**Exploring Lipid Levels as Indicators of Cardiovascular Risks in a University’s Executive staff: A Case Study at Rivers State University, Nigeria**

**Abstract**

**Introduction:** Executive staff, are the senior administrative and academic officers responsible for overall management of the university. These group of officers are at risk of developing abnormal lipid profile, which a major risk factor developing cardiovascular disease (CVD), due to occupationally related stress and sedentary lifestyles. This research was designed to explore the status of lipid parameters of executive staff in Rivers State University. **Materials and Methods:** A total of two hundred executive staff, ranging from administrative to senior academics enrolled for this study and blood samples were obtained from all participants who indicated interest to participate in the study and also qualified in the inclusion criteria. Serum triglyceride (TG), total cholesterol (TC), high density lipoprotein cholesterol (HDL Cholesterol) was analyzed spectrophotometrically with kits obtained from Spectrum Diagnostics employing manufacturers instructions, while Low density lipoprotein cholesterol (LDL cholesterol) was calculated using the Friedewald’s equation. BMI was determined by calculation from height and weight of participants, while the blood pressures were determined using automatic blood pressure kit. The results were analyzed with SPSS version 24. Mean values were considered statistically significant when p<0.05. **Results:** The mean value of total cholesterol, triglyceride, high density lipoprotein cholesterol and low-density lipoprotein Cholesterol levels were 4.37±1.04mmol/L 0.78±0.55mmol/L, 1.65±0.44mmol/L and 2.47±1.15mmol/L respectively for male and 4.56±0.79mmol/l, 0.72±0.79mmol/l, 1.65±0.55mmol/l and 2.50±0.90mmol/l respectively for women. There were no significant differences when males were compared with females. However, when the participants were grouped into age bracket, the middle aged and the older participants had significant elevation in total cholesterol (p=0.04), triglyceride (p=0.003) and LDL (p=0.04). Furthermore, when the BMI of the participants were grouped into normal weight, overweight and obese, the triglyceride was significantly elevated in the overweight and the obese participants (P=0.03). The total cholesterol (P=0.007) and the triglyceride (P=0.001) were significantly elevated in participants with high blood pressure. **Conclusion**: The results of this research have shown the incidence of dyslipidemia in the executive staff of Rivers State University. Based on these findings, we advocate for life style modifications such as regular exercise, healthy dieting and regular medical checks among the study population in order to prevent and manage unhealthy lipid profile levels.

**Key words:** Lipids, Dyslipidemia, HDL Cholesterol, LDL Cholesterol, Triglycerides

**Introduction**

Lipids play essential role in metabolism as they help in energy storage, cell signaling, and also acting as structural components of cell membranes. Abnormal lipid metabolism results in dyslipidemia which is characterized by altered levels of lipid components, including high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides, in the blood.

Elevated levels of low-density lipoprotein cholesterol and triglycerides, coupled with low levels of high-density lipoprotein cholesterol, are indicative of dyslipidemia (1, 2). Dyslipidemia is most often asymptomatic, but it is a major and independent modifiable risk factor for cardiovascular disease. It encompasses a group of metabolic disorders typically marked by elevated total cholesterol (TC), increased low-density lipoprotein cholesterol (LDL-c), heightened triglycerides (TG), and/or reduced high-density lipoprotein cholesterol (HDL-c).

These conditions result in a sustained increase in plasma cholesterol and triglyceride levels (3). Elevated blood cholesterol is a major risk factor for heart disease and stroke, significantly contributing to the global burden of ischemic heart disease (4). High levels of low-density lipoprotein cholesterol (LDL-c) are strong predictors of atherosclerotic cardiovascular disease (ASCVD), and LDL-c-lowering therapies have consistently been shown to reduce cardiovascular disease (CVD) risk across various populations (5). CVDs remain the leading cause of death worldwide, accounting for more annual fatalities than any other condition (6).

