with tribal authorities, provincial heads of education department, district managers and the principals of schools in the area. All subjects were informed about the objectives and procedures. Field workers were available to do the translation in the participant’s native language. Confidentiality and anonymity of all the results were assured.

Anthropometry

All study participants underwent a series of anthropometric measurements (height, weight, and waist circumferences) according to standard procedures of the International Society for the Advancement of Kinanthropometry²¹. The weights and heights were measured using an electronic scale to the nearest 0.1 kg, and Martin anthropometric equipment to the nearest 0.1 cm. A flexible steel tape was used to measure the waist circumference (WC) to the nearest 0.1 cm, midway between the last rib and the iliac crest, with the participants standing. Waist-to-height ratio (WHtR) was calculated as WC divided by height. Females with waist circumference ≥ 88 cm and males with waist circumference ≥ 102 cm were classified as obese²². Body mass index (BMI) was calculated as weight (kg) per height squared (m^2). Body mass index cut-offs was as follows: below $18.5 kg/m^2$ - underweight, $18.5 kg/m^2$ to $24.99 kg/m^2$ - normal, $25 kg/m^2$ to $29.99 kg/m^2$ - overweight and above $30 kg/m^2$ - obese^{22, 23}.

Blood Pressure Measurements

Using an electronic Micronta monitoring instrument, at least three blood pressure (BP) readings of systolic (SBP) and diastolic pressure (DBP) were taken at an interval of five minutes apart after the subject has been seated for 5 minutes or longer^{24, 25}. Participants were classified as being hypertensive if they had an average systolic blood pressure of 140 mmHg or above, or if the average diastolic blood pressure was 90 mmHg or above^{26, 27}.

Fasting Blood Samples

All participants were asked to fast overnight prior to blood collection. Blood samples were collected in the morning by a registered nurse, according to the procedure by Kemper²⁸. Blood samples were collected into 4 mL grey and gold top vacutainer tubes (vacutainer BDTM) containing sodium fluoride and gel. Samples were then placed in a cooler box with ice ($0-8^{\circ}C$). At the laboratory, blood samples were centrifuged at 2500 revolutions per minute (rpm) for 15 minutes to obtain serum. The clotted and hemolysed samples were discarded. Serum was stored at $-80^{\circ}C$ for further analysis. Total cholesterol, fasting blood glucose, high-density lipoproteins cholesterol and triglycerides levels were measured on AU480 auto-analyser and access 2 immunoassay, using reagents supplied by Beckman Coulter USA. All measurements were done at the University of Limpopo’s Medical Sciences laboratory²⁹.

Alcohol Consumption Questionnaire

The study applied a number of strategies to strengthen the study trustworthiness and rigour. Validated tools and approaches were applied in the data collection³⁰. The questionnaire which covers important concepts relating to alcohol use from birth-to-twenty study, Amsterdam Growth and Health

Longitudinal Study and the Global Youth Tobacco Survey were studied ³¹. In the previous related studies, alcohol use questionnaires regarding the use from such studies were investigated thoroughly and list of concepts were developed. Questions addressing relevant concepts (social demographic data, and alcohol habits) of the current study were extracted from the previously validated questionnaire. The standard guidelines as proposed by the UK Chief Medical Officer's low risk drinking guidelines (2016) ³², suggested stratification of alcohol consumption by type and volume / percentage content.

The questionnaire included separate items such as the type of alcohol consumed, e.g. beer, wine, spirits and homemade beer. The participants were asked if they ever consumed alcohol? A negative answer resulted in classifying the participant as an abstainer, and a positive answer led to follow-up questions. Questions such as how many drinks/units of beer, wine, spirits and homemade beer each participant takes per week were asked. Alcohol percentages contained in beverages differed, with the common percentages given as follows: the content of alcohol per drink was 5% for beer, 13% for wine, and 43% for liquid spirits ³³.

