Polytechnic Journal

Polytechnic Journal

Volume 13 | Issue 1 Article 16

July 2024

Statistical Analysis of Lipid Profiles Associated with Coronary Heart Disease in Erbil City-Iraq

Dler Hussein Kadir
Salahaddin University-Erbil, Kurdistan Region, Iraq

Karzan Abdullah
University of Kurdistan Hewler, KRG, Iraq

Aziz Muazafar Jafaar
Ministry of Health, Kurdistan Regional Government, Erbil-Iraq

Rebaz Hamza Salih
Kurdistan Regional Government. Erbil-Iraq

Shukur Wasman Smail
Salahaddin University-Erbil, Iraq, shukur.smail@su.edu.krd

See next page for additional authors

How to Cite This Article

Kadir, Dler Hussein; Abdullah, Karzan; Jafaar, Aziz Muazafar; Salih, Rebaz Hamza; Smail, Shukur Wasman; Rahman, Gashaw Qasim; Awla, Harem Khdir; and Khudhur, Zhikal Omar (2024) "Statistical Analysis of Lipid Profiles Associated with Coronary Heart Disease in Erbil City-Iraq," *Polytechnic Journal*: Vol. 13: Iss. 1, Article 16.
DOI: https://doi.org/10.59341/2707-7799.1831

Statistical Analysis of Lipid Profiles Associated with Coronary Heart Disease in Erbil City-Iraq

Abstract

Background and objectives: Coronary heart disease (CHD) is one of the most prevalent diseases worldwide. The primary risk factor for coronary heart disease (CHD) lies in the presence of hypertension, elevated levels of triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL) in the bloodstream. Furthermore, a reduction in high-density lipoprotein (HDL) levels is linked to an elevated risk of cardiovascular disease-related mortality.

The current retrospective study was undertaken to evaluate the alterations in the lipid profile of patients with CHD.

Methods: The current survey involved collecting data from 867 patients diagnosed with acute or severe CHD, with an average age of 48.38± 0.503. In addition, the study included 850 healthy controls whose average age was 47.22±1.234. The serum levels of TC, HDL, LDL, and TG were obtained from Zanko Hospital in Erbil city, Iraq. The comparison between the recorded parameters of healthy controls and patients was conducted using the t-test function in GraphPad Prism 6.0.

Results: The lipid profile consisted of measurements for TC, LDL, HDL, and TG. The TC levels were notably higher in cases of CHD in individuals under 40 years old compared to controls. Moreover, there was a notable rise in TG levels among individuals with CHD aged 40-60, in contrast to the control group. Conversely, there was no significant difference in the levels of HDL and LDL between the cases and control group.

Conclusions: There was a significant difference in TC and TG levels between cases and controls in certain groups, while other lipid profiles did not show significant changes.

Keywords

Cardiovascular disease, Cholesterol, Coronary Heart Diseases, Lipid Profile, Triglycerides

Authors

Dler Hussein Kadir, Karzan Abdullah, Aziz Muazafar Jafaar, Rebaz Hamza Salih, Shukur Wasman Smail, Gashaw Qasim Rahman, Harem Khdir Awla, and Zhikal Omar Khudhur

Polytechnic Journal. 2023(13,1)
ISSN: 2313-5727

POLYTECHNIC JOURNAL

RESEARCH ARTICLE

Statistical Analysis of Lipid Profiles Associated with Coronary Heart Disease in Erbil City-Iraq

Dler hussein kadir[1,2], Karzan Abdullah[3,4], Aziz Muazafar jafaar[5,6], Rebaz Hamza Salih[7,8], Shukur Wasman Smail[9,10]*, Gashaw Qasim Rahman[3], Harem Khdir Awla[9], Zhikal Omar Khudhur[11]

[1]*Department of Statistics, College of Administration and Economics, Salahaddin University-Erbil, Kurdistan Region, Iraq*
[2]*Department of Business of Administration, Cihan University-Erbil, Kurdistan region, Iraq*
[3]*School of Medicine, University of Kurdistan Hewler, KRG, Iraq*
[4]*Zanco Private Hospital, Kurdistan Regional Government. Erbil-Iraq*
[5]*Department of Endocrinology, Ministry of Health, Kurdistan Regional Government, Erbil-Iraq*
[6]*Department of Endocrinology, Iraqi Board for Medical Specializations, Erbil, Iraq*
[7]*Ministry of Health, Kurdistan Regional Government. Erbil-Iraq*
[8]*PAR Private Hospital, Kurdistan Regional Government. Erbil-Iraq*
[9]*Department of Biology, College of Science, Salahaddin University-Erbil, Iraq*
[10]*Department of Medical Microbiology, College of Science, Cihan University-Erbil, Kurdistan Region, Iraq*
[11]*Biology Education Department, Tishk International University, Erbil, Iraq*

