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A Cross-Sectional Study on the Evaluation of the Lipid Profile of Regular Blood Donors in the Buea Regional Hospital, Cameroon

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Abstract: There is an acute shortage of blood in most blood banks worldwide to meet up with demands for several medical interventions. A few reports have associated regular blood donation to the lowering of lipid profile parameters. Estimating the lipid profile is a conventional method of assessing an individual's risk for coronary heart disease. The purpose of this study was to evaluate the lipid profile of blood donors as a whole and to determine the effect of regular blood donation on lipid profile. This study was a cross sectional study that involved 146 consented blood donors, 90 of whom were regular blood donors (study group) and 56 irregular blood donors (control group). A volume of 5ml venous blood was drawn from each fasting participant into a dry biochemistry screw capped tube. This was allowed to clot and the serum was used to determine total cholesterol, Low-density lipoprotein, High-density lipoprotein and triglycerides. Their atherogenic indices were also calculated from the values of the lipid profile parameters. The student's t test was use to compare means of the study group and control group, while linear regression analysis was used to measure amount of change. The mean total cholesterol (173.54 ± 46.28mg/dl), low-density lipoprotein (96.68 ± 39.37mg/dL), triglycerides (79.28 ± 42.95mg/dL) were comparatively lower in the regular blood donors than the irregular donors (174.61 ± 50.57, 98.16 ± 42.71, 79.82 ± 50.07) respectively, even though did not reach statistical significance (P > 0.05). The mean Low/High-density lipoprotein ratio was also lower in the regular donors than in the irregular donors, though not statistically significant (P > 0.05). 2.05% of the population of blood donors had a risky Low/High-density lipoprotein ratio (i.e. ratio ≥ 3.0). Blood donors as a whole may be said to have a reduced risk of developing coronary heart disease as reflected by the low prevalence of risky Low/High-density lipoprotein ratio and this benefit may be enhanced with regular blood donation as reflected by the lower total cholesterol, low-density lipoprotein, and triglyceride levels in regular blood donors.

Keywords: Regular Blood Donor, Total Cholesterol, Low/High-Density Lipoprotein Ratio, Buea

1. Introduction

"Safe blood starts with me, blood saves lives" was the World Health Organization's theme for World Blood Donor Day celebration on April 14, 2000. However, despite the usefulness of blood in medical practice, there is an acute shortage of blood even in large cities, with the supply below 50% of requirement [1]. "Every year, millions of people rely on the generosity of another person to donate blood. Yet, blood donation rates vary considerably and the demands for blood and blood products are increasing worldwide. To meet these needs, more people must come forward to give blood voluntarily, and regularly", said the WHO on World Blood Donor Day, June 14, 2012 [2].

In 2006, Cameroon's blood transfusion need was estimated at 170,000 units, while less than 40% of this amount was available, and 80% of that was provided by patients' family members or paid donors [3].

A report over Voice of America on July, 25th 2013, stated that "Blood banks in Cameroon were facing a crisis because of the prevalence of HIV and hepatitis infections among blood donors [5]. Up to 2010, the Central African sub-region had a 6% prevalence of hepatitis and Cameroon alone had 16%, almost the same figures for HIV" [4]. The report went further to highlight that for the past three years, the general hospital in Yaoundé had not been able to fill 40% of its 75,000 blood bags. The consequence was that many patients in the hospital were asked to bring their family members to donate blood [4]. Unfortunately, this is the picture with most of the blood banks in Cameroon and this is because voluntary blood donation is not well accepted by most people.

Regular blood donation, however, has been found to be beneficial in several ways. It challenges the bone marrow to increase its red marrow, producing more blood for the donor. It also prevents the accumulation of body iron which can cause free radical formation in the body [6]. A few reports have linked regular blood donation to the lowering of parameters of lipid profile. The very few past research works done on this subject suggested that there may be a healthy lipid profile in regular blood donors [4, 6].