From those inquiries, it was possible to derive and categorise further the alcohol consumption level into light drinkers (1-3 drinks per week), moderate drinkers (>3 to 6 drinks per week for females and >3 to 14 drinks per week for males, and heavy drinkers (>6 drinks/week for women and >14 drinks/per week for males ³³. A group of communal drinkers (occasional/social drinkers) refers to those individuals who drink in low-risk patterns, there are also recognised as casual drinkers of alcoholic beverages in a social setting without an intent to become intoxicated ³³.

Quality Control

All selected field workers (from the Lephalale area, University of Limpopo postgraduate students, professional nurses, and principal investigator) underwent an intensive training for one week prior to the survey. All field workers measuring weight, height, and waist, circumferences were trained in accordance with the standard procedures of ISAK guidelines ¹⁹. Blood pressure measurements were standardized against a using a double-headed stethoscope with measurements recorded to the nearest 2 mm Hg. Height, weight, and waist circumferences were taken by criterion testers according to the ISAK guidelines ¹⁹. Reliability and validity of anthropometric measurements and BP measurements were reported ¹⁶. The field workers' and principal investigator's technical error of measurements ranged from 96 to 100% in agreement, whereas questionnaires relating to cardiovascular diseases ranged from 93 to 97% agreement.

STATISTICAL ANALYSIS

All the analyses were carried out using the SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were computed by gender for age, SBP, DBP, anthropometric and biochemical parameters. The independent Student t-test was applied to test the significance level ($P < 0.05$) between genders. Fisher's exact test was used when frequency cells were small (less than five or ten) between genders.

We classified each participant into categories (drinking patterns) of total alcohol consumption. The cut-off point for moderate drinking is defined as (1 standard drink for women and two drinks per day for men (44 ml whisky, 148 ml wine or 355 ml of beer) ³⁴. Heavy drinking was defined as consuming (>40 grams for males per day

and >20 grams for females per day/ (>6 drinks/week for women and >14 drinks /per week for males ³⁴. In order to analyse the relationship between alcohol consumption with selected biological risk factors we carried out a linear regression model approach, adjusted for age (continuous variable), and gender. In addition, the Beta , along with the p value was obtained by fitting the (dependent variable) and one or more explanatory variables (independent variables). Moreover, the amount of alcohol consumed by each participant daily used were continuous variables, while the biological risk factors used were absolute variables. The set of potential risk factors included: blood pressure factors (systolic blood pressure and diastolic blood pressure), fasting blood glucose, high total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein, and raised triglycerides. To analyse the odds/probability of developing cardiovascular risk factors due to alcohol consumption, we carried out a binary logistic regression analysis model using a dependent variable (1 = yes, 0 = no) while other factors were independent variables, unadjusted and adjusted for age and gender.

RESULTS

The prevalence of biological, biochemical risk factors, overall alcohol consumption by gender among young adults aged 21 to 30 years

Table 1 demonstrates the prevalence of biological and biochemical risk factors stratified by gender among young adults aged 21 to 30 years. The prevalence of hypertension, and elevated triglycerides was significantly higher in males than females. A higher prevalence of obesity and overweight were observed among females in the study (overweight being 23.45%; obesity of 25.8%). Female participants showed a higher prevalence of total cholesterol (TC) levels of 21.3% when compared to males 9.1%. On the other hand, we obtained a significantly higher prevalence of fasting blood glucose in males.

Overall, the prevalence of alcohol consumption was found to be 33.3% in the total population (38.6% males, 28.0% females). The prevalence of alcohol consumption (consumed alcoholic drinks in last 12 months) was 26.3% in the total population and males had higher prevalence than females 30.4% vs 22.2% (Table 1).

Table 1 Presents the prevalence of biological, biochemical risk factors, and overall alcohol consumption by gender in Ellisras rural young adults, South Africa (Males; 306, females; 316).