Elevated blood cholesterol levels have been associated with a heightened risk of coronary heart disease (CHD), stroke, and peripheral arterial disease. The Global Burden of Disease Project reported that in 2015, high total cholesterol contributed to 4.3 million deaths worldwide and accounted for 88.7 million disability-adjusted life years. (7). The global burden of high total cholesterol is increasing, likely due to aging populations and the adoption of Westernized diets.

The nature of job of these executive staff, predisposes them extended work hours, decreased physical activity, and poor dietary choices, including junk food and sugary beverages (8). It has been reported that mental and job-related stress (9) can contribute Increased low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels, coupled with reduced high-density lipoprotein cholesterol (HDL-C) levels a typical case of dyslipidemia which results in coronary artery disease, a type of cardiovascular disease. Because coronary heart disease (CHD) has been reported as major cause of death in developed countries and recently in developing countries, Efforts to reduce the incidence of CHD risk is a significant public health issue (10). Dyslipidemia has been identified as a key modifiable risk factor in the onset and progression of coronary heart disease (CHD) (10) Epidemiological studies have shown that reduced cholesterol levels, especially lower low-density lipoprotein cholesterol (LDL-C), are linked to a decreased risk of CHD-related illness and mortality. Therefore, assessing the lipid profile of these officers is a vital diagnostic tool that can provide critical insights into an individual's cardiovascular health. These parameters not only help in early detection of abnormalities but also guide clinicians in tailoring interventions such as dietary modifications, lifestyle changes, and pharmacological treatments. This study aims to examine lipid levels as key indicators of cardiac health within the study population.

**2. Methodology**

**2.1 Experimental Design**

This observational study follows a prospective cohort design and is conducted among executive staff of Rivers State University, Port Harcourt, Rivers State. A total of two hundred executive staff were involved in the study and ethical approval for the research was obtained from the Office of the Research and Ethics Committee of the Rivers State Health Management Board. Oral consent was obtained from all participating staff and a well-structured questionnaire was employed to collect important information from the participants.

**2.2 Sample Collection**

Six milliliters of fasting blood was obtained aseptically from all participants and dispensed into plain sample bottle and allowed to stand for one hour at room temperature for complete clot retraction. The sample were then spun at 3500 rpm for 10 minutes and serum separated, and stored frozen until analysis is done.

**2.3 Sample Analysis**

A total number of two hundred serum samples were analyzed, by the enzymatic methods for determination of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-cholesterol), using diagnostic kits obtained from Spectrum Diagnostics Egypt. Thereafter, the values for low density lipoprotein cholesterol (LDL) were calculated by applying the Friedewald formula (11).

**2.4 Height/Weight determination**

Participants weight was determined using an AccuSure Classic Retro Style Analog Mechanical Personal Weighing Scale with Zero Adjuster and results of weight expressed in kilogram, while the height was determined using a measuring tape with the participants standing erect, without shoes and backing the investigator. Height was expressed in meter.

**2.5 BMI Measurement**

The BMI was determined by calculation using the appropriate formula Kg/m2

**2.6 Blood pressure**

The blood pressure of the participants was determined using a mercury sphygmomanometer.

**2.8 Statistical Analysis**

Statistical analysis was performed with t=- Test using SPSS version 24, with data presented as Mean ± Standard Deviation (SD). A 95% confidence interval (p ≤ 0.05) was used to determine statistical significance.

**3. Results**

3.1 Demographic characteristics of the participants (n=200)

The demographic characteristics of the participants (n=200) revealed a relatively even distribution of age groups, with 46% of participants falling within the 35-40 age range, followed by 20% in the 51 and above age range. The sample comprised 46% males and 54% females. In terms of faculty affiliation, the majority of participants (32%) were from the University Administration, followed by faculty of science (20%) then College of Medicine (16%), Faculty of Engineering (14%), while Faculty of Education (10%) and lastly Faculty of Environmental Science (8%).