Estimating the lipid profile is an accepted method of assessing an individual's risk for coronary heart disease as shown by several studies [7-9], particularly if there is evidence of lipid peroxidation. Regular blood donation may lower iron stores, and this in turn lowers lipid peroxidation [5]. Moreover, a study that examined the effects of blood donation found that donating blood every 6 weeks lowers the oxidation of low-density lipoprotein (LDL), which is associated with the development of atherosclerosis [10]. Some studies suggest that high iron levels may play a role in this lipid oxidation process, which is a prelude to atherosclerosis. Furthermore, another study showed that LDL-C/HDL-C ratio was an excellent predictor of coronary heart disease risk and an excellent monitor for the effectiveness of lipid-lowering therapies. This ratio is also obtainable from values of a standard lipid profile [11].

However, studies that clearly states the effect of regular blood donation on the levels of serum cholesterol and lipid profile in general, which is a major factor in the development of atherosclerosis and other cardiovascular diseases, are very few, especially in Central Africa and Cameroon in Particular.

The rationale of this study was to bring out the benefit of regular blood donation in the prevention of coronary heart disease as would be reflected in the serum lipid profiles of regular blood donors in Buea, thereby encouraging more voluntary blood donation by the public, which will in turn contribute in solving the problem of acute shortage of blood in our blood banks all over the country.

This study will contribute to tell if there is an actual health benefit to the blood donor in donating blood especially at the level of reducing serum cholesterol levels which are associated with the development of cardiovascular diseases.

2. Material and Methods

2.1. Study Design

This study was a hospital based cross-sectional study involving 146 consenting blood donors recruited between March and May, 2014.

2.2. Setting

This study took place in Buea, the political headquarters of the South West Region of Cameroon. There are many ethnic groups in Buea including the Bakweri (indigenes), Bamileke, Bafout, Balondu, Metta and Bayangi among others. Buea has a population of about 200.000 inhabitants and is located 15kms from the Atlantic Ocean, and 60 kilometers from Douala, the economic capital of Cameroon. Most inhabitants practice agriculture as the main economic activity. Almost all ethnic groups in Cameroon are represented in Buea, attracted by the fertile volcanic soil and the Cameroon Development Corporation, a giant agricultural corporation that seconds the state of Cameroon in employment [12]. There is also the presence of a state university in Buea, and other higher institutions of learning. All these factors have contributed to the now cosmopolitan nature of Buea.

2.3. Study Population

The study population was made up of male and female consenting blood donors, who had been donating blood at the Buea Regional Hospital Blood Bank within the last three years (i.e. from April 2011 to April 2014).

Inclusion criteria were consenting blood donors between 21–60 years of age. Regular blood donors were considered to those who had donated blood at least two times in the past 12 months, four times in the past 24 months, or at least six times in the past 36 months. While irregular donors were those who had donated blood fewer number of times within the same time intervals. Exclusion criteria were donors with history of hypertension, diabetes mellitus, Kidney diseases and cardiovascular disease, as well as pregnant and lactating women.

2.4. Ethical Approval

This study was approved by the Faculty of Health Science Institutional Review Board of the University of Buea. Participation in this study was voluntary, and an informed consent was obtained from each study participant before the interview and collection of blood samples

2.5. Data and Sample Collection

Structured questionnaires were used to get information about age, sex, history of blood donation, chronic diseases and other demographic data from the participants. Venous blood (5mL) was drawn from each participant after a 10-12 hour fast into dry biochemistry tubes and allowed to stand at

room temperature until clotted and the clot retracted. After centrifugation at 3000rpm for 10 minutes, the sera were separated and transferred to plain Eppendorf tubes carrying the code of each participant. This was stored at −20°C until time of analysis. Samples were analyzed in batches after having been brought to room temperature.

2.6. Laboratory Procedures

Commercial test kits manufactured by INMESCO laboratories were used for quantitative determination of total cholesterol (TC) [Enzymatic-colorimetric, Trinder. End Point reaction, Mono liquid reagent], High-density lipoprotein cholesterol (HDL-C) [Precipitation technique, Phosphotungstic acid, INMESCO reagent] and triglyceride (TG) [Enzymatic-colorimetric, end point reaction, INMESCO triglyceride PAP Mono liquid reagent], while low-density lipoprotein cholesterol (LDL-C) was calculated using the Fridewald equation as follows:

$$LDL\text{-}C = TC - HDL\text{-}C - TG/5 \qquad (1)$$

All procedures were carried out as per the instruction manual of the test kits.