Risk factors	Gender		P-value
	Males	Females	
	% (n)	% (n)	
Hypertension (BP $\geq$ 140/90mmHg)	22.2(78)	4.6(17)	0.001**
Increased SBP (BP $\geq$ 140mmHg)	14.5(56)	1.9(7)	0.001**
Increased DBP (BP $\geq$ 90mmHg)	3.2(11)	2.2(8)	0.001**
High WC(male $\geq$ 102cm ; female $\geq$ 88 cm)	0.9(3)	36.2(133)	0.001**
Overweight ($\geq$ 25 to $\leq$ 29.9kg/m ²)	9.4(33)	23.4(86)	0.001**
Obese ($\geq$ 30kg/m ²)	4.3(15)	25.8(95)	0.001**
Raised triglycerides ($\geq$ 1.70 mmol/L)	12.7(43)	9.5(35)	0.008*

Risk factors	Gender		<i>P</i> -value
	Males	Females	
High total cholesterol (male ≥ 5.22 mmol/L ; female ≥ 5.14 mmol/L)	9.1(31)	21.3(78)	0.001**
Low HDL-C (male < 1.04 mmol/L; female < 1.30 mmol/L)	28.0(95)	73.0(268)	0.001**
High Fasting blood glucose (≥ 7.0 mmol/L)	48.4(153)	44.1(135)	0.040*
	Population %(n)	Males % (n)	Female % (n)
Current alcohol consumed (YES)	33.3(207)	38.6(118)	28.0(89)
Consumes alcohol (NO)	66.7(415)	61.4(186)	72.0(229)
Consumed last 12 months	26.3(163)	30.4(93)	22.2(70)
Alcohol in 30 days	16.2(100)	24.8(76)	7.6(24)

* $p < 0.05$ - significant differences between males and females; DBP-diastolic blood pressure; SBP-systolic blood pressure; WC-waist circumference; BMI-body mass index; HDL- low-high density lipoprotein- cholesterol. Chi-squared test to determine the significant difference ($p < 0.05$) between both genders.

Alcohol drinking patterns according to gender

The overall prevalence of heavy and light-moderate drinking was 14.5% and 9.7%. The prevalence of occasional drinking in the study was 7.8% in males and 5.0% in females