*Corresponding author:

Shukur Wasman Smail,

Department of Biology, College of Science, Salahaddin University-Erbil, Iraq

E-mail: shukur.smail@su.edu.krd

Received:18 April 2023

Accepted:3 April 2024

Published:10 July 2024

Background and objectives: Coronary heart disease (CHD) is one of the most prevalent diseases worldwide. The primary risk factor for coronary heart disease (CHD) lies in the presence of hypertension, elevated levels of triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL) in the bloodstream. Furthermore, a reduction in high-density lipoprotein (HDL) levels is linked to an elevated risk of cardiovascular disease-related mortality.

The current retrospective study was undertaken to evaluate the alterations in the lipid profile of patients with CHD.

Methods: The current survey involved collecting data from 867 patients diagnosed with acute or severe CHD, with an average age of 48.38± 0.503. In addition, the study included 850 healthy controls whose average age was 47.22±1.234. The serum levels of TC, HDL, LDL, and TG were obtained from Zanko Hospital in Erbil city, Iraq. The comparison between the recorded parameters of healthy controls and patients was conducted using the t-test function in GraphPad Prism 6.0.

Results: The lipid profile consisted of measurements for TC, LDL, HDL, and TG. The TC levels were notably higher in cases of CHD in individuals under 40 years old compared to controls. Moreover, there was a notable rise in TG levels among individuals with CHD aged 40-60, in contrast to the control group. Conversely, there was no significant difference in the levels of HDL and LDL between the cases and control group.

Conclusions: There was a significant difference in TC and TG levels between cases and controls in certain groups, while other lipid profiles did not show significant changes.

Keywords: Cardiovascular disease, Cholesterol, Coronary Heart Diseases, Lipid Profile, Triglycerides

INTRODUCTION

Coronary heart disease (CHD), a form of cardiovascular disease, is widely recognized as a prominent contributor to mortality and morbidity, responsible for roughly one-third of yearly fatalities (Dai et al., 2023). CHD occurs as a result of the development of plaques on the arterial walls caused by the accumulation of excessive cholesterol. (Boudoulas et al., 2016). This plaque may lead to a reduction in blood flow when it blocks the artery, either completely or partially. The major risk factors for CHD consist of age, male sex, ethnic background, family history of CHD, diabetes, obesity, hypertension, smoking, physical inactivity, and hyperlipidemia (Navar-Boggan et al., 2015, Tsao et al., 2022).

The evaluation of cardiovascular disease risk commonly involves the administration of a group of tests, collectively referred to as lipid profiles, which include triglycerides (TG), total cholesterol (TC), low-

density lipoprotein (LDL), and high-density lipoprotein (HDL). The measurement of lipid profiles offers reliable insights into an individual's predisposition to suffer from a myocardial infarction (MI) or stroke caused by the obstruction of blood vessels or the calcification of arteries. There is a significant correlation between elevated TC levels in the bloodstream and the onset of cardiovascular disease. The estimated daily average biosynthesis of TC for an individual weighing 68 kg is 1 g (1,000 mg) (IUNG et al., 2006). As per the guidelines unveiled by the American Heart Association, the lipid profile values for cardiovascular disease risk factors are as follows: TC should exceed 200 mg/dL and LDL should be higher than 130 mg/d (Bonow et al., 2006).

To minimize the risk factors that influence CHD, a coordinated strategy is imperative. Therefore, it is crucial to precisely recognize and handle these risk factors. The management of risk factors must encompass both preventive and therapeutic approaches to the progression of atherosclerosis. (Singh et al., 2007). The direct link between cardiovascular diseases and lipoproteins and lipids has elevated the importance of these two parameters in clinical practice. Based on epidemiological studies, specifically in affluent nations with a high fat intake, dyslipidemia (abnormalities in lipoproteins and lipids) has emerged as the predominant risk factor for the onset of CHD due to its direct correlation (Gaziano et al., 2010, Khudhur and Kadir, 2022, Othman et al., 2019). The objective of this study is to establish the relationship between lipid profile and cardiovascular diseases, as well as predict the prevalence of CHD in the population of Erbil city, Iraq.