**Table 1: Demographic characteristics of the participants (n=200)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age |  | N | % |  |
|  | 35-40 | 92 | 46 |  |
|  | 41-45 | 36 | 18 |  |
|  | 46-50 | 32 | 16 |  |
|  | 51-60 | 40 | 20 |  |
|  |  |  |  |  |
| Sex  | Male | 92 | 46 |  |
|  | Female  | 108 | 54 |  |
|  |  |  |  |  |
| Faculties  | Faculty of Science  | 40 | 20 |  |
|  | Faculty of Environmental Science  | 16 | 8 |  |
|  | Faculty of Engineering  | 28 | 14 |  |
|  | College of Medical Science  | 32 | 16 |  |
|  | Faculty of EducationAdministrative staff  | 2064 | 1032 |   |

The results of the comparative analysis of lipid parameters among males and females are presented in Table 2. The results revealed that there is no significant difference in the mean values of TC, TG, HDL, and LDL among male and female participants in this study.

**Table 2: Mean Lipid profile compared by gender**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gender | Total cholesterol (mmol/L) | Triglycerides (mmol/L) | High density lipoprotein cholesterol (mmol/L) | Low density lipoprotein cholesterol (mmol/L) |
| Male | 4.37±1.04 | 0.78±0.55 | 1.65±0.44 | 2.47±1.15 |
| Female  | 4.56±0.79 | 0.72±0.79 | 1.65±0.55 | 2.50±0.90 |
| T-test | -0.721 | 0.495 | 0.036 | 0.084 |
| P-value  | 0.284 | 0.220 | 0.235 | 0.544 |
| Remark  | NS | NS | NS | NS |

*Legend: S= Significant, NS= Not Significant,*

The results of the comparative analysis of lipid profile parameters across different age groups are presented in table 3. The middle and upper age group have significantly elevated total cholesterol, triglyceride and low density lipoprotein cholesterol when compared with the lower age group

**Table 3 Mean lipid profile compared by age groups**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total cholesterol (mmol/L) | Triglycerides (mmol/L) | High density lipoprotein cholesterol (mmol/L) | Low density lipoprotein cholesterol (mmol/L) | Total cholesterol (mmol/L) |
| 35-40 | 4.324±0.826 | 0.76±0.38 | 1.593±0.598 | 2.33±0.806 |
| 41-45 | 4.0875±1.14 | 0.545±0.245 | 1.755±0.367 | 2.09±1.271 |
| 46-50 | **5.19±0.796** | **1.02±0.736** | **1.65±0.517** | **3.08±1.206** |
| 51-60 | **5.24±0.98** | **1.34±0.418** | **1.60±0.242** | **3.04±0.970** |
| P-value  | 0.04 | 0.03 | 0.588 | 0.040 |
| Remark  | S | S | NS | S |

*Legend: S= Significant, NS= Not Significant.*

The comparative analysis of the lipid profile parameters across different BMI categories are shown on table 4. The results show a marked elevation in values of triglycerides (TG) across the different BMI categories (p = 0.003), but there was no difference in the other parameters measured.

**Table 4 Mean lipid profile compared by BMI**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total cholesterol (mmol/L) | Triglycerides (mmol/L) | High density lipoprotein cholesterol (mmol/L) | Low density lipoprotein cholesterol (mmol/L) | Total cholesterol (mmol/L) |
| 18.5-24.9 | 4.563±1.04 | 0.680±0.34 | 1.708±0.39 | 2.481±1.028 |
| 25-29.9 | **5.2±0.94** | **1.1±0.36** | **1.63±0.52** | **3.07±0.876** |
| ≥30.0 | **5.4±0.71** | **1.21±0.61** | **1.81±0.34** | **3.04±1.18** |
| P-value  | 0.570 | 0.003 | 0.557 | 0.230 |
| Remark  | NS | S | NS | NS |

*Legend: S= Significant, NS= Not Significant.*

The comparative analysis of the lipid profile parameters across different blood pressure categories are shown on table 5. The results revealed a significant difference in the mean values of total cholesterol and triglycerides across the different blood pressure categories (p< 0.0076) and (p < 0.001) respectively while there was no significant difference in the values of high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol across the different blood pressure categories (p > 0.05). However, the LDL cholesterol has an upward trend in the blood pressure of 180/120, a typical case of hypertension.

