

Effects of smoking on the Lipoprotein levels among Mauritian of different ethnic groups and their preponderance to cardiovascular threats

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ABSTRACT: Disease progression and initiation has since long been known to be influenced by smoking and also genetic variability, owing to ethnic differences. Past studies conducted among Mauritian, have reported certain genetic preponderance to diseases. In the current study, effect of smoking on various cardiovascular parameters in two different ethnic groups of Mauritius was studied. Smokers and non-smokers volunteers were recruited from ethnic Asian and African population and blood sample collected by venipuncture. Myeloperoxidase, APOA1, OxLDL, HDL, TG, LDL, and cholesterol were assessed. The level of cholesterol, TG, HDL, LDL, myeloperoxidase, APO A1, and OxLDL was 5.56 ± 1.09 , 2.13 ± 1.70 , 0.67 ± 0.11 , 4.07 ± 0.93 , 145.90 ± 9.59 , 0.42 ± 0.13 and 74.55 ± 13.73 mmol/L respectively in Asian smokers. Corresponding values in African smokers were respectively 4.65 ± 0.88 , 1.17 ± 0.78 , 1.18 ± 0.42 , 2.33 ± 0.67 , 172.50 ± 15.55 , 0.47 ± 0.88 and 65.11 ± 7.38 . Results of our study indicate a significant difference ($p < 0.05$) in cardiovascular parameters between Asian and African smokers. Furthermore, Asians were also observed to be prone to dyslipidaemia. On the other hand, smoking did not seem to influence cardiovascular parameters among African smokers, but rather seemed to have an underlying genetic protective effect against the deleterious effects of smoking.

KEY WORDS: Smoking; Lipoproteins; Ethnic differences; Myeloperoxidase; Dyslipidaemia; Cardiovascular

INTRODUCTION

Smoking is socially accepted in various communities and cigarette consumption has drastically increased around the world¹. Recent study carried out by a local research body, indicated an increase in the rate of teenage smokers². Harmful effects of smoking appear at an early age, seriously affecting the brain, gastrointestinal systems, immune functioning and respiratory systems³. Dependency of smoking also develops very rapidly, which might not be expected by new consumers⁴. It has been estimated that smoking will kill about 10 million people by the year 2020, if current trend of smoking persists⁵. Smoking is associated with many unwanted

effects and can predispose one to a multitude of disease such as atherosclerosis⁶, and dyslipidaemia⁷. Cigarette smoke is also a potent source of free radicals⁸ which can also deplete scavengers of reactive oxygen species (ROS), accentuating oxidative damage⁹. The free radicals produced physiologically, have the propensity of oxidizing LDL, thereby increasing risk of atherogenicity¹⁰. Smokers generally demonstrate increased level of pseudo halide thiocyanate (SCN)¹¹, a major risk factor for cardiovascular diseases. SCN can in turn enhance the activity of myeloperoxidase by acting as a catalyst at the same and thereby leading to oxidation of LDL¹².

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Coronary heart disease is a multifactorial disease, which can be caused by both genetic and environmental factors¹³. Though CVD is a major cause of mortality and morbidity worldwide, the incidence rate varies between ethnicities¹⁴. Genetic variations can also influence the propensity for the initiating event, the progression of a clinical disease state and the trajectory of the disease¹⁵.

Mauritius being a multiethnic country carries a certain probability of genetic variation. Previous cross sectional studies indicated divergence and ethnic susceptibility among the Mauritian, influencing disease progression¹⁶. The aim of the current study was to investigate the effect of smoking on cardiovascular parameters between Asian and African ethnic groups, and a possible preponderance to CVD.

MATERIALS AND METHODS

Population sample: Study sample was taken from two ethnic groups of Mauritius: Asian and African type population depending on their country of origin. Each group included 30 smokers and 30 non-smokers. The volunteers were initially screened for any complications such as cardiovascular complications, diabetes and kidney insufficiency and any history of medication. Any volunteer with a history of hypertension or hospitalization following high blood pressure was excluded from the study. History of smoking and number of cigarettes was evaluated in each subject. Volunteers smoking more than 5 cigarettes per day were labeled as smokers. Non smokers were those who had never smoked. The population sample included volunteers aged between 25-45 years. A signed consent form was obtained from the volunteers prior to the study.

Statistical analysis: Results were interpreted by using SPSS software 10.0.