All analyses were done using MindRay BA88A Spectrophotometer.

2.7. Statistical Analysis

Data was analyzed using stata version 10. Chi- square (X^2) and ANOVA were used where necessary to compare the relationship between categorical variables, the student t test was used to measure difference between means, while regression analysis was also used where necessary to measure amount of change. Data was summarized using contingency tables, pie charts, histograms. A P-value < 0.05 was considered to be statistically significant for all tests conducted.

3. Results and Discussions

A total of 146 blood donors were enrolled into the study, 90 (61.64%) of whom were regular donors and 56 (38.36%) irregular donors. One hundred and five (71.92%) of the blood donors were family or replacement donors (FR), 10 (6.85%) were paid donors (PD) and 31 (21.23%), voluntary donors (VD). The above information is shown in Figure 1.
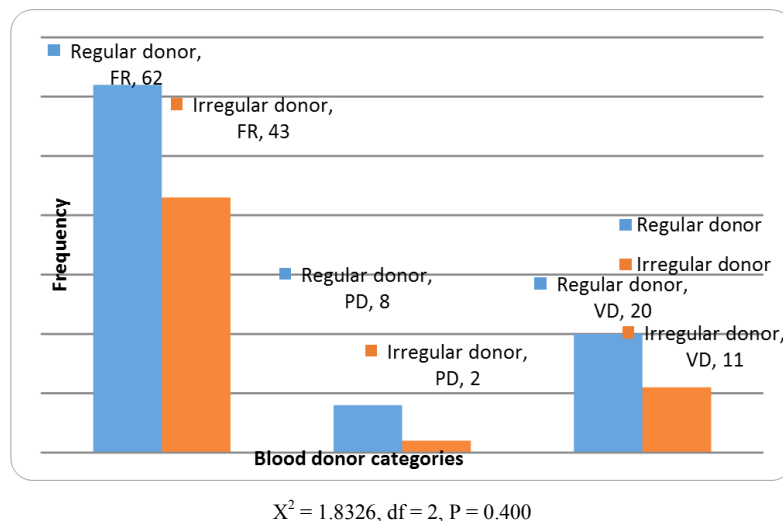

$X^2 = 1.8326$, df = 2, P = 0.400

Figure 1. Distribution of blood donors by subgroups and category.

There were 131 male blood donors and 15 female blood donors. The age of the blood donors ranged from 21-56 with a mean age of 34.18 ± 8.20 years. The difference in the mean age of regular blood donors to those irregular blood donors was not statistically significant. The distribution of blood donors by age group is shown in Figure 2.

It was observed that most of the blood donors were in the 21-30 age group with 58 participants and the least number of participants were in the 51-60 age group with just 6 participants as shown in figure 2 below. Again there was no significant difference in the ages in the number of participants in the subgroups of regular and irregular blood donors.
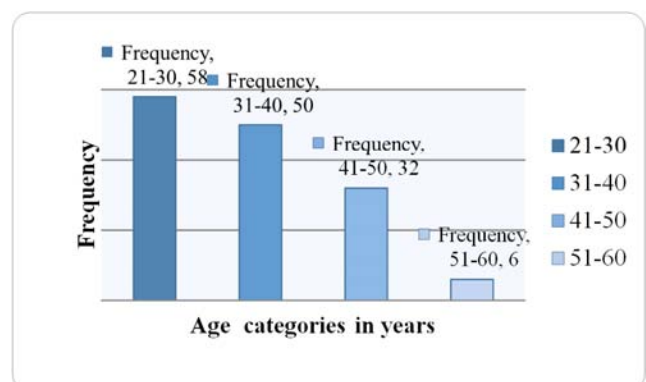

Figure 2. Distribution of blood donors by age group.

