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Research Article

Lipid Profile Alterations and Cardiovascular Risk among Automobile Mechanics Chronically Exposed To Petroleum Products

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Abstract

Objectives : This study assessed the impact of petroleum product exposure on lipid profiles in thirty-eight automobile mechanics compared to fifteen age-matched controls (students aged 20–28 years from the University of Benin). Lipid parameters analyzed included total cholesterol (T-Chol), triacylglycerols (TAG), high-density lipoprotein (HDL), cholesterol, low-density lipoprotein (LDL), cholesterol, very-low-density lipoprotein (VLDL), cholesterol, and phospholipids.

Methods : Blood samples were collected from thirty-eight male automobile mechanics in Benin City as well as 400-level Biochemistry students at the University of Benin following their consent to participate voluntarily. Enzymatic and precipitant methods were employed for lipid quantification. .

Results : Mechanics exhibited significant increases in T-Chol and LDL cholesterol levels ($p < 0.05$), alongside reductions in HDL cholesterol, VLDL cholesterol, TAG, and phospholipids, compared to controls. Regression analyses revealed that the length of service was significantly correlated with total cholesterol ($p < 0.05$), suggesting a cumulative effect of exposure over time. In contrast, age, weight, and height showed no significant correlations with lipid parameters.

Conclusion : These findings indicate that prolonged occupational exposure to petroleum products disrupts lipid metabolism, potentially predisposing workers to cardiovascular diseases. This study underscores the need for regular health monitoring of exposed workers and implementation of occupational safety measures, including protective equipment and exposure mitigation strategies. Further research is required to explore the long-term health consequences of these lipid disturbances and their potential progression to cardiovascular diseases. The results emphasize the critical need for effective public health interventions to safeguard workers in petroleum-related industries.

Keywords: Cholesterol; Petroleum; Automobile mechanics; Occupational; Exposure; Protective.

INTRODUCTION

Petrol and other petroleum-based fuels contain complex mixtures of aliphatic and aromatic hydrocarbons. Mechanics are continuously exposed to these biohazards, which have been observed to cause various health issues, including renal failure and glomerulonephritis with prolonged exposure [1,2]. Such exposure can occur through inhalation, skin contact, and occasional ingestion, leading to a high tendency to develop hyperlipidemia-related problems [3]. Inhalation of petroleum products can either be accidental or intentional. Inhalant abuse, the deliberate inhalation of hydrocarbon as a form of recreational drug use, has become a significant issue affecting children and adolescents [4]. Their ready availability, affordability, and easy usage is a major contribution to this problem. Inhalation is mostly acquired by sniffing, huffing and bagging [5]. Incidents of sudden death of undiagnosed causes are becoming alarming in our society as sudden death is linked to the misuse of volatile substances [3,5,6].

The health and environmental risks associated with petroleum products have been explored through studies conducted over the past decades [1]. However, many of these studies are outdated, relying on older fuel types and lacking modern inhalation exposure assessments. Furthermore, the level of detail in hazard and exposure data is insufficient by today's standards [1]. Human data on these risks remain scarce, and the limited research available is often inaccessible to vulnerable populations. This research aims to evaluate the effects of petroleum product exposure on the lipid profiles of automobile mechanics and examine the relationship between the duration of exposure and lipid profile alterations.

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MATERIALS AND METHODS

Collection of Samples

Blood samples were collected from thirty-eight (38) male automobile mechanics in Benin City, Edo State, Nigeria, who are involved in car repair. Consent was obtained from the participating volunteers, and questionnaires were administered to record their age, weight, height and length of service. Additionally, fifteen (15) blood samples were collected from 400-level Biochemistry students at the University of Benin to serve as control.

Sample Preparation

Blood samples were collected in appropriate containers: 10 *ml* of whole blood from subcutaneous veins after disinfecting with methylated spirit. About 6 *ml* was dispensed into the main container, and 2 *ml* each into lithium heparinized and EDTA containers. For serum preparation, blood in plain containers was left at room temperature for 45 minutes, centrifuged at 3500 rpm for 10 minutes, and the serum was separated using an aspirator.