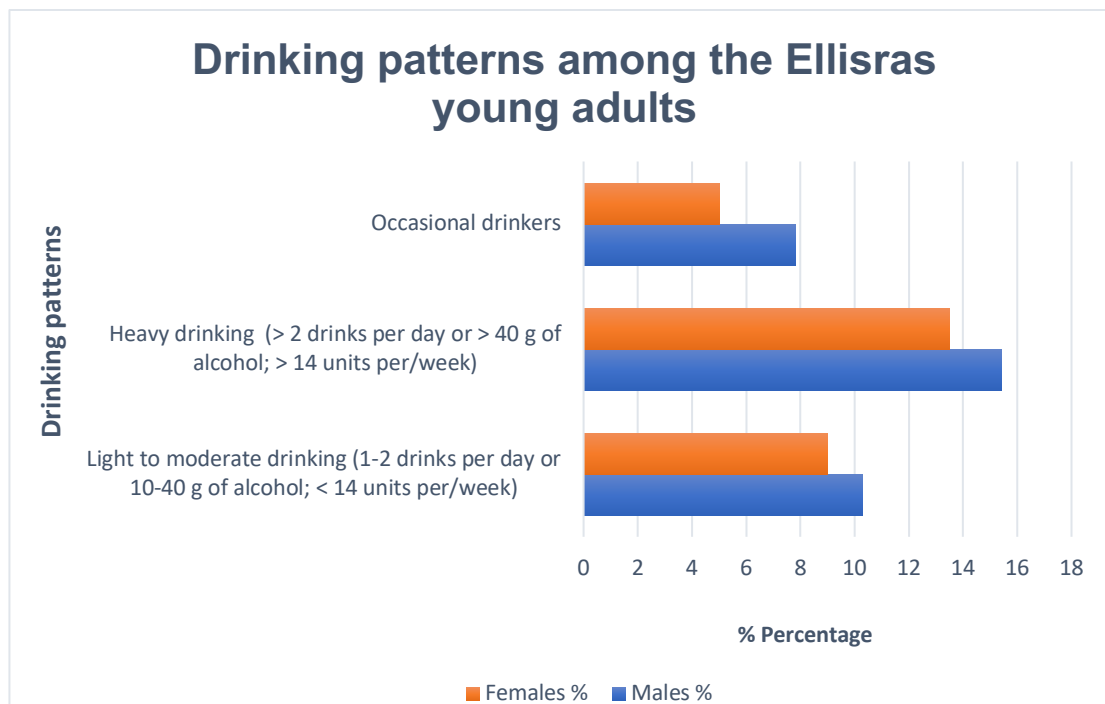


Figure 1 Alcohol drinking patterns according to gender among the Ellisras young adults

The association of alcohol consumption with systolic blood pressure, waist circumference, diastolic blood pressure, triglycerides, total cholesterol, low-density lipoprotein, fasting blood glucose and high-density lipoprotein

Table 2 shows a linear regression coefficient, *p*-value and 95% confidence intervals for the association between alcohol consumption with biological risk factors. There was strong positive significant association between alcohol consumption with raised triglycerides (TG)

(β ranged from 4.088 to 2.393 and 95%CI ranged from 3.993; 4.188 to 1.356; 3.440, $p<0.001$) adjusting for age and gender. Similarly, there was another stronger association between alcohol consumption with low-density lipoprotein cholesterol ($\beta=5.554$ 95%CI 5.437; 5.671, $p<0.001$). the results further showed a negative significant association between alcohol consumption with high-density lipoprotein cholesterol (β ranged from -0.087 to -0.071 and 95%CI ranged from -0.228;0.012 to -0.207; 0.011, $p<0.05$).

Table 2 Linear regression coefficient, P-value and 95% confidence intervals for the association between alcohol consumption with cardiovascular risk factors in Elliras young adults.

	Unadjusted				Adjusted for age and gender			
	β	95% CI		P- value	β	95% CI		P- value
Alcohol consumption								
WC (cm)	0.639	0.212	1.924	0.001*	0.641	0.215	1.938	0.014*
SBP (mmHg)	0.651	0.374	1.134	0.001*	0.685	0.386	1.216	0.001*
DBP (mmHg)	0.900	0.383	2.115	0.170	0.925	0.393	2.180	0.650
TC (mmo/L)	4.088	3.993	4.188	0.020*	2.393	1.356	3.440	0.001*
TG (mmol/L)	0.517	0.288	1.428	0.022*	0.531	0.294	1.958	0.025*
LDL-C (mmol/L)	5.554	5.437	5.671	0.001**	4.932	3.631	6.233	0.001*
FBG (mmol/L)	0.192	0.116	0.317	0.168	0.593	0.272	1.292	0.189
HDL-C (mmol/L)	-0.087	-0.228	0.012	0.029*	-0.071	-0.207	0.011	0.030*

** $p<0.01$; * $p<0.05$; β - Beta; CI- Confidence Interval; WC- increased waist circumference; FBG- elevated fasting blood glucose; TC- high total cholesterol; HDL- low high density lipoprotein; LDL- high low-density-lipoprotein; TG - elevated triglycerides; SBP- increased systolic blood pressure; DBP- increased diastolic blood pressure.

Logistic regression analysis showing the odds/probability of developing cardiovascular risk factors due to alcohol intake

Table 3 shows a binary logistic regression analysis to determine the influence of alcohol consumption on biological risk factors. The results showed that those participants who consumed alcohol were more likely to present with

hypertension (OR= 1.08 95%CI 0.408; 2.869, $p<0.050$). However, with the adjustment for age and gender confounding effect, the p value was no longer significant. Similarly, participants who consumed alcohol were more likely to be present with increased low-density lipoprotein cholesterol (OR ranged from 1.50 to 1.62 95%CI ranged from 1.846; 2.677 to 1.751; 2.862, $p<0.002$).

Table 3 The logistic regression coefficients, P -value and 95% confidence intervals for the association between alcohol consumption with biological risk factors in Elliras young adults.