Figure 3 below shows that 17.89% of the blood donors were cigarette smokers while 71.23% were alcohol consumers. In the overall population of blood donors, 26 (17.81%) were cigarette smokers and 71.23% were alcohol consumers (Figure 3). The proportion of cigarette smokers and alcohol consumers was not significantly different in the subgroups of regular donors and irregular donors.
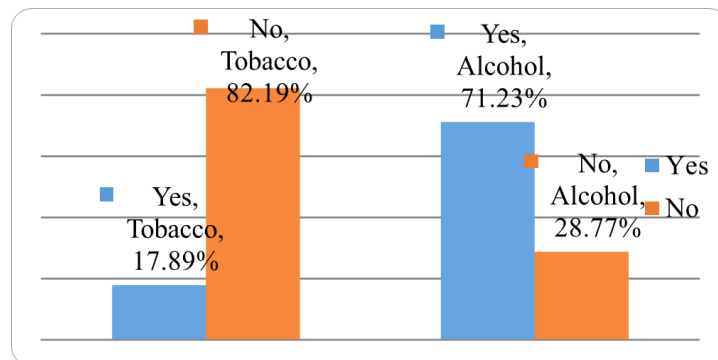

***Figure 3.** Distribution of blood donors by Tobacco and Alcohol consumption.*

Results presented in table 1, indicate that the regular (R) blood donors had a lower mean TC (173.54 ± 46.28mg/dL), LDL (96.68 ± 39.37mg/dL), triglyceride (79.28 ± 42.95), TC/HDL (2.93 ± 0.86) and LDL/HDL (1.67 ± 0.75) compared to the irregular (IR) blood donors (174.61 ± 50.57, 98.16 ± 42.71, 79.82 ± 50.07, 2.96 ± 0.81 and 1.68 ± 0.76 mg/dL respectively). However none of these reached statistical significance (P-values of 0.899, 0.8342, 0.9465, 0.8733 and 0.8672 respectively). The mean HDL in the irregular blood donors (61.45 ± 21.63mg/dL) was higher than that of regular blood donors (61.21 ± 16.37mg/dL) though it did not reach statistical significance (P = 0.944).

***Table 1.** Comparison of mean lipid concentrations (mg/dL) and atherogenic ratios of regular and irregular blood donors.*

	Bivariate analysis using t-test				
Serum lipids	R (n=90) mean ± SD	IR (n=56) mean ± SD	t	df	P
T C	173.54 ± 46.28	174.61 ± 50.57	0.1275	108.988	0.899
HDL	61.21 ± 16.37	61.45 ± 21.63	0.0699	93.8323	0.944
LDL	96.68 ± 39.37	98.16 ± 42.71	0.2098	109.61	0.8342
TG	79.28 ± 42.95	79.82 ± 50.07	0.0673	103.483	0.9465
TC/HDL	2.93 ± 0.86	2.96 ± 0.81	0.1598	122.751	0.8733
LDL/HDL	1.67 ± 0.75	1.68 ± 0.76	0.1676	115.883	0.8672

In looking at the prevalence of abnormal lipid profile parameters, it was observed that among the 146 blood donors who were tested, 39 of them had a TC concentration ≥ 200mg/dL [13] given a prevalence of 26.71% for hypercholesterolemia, 9 had a TG concentration ≥ 150mg/dL [13] given a prevalence of 6.16% for hypertriglyceridemia. Three blood donors had risky TC/HDL index (≥ 4.5) [14] and 3 had a risky LDL/HDL index (≥ 3.0) [14] given a prevalence of 2.05% and 2.05% respectively for both risky indices. This is shown in Table 2.

***Table 2.** Prevalence of abnormal lipid profile parameters.*

Abnormal parameters	Frequency	Prevalence (%)
Hypercholesterolemia (TC ≥ 200mg/dL)	39	26.71
Hypertriglyceridemia (TG ≥ 150mg/dL)	9	6.16
Risky TC/HDL (≥ 4.5)	3	2.05
Risky LDL/HDL (≥ 3.0)	3	2.05

Table 3 shows that there was no significant difference in the mean lipid profile in male compare to female blood donors. There was a lower mean total cholesterol and LDL in males (173.86 ± 49.08mg/dL and 97.07 ± 41.46mg/dL) than in female blood donors (174.80 ± 35.99mg/dL and 98.83 ± 32.58mg/dL). The mean HDL and triglyceride in the females (60.67 ± 12.32mg/dL and 76.53 ± 32.68mg/dL respectively) was lower than that of male donors (61.37 ± 19.11mg/dL and 79.82 ± 46.98mg/dL respectively).