MATERIAL AND METHODS

In this retrospective study, a total of 867 patients who were admitted to the coronary care unit in the Erbil city-Iraq region, and who had experienced angina and survived a MI were recruited. There is a possibility that the patients have hypertension and diabetes mellitus, and the collection of samples spanned from June 2019 to December 2020. Patients with comorbidities, such as thyroid, renal, and liver impairment diseases, were excluded. Furthermore, an additional 850 healthy controls were included in the study. Informed consent has been obtained from the patients. The study has received approval from the Ethics Committee at Salahaddin University-Erbil (SUE) (Approval number: R02-023; 84 approved on April 9, 2019).

Laboratory methods

The lipid profile tests have been conducted at Zanko Hospital in Erbil, Iraq, which encompassed TC, TG, HDL, and LDL. Blood samples were collected following a minimum 12-hour fasting period. An enzymatic colorimetric reaction is utilized in the in vitro test for the quantitative determination of TC, TG, HDL, and LDL in human serum, which is conducted by the Cobas Integra 400+ Systems (Roche Diagnostics System, Mannheim, Germany). Prior to analyzing the sample, the calibrator and quality control in Cobas were verified. The normal ranges for TC, TG, HDL, and LDL were identified as below 200 mg/dL, below 150 mg/dL, above 60 mg/dL, and below 100 mg/dL, respectively.

Statistical analysis

To perform statistical analysis and create graphs, we utilized GraphPad Prism 6.0 software. Normality of the data was evaluated through the utilization of Kolmogorov, De-Agostino, and Shapiro tests. The independent t-test was employed in GraphPad Prism 6.0 to compare the recorded parameters between the group of healthy controls and the group of patients. The data being analyzed are parametric and are represented by the mean and standard error of the mean (SEM). A P-value of less than 0.05 is considered statistically significant and will be awarded one star (*).

RESULTS

According to the statistics, the average age of the patients was 48.38±0.503, while the healthy controls had an average age of 47.22±1.234. Among a total of 867 patients with CHD, 54.33% were male, while the remaining 45.67% were female. Nevertheless, the male population accounted for 52.94% of the controls, while females made up 47.06% (table 1). Regarding age, there was no significant difference observed between the patients and healthy controls (Figure 1).

Table 1. Baseline characteristics and risk factors for coronary heart disease in cases and controls subjects.

	Control (n=850) (mean ± SE)	**CHD patients (n=867) (mean ± SE)**
Age	47.22 ±1.234	48.38±0.503
Gender		
Male	450 (52.94%)	471 (54.33%)
Female	400 (47.06%)	396 (45.67%)

The data is represented by mean ± SE. CHD: coronary heart disease.

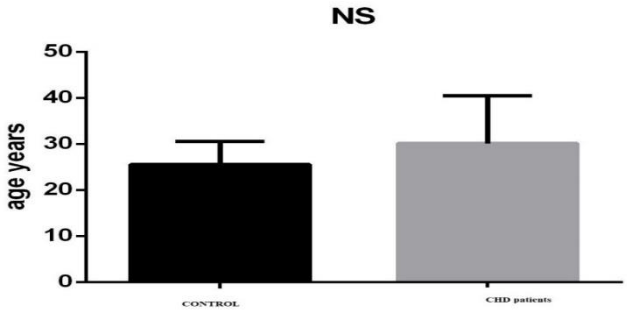


Figure 1. The result of the t-test, which was used to compare the ages of control and CHD patients. NS: non-significant, CHD: coronary heart disease.

In the present study, it was observed that the patients afflicted with CHD exhibited a lipid profile that displayed less notable variability in comparison to the control group. The conducted statistical analysis revealed a significant difference in TC between patients and controls in the age group below 40 years. The TC levels were markedly higher ($p<0.0001$) in cases of CHD in individuals under 40 years old compared to the control group (191.8 ± 5.400 and 150.2 ± 4.700, respectively). Furthermore, a notable variation was evidenced in the age category of individuals aged over 60 years, wherein patients displayed elevated levels of TC (181.4 ±3.487). Nevertheless, no significant disparity was found between the control group and patients in the age range of 40-60 years (as shown in Table 2 and Figure 2).