Biochemical Estimations

Total cholesterol was determined using Richmond's enzymatic endpoint method [7]. HDL/LDL Cholesterol was determined using the precipitant method described by Jacobs [8]. Triglyceride level was determined using the Glycerol-3 phosphate oxidase-p-aminophenazone (GPO-PAP) method described by Tietz [9]. Phospholipids were determined using the Trinder method [10]. LDL Cholesterol Calculation was done according to Fridwal's equation [11]: Total cholesterol – (Triglyceride/5) - HDL cholesterol, while VLDL Cholesterol Calculation was done as Total cholesterol - (HDL + LDL).

RESULTS

The automobile mechanics' serum levels of total cholesterol, triacylglycerol, HDL cholesterol, LDL cholesterol, VLDL cholesterol, and phospholipids were compared to the control group. The data showed significant differences in lipid profiles between mechanics and controls.

Table 1 shows the Serum levels of lipid parameters. Table 2 shows the Regression of age over lipid parameters. Table 3 shows the Regression of weight over lipid parameters. Table 4 shows the Regression of length of service over lipid parameters. Table 5 shows the Regression of height over lipid parameters. Table 6 shows the Correlation of age, weight, length of service, and height over lipid parameters.

The data in Table 1 suggest that mechanics exposed to petroleum products experience significant changes in lipid profiles compared to non-exposed controls. These include higher total and LDL cholesterol levels, reduced triglycerides, VLDL, phospholipids, and elevated HDL cholesterol. These alterations indicate a potential increased risk of cardiovascular disease and metabolic disruptions associated with chronic petroleum exposure.

The regression analysis indicates that age significantly correlates only with total cholesterol (T-Chol), showing a weak positive relationship. Other lipid parameters, including TAG, HDL, LDL, VLDL, and phospholipids, show no significant association with age. This suggests that age-related changes in lipid profiles in the test group are primarily reflected in total cholesterol levels.

The analysis shows that weight is significantly correlated only with total cholesterol (T-Chol), with a weak positive relationship. Other lipid parameters, including TAG, HDL, LDL, VLDL, and phospholipids, show no significant associations with weight, although weak negative or positive correlations are observed. This suggests that among lipid parameters, weight-related changes are primarily reflected in total cholesterol levels.

The regression analysis reveals no significant relationships between length of service and any lipid parameters. However, there are observable moderate correlations for total cholesterol (positive), and phospholipids (negative), which may warrant further investigation in larger sample sizes or different populations. These trends suggest possible cumulative effects of prolonged exposure to petroleum products, though they are not statistically conclusive based on this data.

The analysis reveals that height significantly correlates with total

Table 1: Serum levels of lipid parameters

	T-Chol (*mgldl*)	TAG (*mgldl*)	HDL-chol (*mgldl*)	LDL-Chol (*mg/dl*)	VLDL (*mgldl*)	PHOSP (*mg/dl*)
Control	174.40±11	188.46±18	46.06±40	92.40+90	36.26±30	300.86±5
Test	198.78±11	106.92±40	106.89±10	107.15±10	21.10+10	117.42±60

Table 2: Regression of age over lipid parameters

PARAMETER	T-Chol	TAG	HDL-chol	LDL-chol	VLDL	PHOSP
Test (t)	2.272	0.757	0.026	-1.053	-0.609	0.225
Significant (p)	0.030[b]	0.455[a]	0.980[a]	0.301[a]	0.547[a]	0.823[a]
Correlation (r)	0.170	0.024	-0.059	-0.082	-0.026	-0.066

*Values carrying "a" are not significant, while those carrying "b" are significant

Table 3: Regression of weight over lipid parameters

PARAMETER	T-Chol	TAG	HDL-Chol	LDL-Chol	VLDL	PHOSP
Test (t)	2.840	0.48 1	0.090	-1.399	0.372	-1.572
Significant (p)	0.008[b]	0.634[a]	0.929[a]	0.172[a]	0.712[a]	0.126[a]
Correlation (r)	0.111	0.091	-0.198	-0.205	0.114	-0.222

*Values carrying "a" are not significant, while those carrying "b" are significant

Table 4: Regression of length of service over lipid parameters.