***Table 3.** Comparison of mean lipid concentrations (mg/dL) in female and male blood donors.*

	Bivariate analysis using t-test				
Serum lipids	Female (n = 15) mean ± SD	Male (n = 131) mean ± SD	t	df	P
TC	174.80 ± 35.99	173.86 ± 49.08	0.0923	20.500	0.9273
HDL	60.67 ± 12.32	61.37 ± 19.11	-0.1969	22.586	0.8457
LDL	98.83 ± 32.58	97.07 ± 41.46	0.1921	19.599	0.8497
TG	76.53 ± 32.68	79.82 ± 46.98	-0.3508	21.284	0.7292

Comparison of the mean serum lipid concentrations in the different age group as shown in Table 4 revealed a statistically significant difference in total cholesterol (P = 0.0127) and HDL (P = 0.0039). There was a continuous increase in the TC changing from a lower age group to another. Only the age group 50-60 years showed mean total cholesterol (232.17 ± 70.28 mg/dL) higher than what is considered normal or healthy (i.e. < 200mg/dL).

Table 4. *Comparison of mean lipid concentrations (mg/dL) by age groups amongst blood donors.*

	Age groups in years				ANOVA test		
Lipids	**21-30 (n = 58)** **mean ± SD**	**31-40 (n = 50)** **mean ± SD**	**41-50 (n = 32)** **mean ± SD**	**51-60 (n = 6)** **mean ± SD**	**df**	**F**	**P**
TC	166.74 ± 38.70	172.26 ± 50.67	178.75 ± 47.94	232.17 ± 70.28	145	3.73	0.0127
HDL	59.60 ± 13.98	61.56 ± 16.59	59.06 ± 16.77	87.50 ± 48.57	145	4.67	0.0039
LDL	93.31 ± 36.71	95.91 ± 43.90	100.66 ± 39.61	128.23 ± 47.65	145	1.46	0.2286
TG	70.71 ± 31.42	79.24 ± 51.72	95.28 ± 55.39	82.17 ± 37.66	145	2.040	0.1105

Age group 21-30 years had the lowest mean total cholesterol (166.74 ± 38.70mg/dL). For HDL age group 41-50 years had the lowest mean HDL (59.06 ± 16.77mg/dL) while age group 51-60 years had the highest mean HDL (87.50 ± 48.57mg/dL). The differences in the other serum lipids did not reach statistical significance, however there was a general increase in the mean serum levels of LDL and TG as we move from a lower age group to a higher age group. These changes in serum lipids were quantified by a regression analysis as shown in Table 5 which all reached significance (P<0.05).

Linear regression analysis of serum lipids with respect to age as shown in Table 5 revealed that a unit increase in the age of the blood donor led to an increase in TC, HDL, LDL and TG by 1.45mg/dL, 0.43mg/dL, 0.87mg/dL, and 0.96mg/dL respectively, all reaching significance (P < 0.05). After controlling for other confounders such as Sex, level of physical activity, BMI, and region of origin, significant changes were seen only for TC and HDL.

Table 5. *Regression analysis of serum lipids of blood donors by age.*

	Linear Regression			MLRC		
Serum lipids	**Coef.**	**P**	**95% CI**	**Coef.**	**P**	**95% CI**
T C	1.4529	0.002	0.5227 2.3832	1.5677	0.028	0.1698 2.9656
HDL	0.4300	0.024	0.0559 0.78600	0.6184	0.018	0.1085 1.1283
LDL	0.8660	0.035	0.0639 1.6681	0.8040	0.186	-0.3925 2.0012
TG	0.9557	0.038	0.0523 1.8592	0.7030	0.296	-0.6235 2.0296

Table 6 shows that alcohol consuming blood donors had higher TC, LDL and TG (175.46 ± 50.31mg/dL, 98.38 ± 43.44mg/dL and 83.81 ± 50.40mg/dL respectively) than non-alcohol consumers (170.21 ± 41.27 mg/dL, 94.44 ± 32.59mg/dL and 68.76 ± 28.64mg/dL). The HDL of alcohol consumers was lower (61.05 ± 16.67mg/dL) than that of non-alcohol consumers (61.93 ± 22.60mg/dL), however these differences did not reach statistical significance (P > 0.05) except for TG which showed a significant difference (P = 0.0248).