Table 2. Showing age-wise distribution of TC concentration among normal and CHD subjects.

Age group	Control (mean ± SE)	CHD patients (mean ± SE)	P value
< 40 years	150.2± 4.700	191.8 ± 5.400	< 0.0001
40-60	190.0±3.212	192.0±2.313	0.6136
>60 years	171.5 ±2.344	181.4 ±3.487	0.0188

The data is represented by mean ± SE. CHD: coronary heart disease.

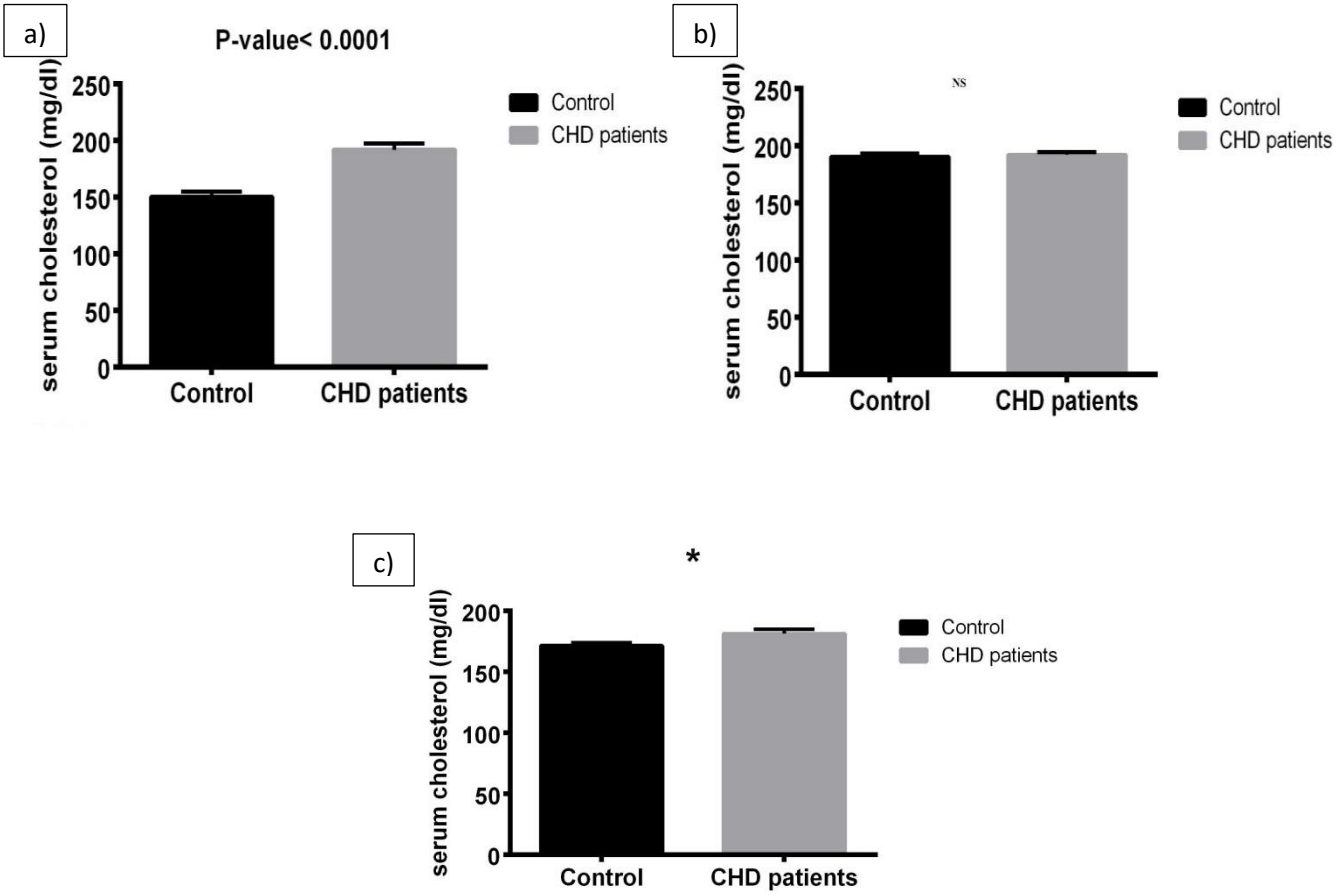


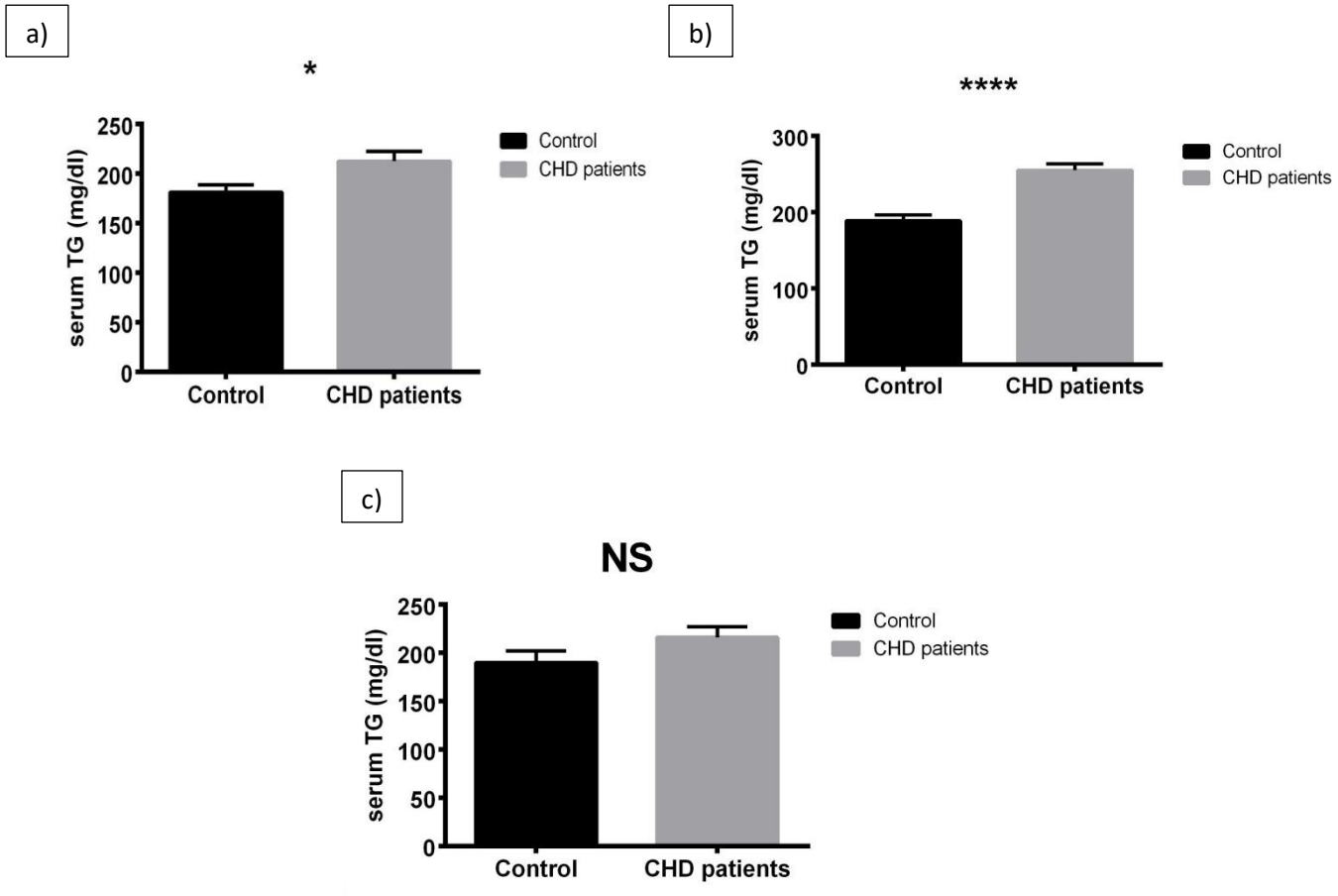
Figure 2. Compare of TC between control and CHD patients according to age groups. a) Below 40 years groups, b) between 40 to 60 years groups, c) over 60 years. *= p< 0.05. NS: non-significant.a)

The increase in TG levels among CHD cases (aged 40-60 years old) compared to controls was determined to be statistically significant (255.2±8.455 and 188.9±7.455, respectively, p< 0.0001). Furthermore, a statistically significant increase in TG levels (p = 0.0108) was observed in patients aged < 40 years (refer to table 3 and figure 3).