**Table 5 Mean lipid profile compared by blood pressure ranges**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total cholesterol (mmol/L) | Triglycerides (mmol/L) | High density lipoprotein cholesterol (mmol/L) | Low density lipoprotein cholesterol (mmol/L) | Total cholesterol (mmol/L) |
| 120/80 | 4.109±0.97 | 0.894±0.484 | 1.625±0.442 | 2.249±0.828 |
| 139/89 | 4.367±0.933 | 0.923±1.597 | 1.674±0.490 | 2.497±0.970 |
| 180/120 | **5.700±0.424** | **1.100±0.424** | **1.860±0.297** | **2.815±0.374** |
| P-value  | 0.007 | 0.001 | 0.77 | 0.06 |
| Remark  | S | S | NS | NS |

*Legend: S= Significant, NS= Not Significant.*

**4. Discussion**

The lipid profile of executive staff of Rivers State University has been studied in six major units of the university, comprising of Faculty of Science, Environmental Science, Engineering, Education, College of Medicine and Administrative staff. Participants are aged between 35 and 60 years, with 92 males and 102 females. This study was aimed at assessing the levels of lipid profile parameters in addition to the body mass index and blood pressure in the executive staff of Rivers State University. The mean result as interpreted by The National Cholesterol Education Program Adult Treatment Panel III Guidelines (12), and (13) show a normal lipid profile. This result is not in agreement with the report of (1) and (14) who reported a dyslipidemia in their subjects. However, when the participants were sorted into groups, a case of dyslipidemia was observed, this finding now corroborates the results of (1), (14); and (15). When the results were sorted into sex, (Table 2) the result show a higher lipid trend with females (16), (17) & (1). The results of this study agree with the report of (18) on assessment of workers Lipid Profile in cement factories on which they reported a significant difference between the lipid profile between genders, however the disparity in this study was not statistically different as reported by (1). It was earlier thought that hormonal changes can contribute to the variations in lipid parameter levels among males and females, however the report of (17) showed that it is not just the hormone, but some unclear physiologic actors. When the participants were separated based on age bracket, the results as presented in table 3 show that the mean values of lipid profile parameters were found to vary across the age groups, it was observed that age groups 46-50 and 51-60 show a clear case of dyslipidemia expressing as combined hypercholesterolemia with elevated total cholesterol and LDL cholesterol and triglycerides. This finding is in consonance with the report of (19) and (20). It also agrees with the report of (21) who reported a significant change in lipid profiles with advancing age. The results of this study were further analyzed with respect to BMI categorized into normal, overweight and obese (table 4). The BMI of normal participants has relatively normal lipid profile when compared to the overweight and obese, who has elevated levels of triglycerides. These results agree with the findings of (22); (23); (18) and many others who reported a positive correlation between BMI and lipid profiles, especially increased total cholesterol, triglyceride and LDL cholesterol. This study also explored the lipid profile status associated to different blood pressure ranges (table 5). We observed a dyslipidemia in participants with elevated blood pressure. This findings agree with the results of (24), (25) and (26). It also agrees with the report of (27) on which they reported a positive association between blood pressure and lipid profile parameters. The reason for the significant increase in the level of TC and TG may be associated to health complications, because the TC and TG level increases with blood pressure therefore highlighting the importance of considering lipid profile and blood pressure in cardiovascular risk assessment.