Table 6. *Comparison of mean lipid concentrations (mg/dL) in alcohol and non-alcohol consuming blood donors.*

	Alcohol Consumption		Bivariate analysis using t-test		
Lipids	**No (n = 42) mean ± SD**	**Yes (n = 104) mean ± SD**	**t**	**df**	**P**
TC	170.21 ± 41.27	175.46 ± 50.31	-0.6514	91.812	0.5164
HDL	61.93 ± 22.60	61.05 ± 16.67	0.2287	59.8583	0.8199
LDL	94.44 ± 32.59	98.38 ± 43.44	-0.5980	100.378	0.5512
TG	68.76 ± 28.64	83.81 ± 50.40	-2.2708	127.991	0.0248

Table 7. *Comparison of mean lipid concentrations (mg/dL) in Cigarette Smoking and non-smoking blood donors.*

	Smoking Status		Bivariate analysis using student's t-test		
Lipids	**Non Smokers (n = 120) mean ± SD**	**Smokers (n = 26) mean ± SD**	**t**	**df**	**P**
TC	173.55 ± 47.47	175.77 ± 50.23	-0.2054	35.3361	0.8384
HDL	61.18 ± 19.17	61.85 ± 15.27	-0.1910	43.904	0.8494
LDL	96.84 ± 39.07	99.13 ± 47.57	-0.2294	32.6984	0.8200
TG	80.37 ± 46.97	75.42 ± 39.52	0.5581	41.82	0.5797

Comparison of mean serum lipids between cigarette smoking and non-smoking blood donors did not show any statistical significance in the result (P > 0.050) for all the lipids, but there were higher mean serum lipids in smokers than in non-smokers. The mean TC, LDL, and HDL for cigarette smokers were 175.77 ± 50.23mg/dL, 99.13 ±

47.57mg/dL and 61.85 ± 15.27mg/dL respectively, while that of non-cigarette smokers were 173.55 ± 47.47mg/dL, 96.84 ± 39.07mg/dL and 61.18 ± 19.17mg/dL respectively. The mean TG of smokers (75.42 ± 39.52mg/dL) was lower than that of non-smokers (80.37 ± 46.97mg/dL).

Comparing the mean serum lipid concentrations of regular and irregular blood donors

The mean serum lipids in the overall population of blood donors were in the normal range i.e. in the range considered non risky to the development of coronary heart disease. Moreover, the mean serum concentrations of all the serum lipids were lower in the subgroup of regular donors than in the irregular donors, though results did not reach significant level. The failure to reach significance could be attributed to the low sample size. A larger study with larger sample size is required. These results were concurrent with that observed by Uche et al. in their studies on the evaluation of lipid profile of regular blood donors in Nigeria [1]. Available literature suggests that TC/HDL and LDL/HDL ratios are predictors for coronary heart diseases [14]. In this regard, the mean of both ratios were lower in the subgroup of regular blood donors than that of irregular donors, even though it did not reach significance. This finding corroborates with the observations of Uche et al. in Nigeria [1]. The lowering in TC and LDL in regular blood donors could be due to the loss of some lipids in the donated unit of blood as suggested by Uche et al. [1]. Panagiostakos et al. in their study on predictors for coronary heart disease concluded that the LDL/HDL is an important predictor for cardiac events [20]. Similarly, Kinosian et al, reported that change in LDL/HDL ratio is a better predictor for coronary heart disease than individual isolated levels [21].