PARAMETER	T-Chol	TAG	HDL-Chol	LDL-Chol	VLDL	PHOSP
Test (t)	1.829	-0.122	0.063	-0.400	-0.173	-1.494
Significant(p)	0.077[a]	0.903a	0.950[a]	0.692[a]	0.864[a]	0.145[a]
Correlation (r)	0.363	-0.141	0.199	0.204	-0.174	-0.319

Table 5: Regression of height over lipid parameters

PARAMETER	T-Chol	TAG	HDL-Chol	LDL-Chol	VLDL	PHOSP
Test (t)	1.829	-0.122	0063	-0.400	-0.173	-1.494
Significant (p)	0.039[b]	0.592[a]	0.570[a]	0.098[a]	0.739[a]	0.323[a]
Correlation (r)	0.98	-0.022	-0.132	-0.175	-0.041	-0.162

*Values carrying "a" are not significant, while those carrying "b" are significant

Table 6: Correlation of age, weight, length of service, and height over lipid parameters

		T-Chol	TAG	HDL-Chol	LDL-Chol	VLDL	PHOSP
Age	Pearson correlation	1.170[a]	0.024[a]	-0.059[a]	-0.082[a]	-0.026[a]	-0.066[a]
	sig. (2 tailed)	0.307	0.888	0.725	0.725	0.875	0.695
	N	38	38	38	38	38	38
Weight	Pearson correlation	0.111[a]	0.024[a]	-0.059[a]	-0.082[a]	-0.026[a]	-0.066[a]
	sig. (2 tailed)	0.507	0.0588	0.231	0.217	0.494	0.181
	N	38	38	38	38	38	38
Length of service	Pearson correlation	0.363[b]	-0.141[a]	-0.199[a]	-0.204[a]	-0.174[a]	0.319[a]
	sig. (2 tailed)	0.025	0.398	0.431	0.219	0.297	0.051
	N	38	38	38	38	38	38
Height	Pearson correlation	0.098[a]	-0.022[a]	-0.132[a]	-0.175[a]	-0.041[a]	-0.162[a]
	sig. (2 tailed)	0.560	0.897	0.431	0.292	0.808	0.323
	N	38	38	38	38	38	38

*Values carrying "a" are not significant, while those carrying "b" are significant

cholesterol, showing a strong positive relationship. Other lipid parameters, including triglycerides, HDL, LDL, VLDL, and phospholipids, do not exhibit significant associations with height, although weak correlations (both positive and negative), are observed for some parameters. This suggests that height may influence total cholesterol levels, but its impact on other lipid measures is minimal.

Data from Table 6 suggests that age and weight do not show significant relationships with lipid parameters. However, length of service significantly correlates with total cholesterol, suggesting that longer exposure to petroleum products may influence cholesterol levels. The correlation with phospholipids is also weak but approaches significance, while height does not significantly correlate with lipid parameters.

DISCUSSION

Automobile mechanics are continuously exposed to petroleum products, which can cause high levels of intoxication and are crucial for various metabolic processes [1]. Petroleum products' toxicity increases with prolonged exposure [12,13], and factors such as age, weight, height, and length of service influence the degree of intoxication [14].

The present study aimed to investigate the impact of petroleum product exposure on lipid profiles among automobile mechanics. The results indicate that exposure to petroleum products significantly alters lipid metabolism, with marked increases in total cholesterol (T-Chol) and low-density lipoprotein (LDL) cholesterol levels, accompanied by decreases in high-density lipoprotein (HDL) cholesterol, very-low-density lipoprotein (VLDL), triacylglycerols (TAG), and phospholipids compared to the control group. These findings suggest that occupational exposure to petroleum products may predispose workers to cardiovascular diseases, as these lipid changes are indicative of dyslipidemia, a known risk factor for atherosclerosis and other cardiovascular pathologies [15-17].

This study observed a significant increase in serum total cholesterol and LDL cholesterol and a significant decrease in HDL cholesterol, VLDL cholesterol, triacylglycerol, and phospholipids compared to controls. One of the key observations in this study was the significant positive correlation between length of service and total cholesterol levels, which further suggests that prolonged exposure to petroleum products may lead to persistent lipid disturbances. While the correlation with phospholipids approached significance, it did not achieve the threshold for definitive conclusions. These results emphasise the cumulative effect of long-term exposure to hazardous substances in the workplace and the potential for this exposure to alter lipid homeostasis over time [18].