Table 3. Showing age- wise distribution of TG concentration among normal and CHD subjects.

Age group	Control (mean ± SE)	CHD patients (mean ± SE)	P value
< 40 years	181.3+ 7.322	212.7±9.860	0.0108
40-60	188.9±7.455	255.2±8.455	< 0.0001
>60 years	190.2±11.78	216.1±10.88	0.1068

The data is represented by mean ± SE.



CHD: coronary heart disease.

Figure 3. Compare of TG between control and CHD patients. a) Below 40 years groups, b) between 40 to 60 years groups, c) over 60 years. *= p< 0.05 and ****= p< 0.0001. CHD: coronary heart disease, TG: triglycerides, NS: non-significant.

In contrast, the level of HDL was non-significantly different between cases and controls (table 4 and figure 4). In addition, the same non-significant differences was observed for LDL when compared the level between patients and healthy controls according to the age groups (table 5 and figure 5).

Table 4. Showing age wise distribution of HDL concentration among normal and CHD patients.

Age group	Control (mean ± SE)	CHD patients (mean ± SE)	P value
< 40 years	50.45±2.889	45.46 ±1.994	0.1557
40-60	47.22±3.177	45.36±1.228	0.5852
>60 years	47.89±9.111	45.42± 3.638	0.8013

The data is represented by mean ± SE. CHD: coronary heart disease.