RESULTS

Cholesterol level among male smokers and non-smokers from different ethnicities:

Cholesterol is a significant marker in CVD and due to lipolysis which occurs from smoking, as discussed earlier; we decided to assess the level of cholesterol in both groups. Mean cholesterol levels in African smokers and Non smokers were 4.65 ± 0.88 and 4.40 ± 1.18 respectively. Corresponding mean values among Asian

smokers and non-smokers were 5.56 ± 1.09 and 4.33 ± 1.31 . Smoker population had a higher mean cholesterol level in both groups. Difference in cholesterol level between smokers and non-smokers from the African type population was lower in comparison to the Asian population. Smoking was observed to have a greater influence on the circulating cholesterol level among Asian smokers in comparison to the African smokers. (Figure 1)

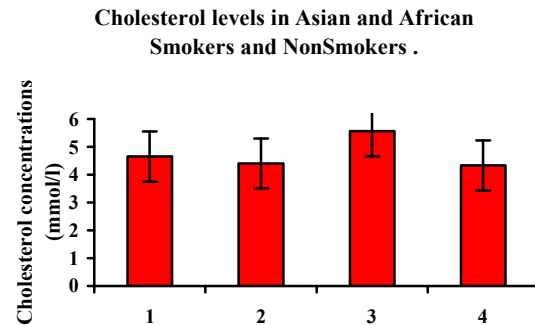


Figure 1: Trends in cholesterol levels between ethnic Mauritian African and Asian smokers population: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers

Triglycerides level among male smokers and non-smokers from different ethnicities:

Smoking is considered to affect the triglyceride level due to the secretion of catecholamines, which cause lipolysis. Genetically there may be an influence on the level of circulating triglycerides in different ethnicities. The mean circulating triglyceride level was observed to be 1.17 ± 0.75 and 1.35 ± 1.18 mmol/L respectively among African smokers and non-smokers. Corresponding values among Asian population were 2.13 ± 1.70 and 1.70 ± 1.82 respectively. TG level was observed to be lower among African smokers, in comparison to Asian smokers. Though the difference in TG was not significant, smoking was observed to influence circulating TG level among Asian smokers, which is comparatively higher with respect to the African population, predisposing Asian smokers to, predisposes Asian smokers to dyslipidaemia. (Figure 2)

Variations in Triglyceride levels in Asian and African Smokers and NonSmokers .

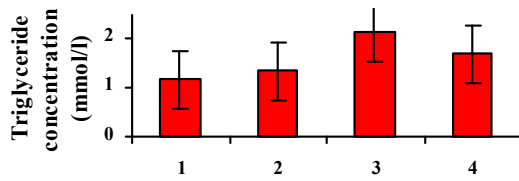


Figure 2: Trends in Triglyceride concentration between ethnic Mauritian African and Asian smokers population: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers

HDL cholesterol Level among male smokers and non-smokers from different ethnicities:

HDL is a carrier, involved in the reverse transport of cholesterol from cells to the liver. It can also be said to act as scavenger for the body cholesterol and blood wall vessel. The HDL level was measured in both communities to assess the possible genetic interplay and role of smoking on HDL expression. Among the Asian smokers and non smokers, the HDL level was observed to be 0.67 ± 0.11 and 0.92 ± 0.19 mmol/L respectively. Corresponding values in the African study population was observed to be 1.18 ± 0.42 and 1.93 ± 0.37 mmol/L respectively. Results from our study indicate that the HDL-C level was higher among the African Non smokers in comparison to Asian Non smokers. Smoking altered the circulating HDL-C in both African and Asian origin smokers, with a more obvious lowering in the Asian smokers category. (Figure 3)

HDL-C levels in Asian and African Smoker and NonSmokers .

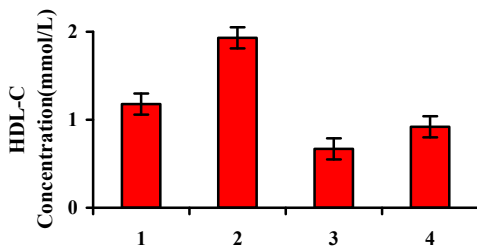


Figure 3: HDL-C levels in Asian and African smokers and Non Smokers: 1-African smokers; 2-African Non smokers; 3-Asian Smokers; and 4-Asian Non Smokers.

LDL cholesterol level among male smokers and non-smokers from different ethnicities:

LDL is rich in cholesterol and its esters and is actively involved in the delivery of cholesterol to the extra hepatic tissues and also regulates its synthesis. We investigated the role of smoking on the LDL level and also whether there was any difference in the LDL level between two ethnic groups in Mauritius. The mean LDL level in Asian smokers and non-smokers were 4.02 ± 0.93 and 2.63 ± 0.85 respectively. Corresponding values in African smokers and non-smokers were observed to be 2.33 ± 0.67 and 2.95 ± 0.75 respectively. The LDL level was significantly raised among the Asian smokers as compared to the non smokers. ($p=0.003$). On the other hand, smoking was observed to lower the level of LDL in African study population. (Figure 4)

LDL-C levels in Asian and African Smokers and NonSmokers .