	Unadjusted				Adjusted for age and gender			
	OR	95% CI		P value	OR	95% CI		P value
Alcohol consumption								
High WC male ≥ 103 cm, female ≥ 88 cm	0.64	0.212	1.924	0.426	0.64	0.215	1.938	0.431
High SBP ≥ 140 (mmHg)	0.65	0.374	1.134	0.001**	0.69	0.386	1.216	0.001**
High DBP ≥ 90 (mmHg)	0.90	0.383	2.115	0.800	0.93	0.393	2.180	0.859
Hypertension $\geq 140/\geq 90$ mmHg	1.08	0.408	2.869	0.881	1.12	0.418	2.980	0.827
High total cholesterol (male ≥ 5.22 mmol/L; female ≥ 5.14 mmol/L)	0.87	0.572	1.322	0.051	0.83	0.541	1.268	0.001
Elevated TG ≥ 1.70 mmol/L	0.52	0.288	1.028	0.029*	0.53	0.294	1.058	0.003
Increased LDL-C >3 mmol/L	1.50	1.846	2.677	0.001**	1.62	1.751	2.862	0.002
FBG ≥ 7.00 mmol/L	0.94	0.755	1.161	0.549	0.93	0.746	1.148	0.481
HDL-C(males <1.04 mmol/L; females <1.30 mmol/L)	1.05	0.762	1.439	0.029*	1.04	0.697	1.389	0.020*

** $p<0.01$; * $p<0.05$ 95% confidence interval; OR- odds ratio; WC- increased waist circumference; FBG- elevated fasting blood glucose; TC- high total cholesterol; HDL- low high-density lipoprotein; LDL- high low density lipoprotein; TG- elevated triglycerides; SBP- increased systolic blood pressure; DBP- increased diastolic blood pressure.

DISCUSSION

The aim of the study was to determine prevalence of alcohol consumption and its association with selected biological risk factors of cardiovascular diseases among young adults in a rural setting. The overall prevalence of hypertension was 14% and significantly higher in males than females. The findings were found to be lower compared to the results from two different rural populations by Maimela et al³⁵ and Alberts et al³⁶, which reported that 38% and 25% of the population had hypertension respectively. Sliwa et al³⁷ mentioned that 56% of participants in the Heart of Soweto study were hypertensive. Another study conducted in Vietnam reported similar trends, which suggested that males had higher prevalence of hypertension than females³⁸. The reason for a higher prevalence of hypertension in males than females has not been clear, but some studies have speculated that testosterone in males could play a role in the increase of blood pressure as compared to females³⁹. In females, the presence of estrogen and estrogen receptors stimulation have protective effects on the cardiovascular system that further decrease the incidence of CVDs⁴⁰. Moreover, dietary sodium intake has been linked with hypertension⁴⁰, and in poor rural settings, salt consumption may be generally high because it is frequently used to add flavour to “pap” (porridge), rice, and other types of food.

The rise in the prevalence of obesity and overweight among black rural population was reported to be a public health burden worldwide⁴⁰. A higher prevalence of obesity and overweight was observed in females. Thus, the results were in line with the study conducted in the rural area of India by Kaur et al⁴¹. The same trend

was observed in a study undertaken by Alberts et al³⁶ in South Africa, although the results reported a slightly higher prevalence of obesity (44%). This could be due to higher prevalence of unemployment, poor nutritional practice in the rural populations, smoking and alcohol use⁴¹.