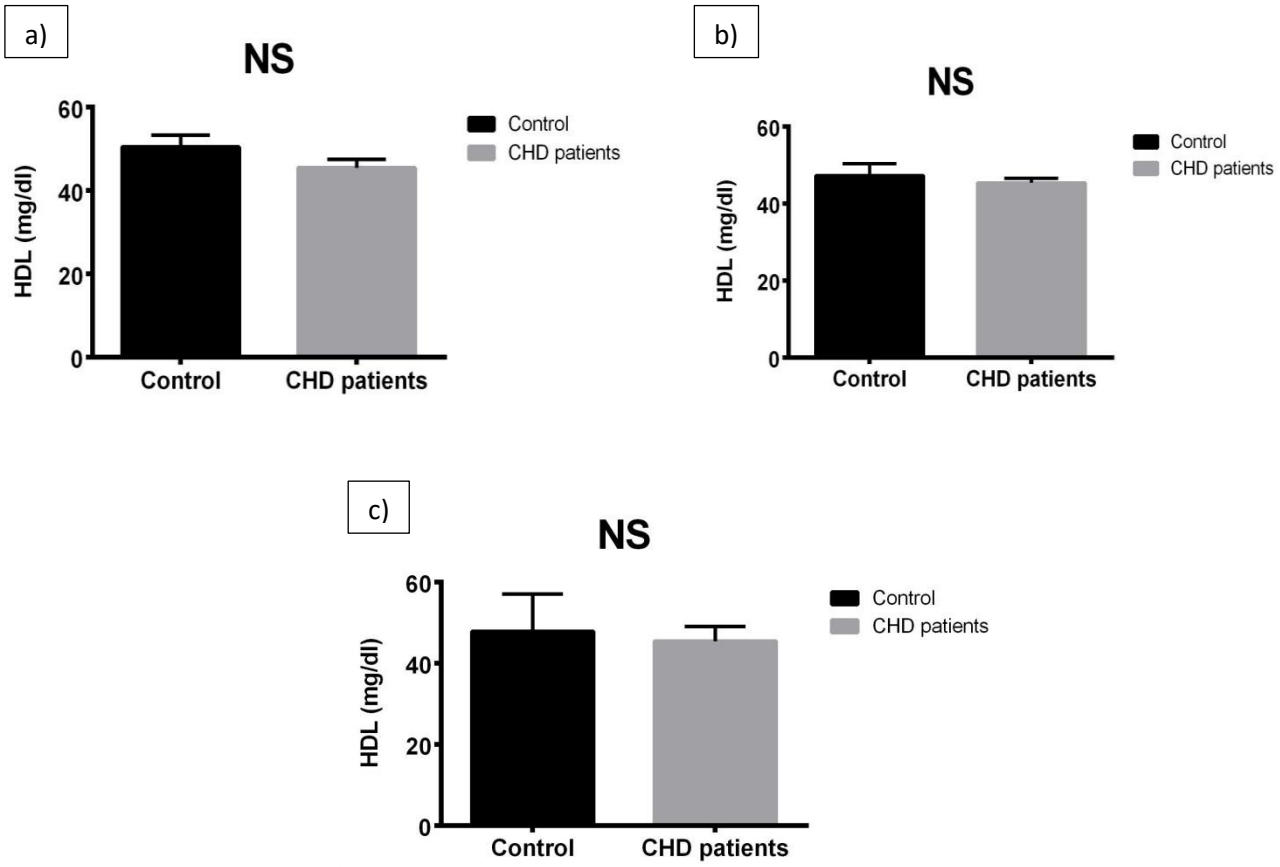


Fig. 4. Compare of HDL between control and CHD patients.
a) Below 40 years groups, b) between 40 to 60 years groups, c) over 60 years. CHD: coronary heart disease, HDL: high-density lipoprotein, NS: non-significant.

Table 5. Showing age-wise distribution of LDL concentration among normal and CHD patients.

Age group	Control (mean ± SE)	CHD patients (mean ± SE)	P value
< 40 years	120.2+ 5.344	128.1±6.018	0.3267
40-60	115.7±6.867	129.1±2.690	0.0698
>60 years	118.8±10.22	126.4± 5.652	0.5155

The age is represented by mean ± SE. CHD: coronary heart disease.