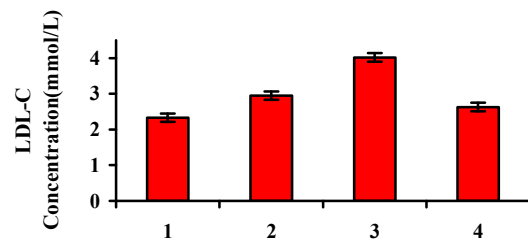


Figure 4: Chart showing the various mean concentration of LDL in African and Asian smokers and non smokers: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers.

APO- A1 level among Mauritian African and Asian male smokers and non-smokers:

APO A1 is a lipophilic apoprotein, which efficiently effluxes tissue cholesterol and, which is then esterified and eliminated by the liver. We investigate the APO A1 level in both study populations with the view to have a better picture of the mechanisms influenced by smoking. The APO A1 level in Asian smokers and non smokers was observed to be 145.90 ± 9.59 and 159.10 ± 16.08 respectively. Corresponding values in the African population was observed to be 172.50 ± 15.51 and 170.0 ± 18.0 . The APO A1 level was significantly reduced in Asian smokers in comparison to non smokers ($p=0.029$). On the other hand, African smokers

demonstrated a higher APO A1 level in comparison to the non smoker. **(Figure 5)**

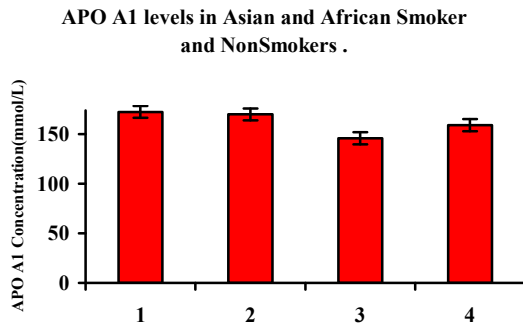


Figure 5: Chart depicting the differential values of APO A1 levels in Mauritian African and Asian smokers population: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers

Myeloperoxidase level between Mauritian African and Asian smokers and Non smokers population: Myeloperoxidase is an enzyme which is actively secreted by the phagocytes and which oxidizes the protein lipid and also the antioxidant component of LDL, which can initiate the atherosclerotic cascade. In view of the above variations, which occur between various ethnic groups, it was decided to study the possible role of smoking on the myeloperoxidase level. The level of the enzyme was observed to be 0.42 ± 0.13 and 0.32 ± 0.08 mmol/l respectively in Asian smokers and non smokers. Among African type population, enzyme level was assessed to be 0.47 ± 0.08 and 0.50 ± 0.018 respectively among smokers and Non smokers. The enzyme level was observed to be higher among Asian smokers, compared to non smokers, which was opposite among African study population. The difference in myeloperoxidase level between African and Asian non smokers was however significant. [$p=0.043$]. **(Figure 6)**

Myeloperoxidase Variations in Asian and African Smokers and NonSmokers .

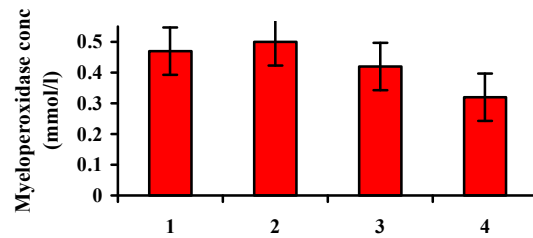


Figure 6: Trends in Myeloperoxidase concentration between ethnic Mauritian African and Asian smokers population: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers

Oxidised LDL level between Mauritian African and Asian smokers and non smokers: Oxidation of LDL is favored by oxidative stress. Based on above observations, since myeloperoxidase level was altered due to smoking, OxLDL was also quantified. The level of OxLDL was measured to be 74.57 ± 13.73 and 46.38 ± 11.87 respectively in Asian smokers and non smokers. In African study population, oxidized LDL level was 65.11 ± 7.38 and 72.25 ± 17.25 mmol/L respectively in smokers and non smokers category. Oxidation of LDL was significantly higher among the Asian population, as compared to the non smokers of same ethnicity. However, oxidation of LDL was reduced among African smokers. **(Figure 7)**

Ox LDL levels in Asian and African Smokers and NonSmokers .

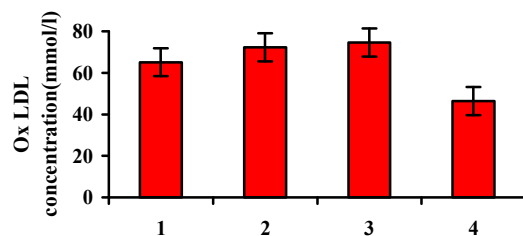


Figure 7: Chart illustrating levels of Ox LDL in Mauritian African and Asian smokers population: 1-African smokers; 2-African non smokers; 3-Asian Smokers; and 4-Asian Non Smokers

DISCUSSION

Cigarette smoking is the second cause of death in the world¹⁷. It is also responsible for 1 in 10 adult deaths or more that 4.9 millions deaths each year¹⁸. A number of adverse effects have been reported to be associated with smoking, affecting several of our physiological systems, including the cardiovascular systems, immunological systems¹⁹, and others.