The effect of age and gender on the mean serum lipid concentration of blood donors

This study also revealed a significant increase in TC, LDL and TG levels as we move from a lower age group to a higher age group. This again is consistent with a previous work done by Okęcka-Szymańska et al., 2011 in Poland and the possible explanation could be the decrease in motor activity and the tendency for a more sedentary lifestyle as one advances in age [23]. The gender difference in the lipid profile parameters could not be effectively seen as most of the blood donors were male donors (89.73%) and only 10.27% were female donors. However a study done on the same subject carried by Uche et al. in Nigeria did not show any statistical significant difference in the serum lipids of Male blood donors to that female blood donors. In this study the female blood donors had a slightly higher TC, LDL and lower TG than the male donors which was concurrent with the findings of Uche et al. [1].

Prevalence of abnormal lipid profile parameters

The prevalence of hypercholesterolemia was 26.71% and hypertriglyceridemia was 6.16%. The prevalence of hypercholesterolemia was higher than that observed by Rahlenbeck et al. in Ethiopia [22] and this seemingly high prevalence of hypercholesterolemia could be attributed to the fact that 58.90% of the blood donors had a sedentary lifestyle

and 63.7% were either overweight or obese, which in many studies have been shown to correlate with hypercholesterolemia [23, 24]. Despite the high prevalence of hypercholesterolemia in the population of blood donors, it is important to note that the prevalence of risky LDL/HDL ratio (≥ 3.0) was 2.05%, and as already explained LDL/HDL ratio is a better predictor for coronary heart disease than isolated cholesterol levels [14, 21].

Effect of alcohol consumption on the lipid profile of blood donors

Alcohol consuming blood donors showed higher TC, LDL and TG levels compared to the non-alcohol consumers. TG in particular was significantly higher in the alcoholics and this is in agreement with the work of Thinnahanumaih et al, 2012 in India [25]. Also the Higher HDL in non-alcohol consumers is in agreement with his findings. It is known that acute alcohol consumption inhibits the activity of lipoprotein lipase (LPL), the main enzyme in the metabolism of chylomicrons and VLDL which are the major forms in which TG is carried about in circulation [26]. The reduction in breakdown of chylomicrons and VLDL leads to excess TG in the system. Also alcohol increases the synthesis of large VLDL particles in the liver, which is the main source of triglycerides in the hypertriglyceridemia associated with chronic excessive alcohol intake [26]

Comparing mean lipid concentrations of smokers and non-smokers

The levels of mean serum lipids were higher in smokers than non-smokers, and this is in agreement with the studies carried out by Bharadwaj in 2005 in India, which showed that regular blood donors had a healthy lipid profile, and that the advantage was even better for non-smoking donors [6]. Smokers had higher Total cholesterol (TC) and LDL than non-smokers, which are the major culprits in the development of coronary heart disease. The slightly higher HDL in smokers could be due to the fact that, they had higher TC as a whole, and HDL is just a component of TC and also due to the very small proportion of blood donors who were smokers, so the effect of cigarette smoking could not really be seen. However cigarette smoking as a whole is known to significantly reduce an individual's HDL level [27, 28]. Also the Lower TG in smokers is inconsistent with other findings that show an association of higher TG levels in cigarette smokers compared to non-smokers [27, 29].

The general reduction of the lipid profile levels, especially total cholesterol and LDL cholesterol, which are the most incriminated in coronary heart disease has been purported to the "iron hypothesis". Which explains that as iron stores are being reduced upon regular blood donation, there is less free iron for the oxidation of LDL, which is associated with atherosclerosis [10]. These studies suggest that high iron levels play an important role in the oxidation process which is a prelude for atherosclerosis [6, 10, 15]. Other studies also suggest that by donating blood regularly, the blood becomes less viscous, due to the lowering of LDL levels and other lipids in blood, perhaps due to some loss of lipids to the donated unit and the dilution effect [1].

4. Conclusions

From the findings of this study, it can be concluded that blood donors as a whole appear to have a healthy lipid profile as reflected by their low prevalence of risky atherogenic indices and therefore might have a reduced risk of developing coronary heart disease, and this benefit seems to increase as one donates blood regularly as reflected by the lower total cholesterol, LDL, triglyceride levels and atherogenic ratios of regular blood donors compared to irregular blood donors.

Secondly, it was also found that alcohol consumption and cigarette smoking can reduce the benefit of regular blood donation to the blood donor, by impairing their lipid profile parameters such as total cholesterol, low-density lipoprotein cholesterol and triglycerides.

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