Female participants showed a higher prevalence of total cholesterol (TC) levels of 21.3% when compared to males with 9.1%. The results were found to be consistent with the findings of the study conducted by Maimela et al³⁵. Li et al⁴² reported different findings, suggesting a higher prevalence of dyslipidaemia in males (41.9%) than females (32.5%) in China. It was reported that elevated levels of total cholesterol are considered to be major modifiable risk factors for cardiovascular events, which can account for approximately 4.4 million annual deaths globally⁴³. We observed a significantly ($p < 0.001$) higher prevalence of low HDL-cholesterol in females than males. The results concurred with the findings of a study conducted in the US, which reported lower HDL-C levels in males than in females⁴⁴. The increased low HDL cholesterol levels could be linked to higher risk of cardiovascular conditions and atherosclerosis. The current study showed that the prevalence of fasting glucose levels was high among males 48.4% than in females 44.1%, at fasting blood glucose level higher than 7mmol/l. The drastic increase in the fasting blood glucose levels among the study participants might not be true reflection of diabetes prevalence. This is because fasting might not have been practised as required, and in addition, it was a challenge to monitor adherence with the participants.

The overall prevalence of alcohol consumption was found to be 33.3% and

significantly higher in males than females. The findings were in line with the prevalence reported in a study consisting of South African adults in all the provinces between the ages of 18 and older (38% males and 21% females) by Reddy et al⁴⁵. A high prevalence of alcohol consumption among males was supported by the findings of studies conducted by Maimela et al⁴⁶ and Ng et al⁴⁷. Although the prevalence of females consuming alcohol was lower, it should be noted that they may also be at risk of developing cardiovascular disease. Plausible explanation for this trend may be attributed to factors such as affordable price of alcohol beverages, poor community policing, poverty, unemployment, and lack of recreational facilities in the rural areas⁴⁸. Finally, the lower number of females drinking alcohol could be due to common traditional beliefs in a rural setting that it is generally strange or a taboo for females to consume alcohol.

The prevalence of heavy alcohol consumption was found to be high in this present study. Studies reported that excessive intake of alcohol may be a major cause of myocardial infarction, hyperlipidaemia, overweight and other cardiovascular conditions⁴⁹. Our findings were found to be consistent with the results by Djousse et al⁵⁰, who observed a higher prevalence of heavy drinking among males and further added that this may contribute to the development of cardiovascular diseases. The same trend was observed in a study which investigated wine and beer consumption and incidence of cardiovascular diseases⁵¹. It is concluded that the high prevalence of heavy alcohol consumption in our study may be due to difference in cultural practices, or data collection time, which in this case was during the festive seasons (December

month). The pattern of alcohol drinking differs according to social groups⁶. Individuals that are divided, separated, single or living in a shared accommodation tend to drink heavily and frequently⁶.

On the other hand, the prevalence of light- moderate drinkers was significantly higher among males when compared to females. A similar trend was observed in several recent and previous studies conducted^{6,10,14,52}. Several studies have suggested that intake of light-moderate alcohol may be associated with reduced risks of developing CVD, coronary artery disease, and all-cause of mortality⁵³. Polyphenols found in these beverages play a cardio-protective role and prevent the occurrence of atherogenesis through sudden changes in the serum lipids, blood clotting protein and insulin resistance, and mainly elevating the levels of HDL-cholesterol^{10,54}.

The linear regression showed a strong positive significant ($p < 0.001$) association between alcohol consumption with high LDL-cholesterol was observed. A similar trend was observed in the study carried out in an Italian population⁵⁵. In contrast, a meta-analysis study by Brien et al¹⁴, reported the absence of any significant association between alcohol consumption and the plasma LDL-C levels. We observed another strong positive significant relationship between alcohol consumption and elevated triglyceride (TG) levels. Multiple observational studies reported similar association between heavy alcohol drinking and increased plasma triglycerides (TG)^{13,56}. Some studies have shown no significant association between alcohol consumption and serum triglyceride levels²⁴. The inconsistent results emphasized the need for a further

exploration of the association between alcohol consumption and the serum triglyceride levels.