Besides, cardiovascular problems are also influenced by genetic predispositions. It has been reported that African Carribeans residing in UK have a lower risk of heart disease as compared to the majority of the population²⁰. Other disparities, such as glucose intolerance, central obesity, fasting TG, have also been reported among various ethnic groups²¹.

This study was undertaken to investigate variations in lipoproteins and associated cardiovascular parameters which might exist between our local population of migrant Asians and Africans. The Cholesterol, triglyceride and LDL levels were observed to increase among the Asian smokers. Results of our study are in accordance with other works^{7,22}. However, in African type population, corresponding values among smokers dropped. Smoking is known to increase lipolysis by stimulation of the adrenal system, increasing catecholamine, and hence increasing the TG, free fatty acids and VLDL²³. Such mechanism might have led to an increase in lipolysis among Asian smokers, thereby increasing circulating TG, LDL and cholesterol level. Consequently, observed decrease in circulating TG, fatty acid and VLDL among African smoker population, implies indirectly a certain reduction in the rate of lipolysis, which might be associated to a genetic down regulation of the adrenergic nervous system, hence decreasing lipolysis and also showing a protective effect.

According to WHO recommendation, individuals with a TG level greater than 1.7mmol/L are considered dyslipidaemic. Among our study population, smoking seemed to influence dyslipidaemia among Asian smoker, which was opposite for African smokers, where as TG level was surprisingly reduced. As inferred earlier, African population seems to benefit from a certain underlying genetic effect, protecting them against deleterious effects of smoking.

HDL-C, which is an important aspect of cholesterol transfer, is known to be down regulated among smokers²⁴. In the current study, mean HDL-c level has been observed to decrease

in both Asian and African smoker category, with respect to the non smokers, which was in accordance to literature. However, the extent of decrease in HDL-c level was steeper among Asians smokers, predisposing them again to dyslipidaemia (HDL <0.9mmol/L).

APO A1 is another major efflux system for the tissue and arterial cholesterol. In the current study, APO A1 was considerably lower among Asian smokers, vis a vis non smokers, whereas African smokers demonstrated an increase in APO A1 level. Reduction in the APO A1 level can be a severe threat to lipid deposition in cells and arteries, predisposing to atherosclerosis. It is obvious from the trend of our results that Asian smokers may be more prone to atherosclerosis compared to African smokers.

Smoking is an established source of free radicals physiologically²⁵. Excess free radicals increases oxidative stress and thus all associated complications, such as atherogenesis, endothelium damage and lipid oxidation^{26,27}. In the current study, similar trend was observed among Asian smokers, but African smokers seem to be benefited with a decrease in OxLDL level, among the African study population. Myeloperoxidase, which is also actively involved in oxidative stress, is observed to increase among Asian smokers and correspondingly reduced among African smokers. This again explains a certain protective effect conferred in African population, probably by a certain genetic interplay. It may be possible, that genetically, there may be a down regulation of the myeloperoxidase enzyme expression, decreasing oxidation of LDL, and up regulation of APO A1, thereby protecting against deleterious effects of oxidants. By contrast, such a protective mechanism is not existent among Asians.

Biochemical parameters tend to be negatively influenced among Asian smokers, which is opposite among ethnic African populations. Observations from our study could also explain previously reported high cardiovascular mortality rates in Asians in comparison to other ethnicities²⁸

CONCLUSION

Smoking, owing to its free radical potential, is a serious risk factor for several complications such as cardiovascular threats, age dependent macular degeneration and others. Ethnicity has also been advocated to be a strong contender to disease progression. In the current study, it has been observed that there is an obvious disparity

between the two studied ethnic groups. Ethnicity implies a difference in genetic predisposition and thus a difference in physiology. The Asian type population, were observed to be more prone to cardiovascular threats as observed by the consequent alteration in the cardiovascular parameters, as a result of smoking. The Asian type populations, both smokers and non smokers, were however prone to smoking, which can be accounted by their lifestyle. By contrast, smoking among the African type population did not negatively alter the cardiovascular parameters, but however, certain parameters, were observed to be below normal range (e.g. a lowering of the LDL level). This only implies a probable genetic adaptation and protection, which might be prevalent among the African type population but not among the Asian population, thus conferring protection to the former against the deleterious consequences of smoking. The molecular mechanism leading to such disparity needs to be studied and a larger sample size study is warranted.

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