Interestingly, age, weight, and height did not show significant associations with lipid parameters in this study, which contrasts with typical findings in broader populations where these factors and other lifestyle factors are often linked to changes in lipid profiles [19,20]. The lack of correlation could indicate that, within this specific occupational group, the primary determinant of lipid disturbances is exposure to petroleum products rather than demographic factors such as age or weight. This observation highlights the importance of occupational exposures in shaping the health outcomes of workers, particularly in environments where hazardous chemicals are prevalent [21,22].

The health implications of these findings are noteworthy. Elevated total cholesterol, LDL levels, and reduced HDL cholesterol are well-established risk factors for cardiovascular diseases, including coronary artery disease [23]. Due to their continuous exposure to petroleum products, the findings suggest that automobile mechanics may be at an increased risk of developing these conditions over time. Reducing protective lipid fractions, such as HDL and VLDL cholesterol, further supports the hypothesis that petroleum product exposure disrupts lipid metabolism and may contribute to atherosclerotic processes [24].

Moreover, these results underscore the importance of regular monitoring and preventive measures in workplaces with high exposure to petroleum products. Given the cardiovascular risks associated with altered lipid profiles, it is essential that such workers undergo periodic health screening to detect early signs of dyslipidemia and related disorders. Implementing workplace interventions, such as using personal protective equipment and exposure reduction strategies, could also mitigate the potential health risks posed by continuous contact with these hazardous substances [25].

While this study contributes to understanding the lipid profile alterations resulting from petroleum product exposure, several limitations warrant further investigation. Future research should explore the long-term health effects of these lipid changes, particularly how they contribute to the development of cardiovascular diseases over time. Additionally, the study's relatively small sample size may limit the generalizability of the results, and more extensive, multi-centre studies would be beneficial in confirming these findings and further elucidating the mechanisms underlying the observed lipid disturbances [12,13,26].

However, the findings from this study highlight the significant impact of petroleum product exposure on lipid profiles among automobile mechanics, suggesting an increased risk for cardiovascular diseases. The alterations in lipid profiles suggest that continuous occupational exposure to petroleum products increases the risk of lipid profile changes and associated cardiovascular diseases. Age, weight, height, and length of service may serve as indicators of the extent of intoxication from petroleum exposure. These alterations in lipid metabolism underline the importance of targeted occupational health interventions and further research to fully understand the long-term health implications of exposure to petroleum products. It is crucial to implement protective measures and routine clinical check-ups to monitor and mitigate the health risks faced by automobile mechanics.

CONCLUSION

This study demonstrates that prolonged exposure to petroleum products among automobile mechanics leads to significant alterations in lipid profiles, including increased total cholesterol and LDL levels and decreased HDL, VLDL, triacylglycerols, and phospholipids with a length of service being a crucial factor in assessing the degree of intoxication. These changes suggest a higher risk for cardiovascular diseases. Continuous occupational exposure to petroleum products increases the risk of lipid profile alterations and associated cardiovascular diseases. The findings highlight the importance of regular health monitoring and preventive measures, such as protective strategies in the workplace, to mitigate health risks. Implementing these measures will help in the early detection and prevention of potential health issues arising from prolonged exposure to petroleum products. Future research should explore the long-term health consequences of these lipid changes and their link to cardiovascular diseases in exposed workers.

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AUTHOR CONTRIBUTIONS

B.K.E and O.O.J conceived the idea for this research and proposed the research design. B.K.E and O.O.J supervised the research and were major contributors to writing the original manuscript. B.K.E and O.O.J conducted the experiment, and I.H.E analysed and interpreted the research data. O-E.U and O.O.J critically reviewed the revised manuscript and were major contributors to editing it. All authors read and approved the final manuscript.

DATA AVAILABILITY

Data will be provided on reasonable request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval was obtained from the Faculty of Life Sciences Ethical Committee, and consent was sought from the participants.

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