Prevention of CVD entails reducing TC levels below currently accepted "normal" thresholds, concomitantly leading to additional lowering the risk of CHD and stroke (28). Individuals with higher HDL-C levels tend to have a lower risk of CVDs, whereas those with reduced HDL-C levels are at heightened risk of heart disease (29). In contrast, LDL-C plays an important role in delivering fat molecules to cells, but can contribute to atherosclerosis development if oxidized within arterial walls (2). Although LDL-C is often labeled as "bad cholesterol," recent research suggests that this label may be misleading, as LDL particles appear harmless until oxidized by free radicals within blood vessel walls (30). Consuming antioxidants and minimizing exposure to free radicals may help reduce LDL-C's contribution to atherosclerosis, although the evidence remains inconclusive.

Elevated triglycerides in the bloodstream has been associated with an increased risk of atherosclerosis, stroke and other forms of heart disease in humans (31). The risk associated with high TG levels is partly attributed to a strong inverse relationship between TG levels and HDL-C. TG levels typically remain elevated for a period after eating, making fasting for 8-12 hours necessary for accurate testing. The American Heart Association recommends maintaining optimal TG levels of 1.1 mmol/L or lower to promote heart health (31). Elevated TG levels are a key feature of metabolic syndrome, a collection of conditions that includes central obesity, hypertension, elevated blood sugar, and elevated cholesterol levels. Some medications, such as birth control pills, beta-blockers, diuretics, and steroids, can contribute to increased TG levels. Conversely, conditions associated with malnutrition, including cancer, cognitive decline, depression, and trauma, may deplete body fat, leading to low TG levels (32).

**5. Conclusion**

This study assessed the lipid profile parameters of some executive staff of Rivers State University, revealing dyslipidemia, particularly hypercholesterolemia. The study revealed an elevated lipid level in overweight and obese subjects as well as participants of middle age and above. Furthermore, individuals with hypertension tend to show elevated lipid levels. These findings corroborating with previous studies in different populations have implications for the prevention and management of cardiovascular diseases among the university's executive staff, highlighting the need for regular health checks, healthy lifestyle modifications, and targeted interventions to address modifiable risk factors. Although age is a non-modifiable risk factor, efforts can be diverted to the modifiable risk factors in other to prevent incidences of dyslipidemia and the adverse health effects.

**Ethical Approval and Consent:**

Ethical clearance and approval were obtained from the Health Research Ethics Committee of Rivers State Health Management Board, Ministry of Health Port Harcourt with approval number: RSHMB/RSHREC/2024/096. All participants were informed of what is expected from them and their rights. Verbal informed consent was obtained from each participant, and the researcher adhered to the ethical principles outlined in the World Medical Association Declaration of Helsinki for medical research involving human subjects.