Further analysis showed a positive association between alcohol consumption with systolic and diastolic blood pressures. Similar trends have been reported in the study by Emberson and Bennett⁶. Briasoulis et al⁵⁷ reported an increase in systolic blood pressure by 4.6 mmHg among males who consumed >6 drinks per day, and 3.9 mmHg among females who take 3-4 drinks daily. Studies have pronounced that beer, which is one of the globally consumed beverages, to be strongly associated with the rise in BP when compared to other types of alcohol⁵⁸. In addition, Zilkens et al⁵⁹ reported that alcohol intake increased the systolic and diastolic BP, regardless of the type of alcoholic beverage consumed. They reported an increase of the systolic BP by 1.7 mmHg and 2.2 mmHg in relation to heavy consumption of beer (41 g of alcohol) and red wine (39 g of alcohol), respectively⁵⁹. However, there are studies which reported cardiovascular benefits of moderate beer and wine intake due to polyphenolic content. These polyphenols are believed to trigger vasodilation in some vascular beds⁶⁰.

The analysis further showed a strong negative significant ($p < 0.05$) association between alcohol consumption with low HDL-cholesterol with alcohol consumption (β ranged from -0.087 to -0.071 and 95% CI ranged from -0.228; 0.012 to -0.207; 0.011, $p < 0.05$). Several studies have also reported a negative association between alcohol consumption and HDL-cholesterol⁶¹. Numerous studies have assessed the importance of HDL-cholesterol and its capacity to protect against atherosclerosis and cardiovascular events⁶¹. The reason for lack of any

beneficial effect of the increase in plasma HDL-C level by heavy alcohol consumption on the CVD risk remains uncertain. However, there is a speculation that the effects of heavy alcohol consumption, which include high blood pressure, increase in oxidative stress, and endothelial dysfunction, may offset any beneficial effect of elevated HDL-cholesterol on the risk of CVD⁶¹.

An association between alcohol consumption and waist circumference was observed. Heavy alcohol intake is generally linked to lean body mass, while increased weight gain was associated with moderate-low alcohol intake⁶². A study by Suter⁶³ reported concordant findings regarding the relationship. Some studies observed a J-shaped association between alcohol consumption and several anthropometric parameters⁶⁴.

Participants who consumed alcohol were more likely to present with hypertension, which is concordant with the findings elsewhere regardless of the level and type of alcohol consumed⁶⁵. We observed that participants that consume alcohol were more likely to present high LDL-cholesterol, low HDL-cholesterol, and raised triglycerides before and after adjusting for confounders (age and gender). Mukamal et al⁶⁶ reported similar findings from a study in India, and further suggested that alcohol consumption elevates triglycerides in a dose-dependent manner. Number of previous observational studies have reported high risk of dyslipidaemia due to alcohol consumption^{10, 37, 67}. Brien et al¹⁴ reported that consuming alcohol may contribute to the decrease in HDL-cholesterol levels and Apo protein A1 levels in a meta-analysis study consisting of young adults. Observational studies carried out in a Japanese population and Danish population reported a higher risk of a raise

in plasma LDL-cholesterol levels because of alcohol consumption ^{67,68}. Heavy alcohol intake brings about numerous negative changes in hepatic cholesterol metabolism that eventually results in reduced extracellular signal-related kinase activation in the liver, leading to the raise in LDL-cholesterol ⁶⁷.

This study had limitations that we identified. It was a cross-sectional study therefore the causative relationship could not be established. The information on the amount of alcohol consumed was based on self-reporting questionnaires, which could be exposed to biasness. With communal drinking commonly practiced in rural settings, there could be participants who mixed drinks at any given time. Finally, participants were expected to fast the previous night before collection of blood for glucose and lipids testing, however, it was a real challenge to measure adherence to that requirement.

CONCLUSION

The findings of this study suggest that alcohol consumption is associated with increased triglycerides, high LDL-cholesterol, low HDL-cholesterol levels, as well as hypertension prevalence in the Ellirras young adults. There is a need that government health officials educate the public, especially young adults about the danger of alcohol consumption and the risk of cardiovascular diseases. The existing adolescent and youth policy, and the national school health policy must be revised to ensure that the burden of alcohol related cardiovascular diseases can be prevented.

CONSENT FOR PUBLICATION

The work of this manuscript is original and has not been published elsewhere. We provide our consent for the publication of this article.

DECLARATION OF CONFLICTING INTEREST

The authors declared no potential conflicts of interest.

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