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References

1. Okafor, A M., Ngwu, E K. and Ayogu, R N.B. (2021). Prevalence and associated factors of dyslipidaemia among university workers in Southeast Nigeria: a cross-sectional study. Archives of Public Health 79:77
2. Centers for Disease Control and Prevention. (2017). LDL and HDL: Bad and good cholesterol
3. Opoku S., Gan Y., Fu W., Chen D., Addo-yobo E., Trofimovitch D (2019). Prevalence and risk factors for dyslipidemia among adults in rural and urban China: findings from the China National Stroke Screening and prevention project (CNSSPP). BMC Pub Health. 19: 1500
4. WHO. Raised cholesterol: Situation and trends. 2020. https://www.who.int/ gho/ncd/risk\_factors/cholesterol\_mean\_text/en/ Accessed 22 Aug 2024.
5. Mcloon CJ, Osman F, Glennon P, Lim PB, Hayat SA. (2016). Global epidemiology and incidence of cardiovascular disease. In Papageorgiou N, editor. Cardiovascular diseases: Genetic susceptibility, environmental factors and their interaction. ; 57–96
6. Forouzanfar, M. H., Afshin, A. & Alexander, L. T. (2016). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: A systematic analysis for the Global Burden of Disease Study 2015. The Lancet, 388(10053), 1659-1724.
7. Catalina-Romero C, Calvo E, Sanchez-Chaparro MA, Valdivielso P, Sainz JC, Cabrera M (2013). The relationship between job stress and dyslipidaemia. Scandinavian J Pub Health. 41(2): 142–149. https://doi.org/10.1177/14 03494812470400 Accessed 22 Aug 2020
8. Ghiasvand M, Heshmat R, Golpira R, Haghpanah V, Soleimani A, Shoushtarizadeh P (2006). Shift working and risk of lipid disorders: a cross- sectional study. Lipids Health Dis. 5: Article No 9.
9. [Wilhelmsen](https://pubmed.ncbi.nlm.nih.gov/?term=Wilhelmsen+L&cauthor_id=11428852) , L.,  [Pyörälä](https://pubmed.ncbi.nlm.nih.gov/?term=Py%C3%B6r%C3%A4l%C3%A4+K&cauthor_id=11428852), K.,  [Wedel](https://pubmed.ncbi.nlm.nih.gov/?term=Wedel+H&cauthor_id=11428852), H., [Cook](https://pubmed.ncbi.nlm.nih.gov/?term=Cook+T&cauthor_id=11428852), T., [Pedersen](https://pubmed.ncbi.nlm.nih.gov/?term=Pedersen+T&cauthor_id=11428852),T.,   [Kjekshus](https://pubmed.ncbi.nlm.nih.gov/?term=Kjekshus+J&cauthor_id=11428852), J (2001). Risk factors for a major coronary event after myocardial infarction in the Scandinavian Simvastatin Survival Study (4S). Impact of predicted risk on the benefit of cholesterol-lowering treatment. European Heart Journal, 22(13):1119-27.
10. Friedewald, W. T., Levy, R. I., & Fredrickson, D. S. (1972). Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical Chemistry, 18(6), 499-502.
11. National Cholesterol Education Program. (2002). Third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circulation, 106(25), 3143-3421.
12. Pappan N, Awosika AO, Rehman A. Dyslipidemia. [Updated 2024 Mar 4]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK560891/>
13. [Oguejiofor](https://pubmed.ncbi.nlm.nih.gov/?term=Oguejiofor+OC&cauthor_id=23103917)O C., [Onwukwe](https://pubmed.ncbi.nlm.nih.gov/?term=Onwukwe+CH&cauthor_id=23103917), C H., [Odenigbo](https://pubmed.ncbi.nlm.nih.gov/?term=Odenigbo+CU&cauthor_id=23103917), C U (2012) Dyslipidemia in Nigeria: prevalence and pattern. Annals of African Medicine. 11(4):197-202.
14. [Okunorobo](https://pubmed.ncbi.nlm.nih.gov/?term=Okunorobo+MN&cauthor_id=38023784), M N.,  [Nnamah](https://pubmed.ncbi.nlm.nih.gov/?term=Nnamah+NK&cauthor_id=38023784), N K.,  [Ude](https://pubmed.ncbi.nlm.nih.gov/?term=Ude+UA&cauthor_id=38023784), U A.,  [Enyioma, A Ude](https://pubmed.ncbi.nlm.nih.gov/?term=Ude+EA&cauthor_id=38023784) ( 2023). Lipids and apolipoproteins C-III and E among treatment-naïve and treatment-experienced persons with HIV in Nigeria. African Journal of Laboratory Medicine. 17;12(1) 2018
15. Holven K B., van Lennep, J R (2023). Sex differences in lipids: A life course approach Atherosclerosis [384](https://www.atherosclerosis-journal.com/issue/S0021-9150%2823%29X0021-5) 117270
16. Wang X, Magkos F, Mittendorfer B (2011). Sex differences in lipid and lipoprotein metabolism: it's not just about sex hormones. Journal of Clinical Endocrinology Metabolism. 96(4):885-93.
17. Airhomwanbor, D. E., Osakue, E. O., & Okhiai, O. (2024). Assessment of workers' lipid profile in cement factories. Journal of Occupational Health, 66(2), 123-129.
18. Feng L, Nian S, Tong Z (2019). Age-related trends in lipid levels: a large-scale cross sectional study of the general Chinese population. BMJ Open 10:e034226. doi:10.1136/ bmjopen-2019-034226
19. Wei Y, Qi B, Xu J, Zhou G, Chen S, Ouyang P, Liu S (2014). Age- and sex-related difference in lipid profiles of patients hospitalized with acute myocardial infarction in East China. Journal of Clinical Lipidology, 8(6):562-567.
20. Grundy, S. M., Stone, N. J., Bailey, A. L., Beam, C., Birtcher, K. K., Blumenthal, R. S & Braun, L. T. (2019). ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease. Circulation, 140(11), e596-e646.
21. Hussain A, Ali I, Kaleem WA, Yasmeen F. (2019). Correlation between Body Mass Index and Lipid Profile in patients with Type 2 Diabetes attending a tertiary care hospital in Peshawar. Pakistan Journal of Medical Science. 35(3):591-597
22. Arora M, Koley S, Gupta S, Sandhu J (2007). A study on lipid profile and body fat in patients with diabetes mellitus. Anthropologist. 9(4):295–298.
23. Chen S, Cheng W. (2022). Relationship Between Lipid Profiles and Hypertension: A Cross-Sectional Study of 62,957 Chinese Adult Males. Front Public Health.
24. Haba, C M S., Mitu, O., Namat, R A., Mitu, I., Aursulesei, V., Mitu, F., Costache, I (2019) Relationship between lipid profile and blood pressure in hypertensive patients Journal of Hypertension Research 5(1):35–41
25. Anika, Umara Lani; Pintaningrum, Yusra; Syamsun, Arfi (2015).  Correlation Between Serum Lipid Profile and Blood Pressure In Ntb General Hospital. Journal of Hypertension 33():p e32,
26. Masoumeh, S., Mohammad, R., & Zahra, F. (2016). Association between blood pressure and lipid profile in Iranian adults. Journal of Cardiovascular and Thoracic Research, 8(2), 58-63.
27. Nichols, M., Townsend, N., Scarborough, P.& Rayner, M. (2014). Cardiovascular disease in Europe 2014: Epidemiological update. European Heart Journal, 35(29), 2950–2959.
28. Musunuru K (2010). Atherogenic dyslipidemia: cardiovascular risk and dietary intervention. Lipids.45(10):907–14.
29. Bassey, I. E., Uwem, O. A., Emono, D. N., Renen, A., Onyinyechi, L. O., & Alphonsus, E. U. (2017). Cardiovascular disease risk factors and cardiac markers among male cement workers in Calabar, Nigeria. Journal of Chemical Health Risks, 7(2), 85-94.
30. Boekholdt, S. M., Arsenault, B. J., Mora, S., Pedersen, T. R., LaRosa, J. C., Nestel, P. J. & Kastelein, J. J. (2012). Association of LDL cholesterol, non-HDL cholesterol, and apolipoprotein B levels with risk of cardiovascular events among patients treated with statins: A meta-analysis. JAMA, 307(12), 1302-1309.
31. Santos, M. G., Pengoraro, M., Sandrini, F. & Macuco, E. C. (2018). Risk factors for the development of atherosclerosis in childhood and adolescence. Arquivos Brasileiros de Cardiologia, 90(4), 301-308.
32. Xavier, H. T., Izar, M. C., Faria-Neto, J. R., Assad, M. H., Rocha, V. Z., Sposito, A. C. & Sociedade Brasileira de Cardiologia. (2013). [V Brazilian Guidelines on Dyslipidemias and Prevention of Atherosclerosis]. Arquivos Brasileiros de Cardiologia, 101(4 Suppl 1), 1-20.