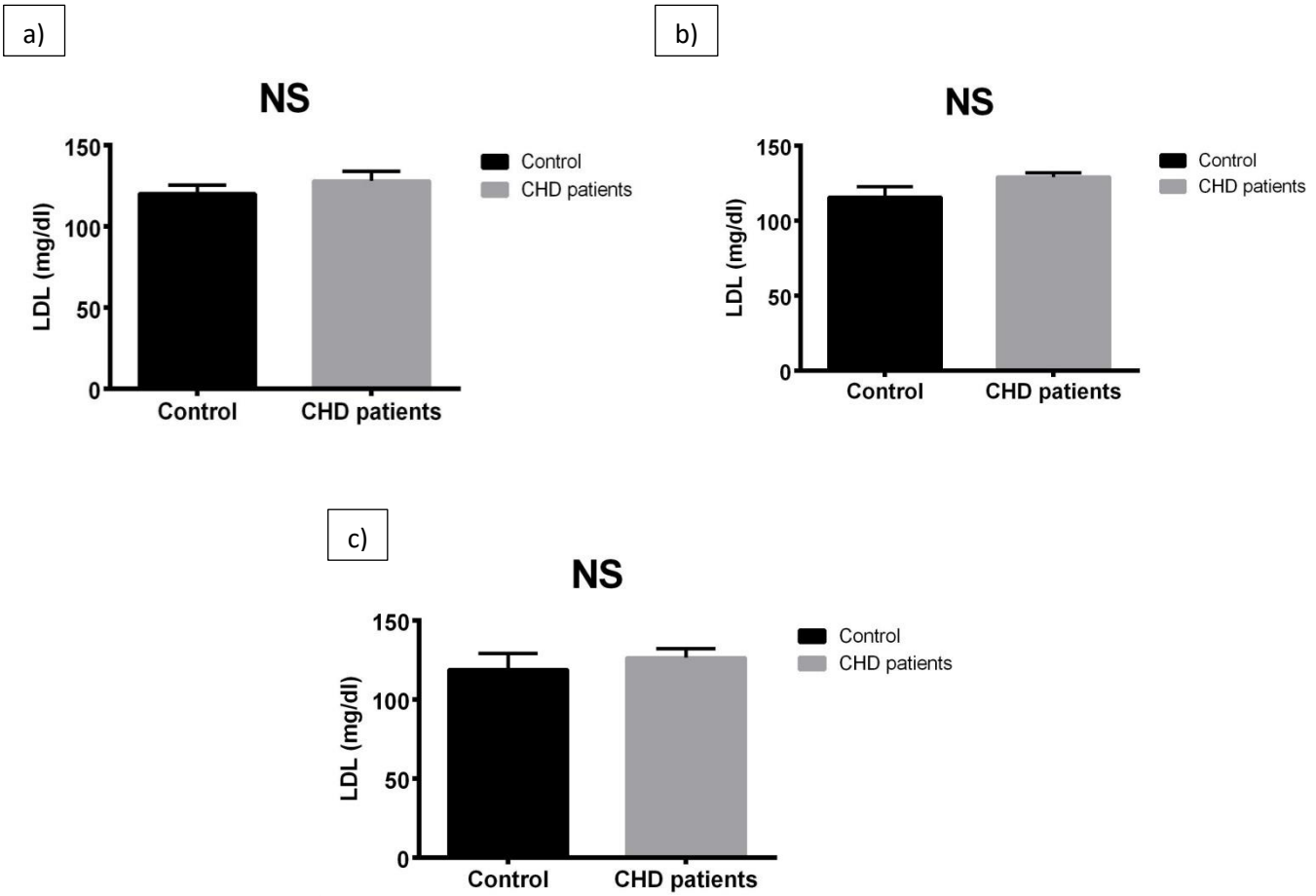


Fig. 5. Compare of LDL between control and CHD patients.
b) Below 40 years groups, b) between 40 to 60 years groups, c) over 60 years. CHD: coronary heart disease, LDL: low-density lipoprotein, NS: non-significant.
a)

Discussion

Despite a significant decrease in the occurrence of vascular disorders like cerebrovascular disease, CHD, and peripheral vascular disease in developed nations like the United States, CHD continues to be the primary cause of mortality. Significant risk factors consist of low HDL-C, heightened LDL-C, insulin resistance with or without overt diabetes, smoking, hypertension, advanced age, and a family medical history of premature CHD. Consequently, reports indicate that even in the presence of other risk factors, maintaining TC levels below 160 mg/dL can decrease the risk of CHD (Friedewald et al., 1972).

Within our study, it was observed that individuals under the age of 40 exhibited elevated TC levels. While the studies indicate that cardiovascular events are less frequent among children and adolescents, those with familial hypercholesterolemia (FH) exhibit both functional and morphological alterations in the vessel wall. Individuals with FH demonstrate increased carotid intima-media thickness and impaired flow-mediated dilatation, which are both recognized surrogate markers for atherosclerosis, when compared to healthy controls (Kusters et al., 2014, Banderali et al., 2022). The findings of our study indicate that patients above the age of 60 demonstrated elevated TC levels, which may contribute to the risk of developing CHD. This finding is consistent with a study that demonstrated a positive correlation between total cholesterol levels and mortality from cardiovascular disease in the elderly (Lewington et al., 2007). Elevated levels of TC were found to contribute to an increased lifetime risk of CHD mortality in individuals with hypertension (Collaboration, 2005, Umemura et al., 2019). Nevertheless, our study found no significant difference in the TC level between patients and controls in the age group of 40-60 years. The outcome may be attributed to a small sample size, whereas a large sample size could potentially impact the results (Satoh et al., 2021).

The controversy surrounding the role of TG as an independent risk factor for coronary artery disease (CAD) persists (Tseng et al., 2006). In the present study, patients exhibited higher levels of TG compared to healthy controls, specifically in the groups of individuals aged >40 years and 40-60 years. This is parallel with the results of Tirosh et al. (2007) that showed the reduction of TG in your could reduce the CHD risk in young (Tirosh et al., 2007). Furthermore, another study revealed a substantial increase in TC and TG levels among women with CHD in comparison to those without the condition (Acartürk et al., 2004).

An adverse connection between atherosclerosis and HDL has been observed in clinical studies. HDL facilitates the reverse transport of cholesterol and exhibits antithrombotic, antioxidative, vasoprotective, and anti-inflammatory characteristics. Furthermore, research has indicated an inverse correlation between HDL and the risk of CHD (Castelli et al., 1992, Zvintzou et al., 2021). Based on these findings, the present study demonstrated a lack of statistically significant decrease in HDL-C levels among CHD patients when compared to the control groups. Regarding the LDL results, our study found that there was a non-significant increase in LDL levels among patients with CHD. Nevertheless, the significance of LDL in the pathophysiology of CHD has been firmly established. LDL and remnant lipoproteins have the ability to infiltrate the sub-endothelial space within the walls of arteries and attach themselves to proteoglycans. This process triggers the deposition of cholesterol and the formation of foam cells (Björnson et al., 2023). The National Cholesterol Education Program (NCEP) recommends a target of less than 100 mg/dl for LDL in patients diagnosed with established coronary heart disease (CHD) and those at equivalent risk for CHD. This objective aims to reduce the incidence of atherosclerosis, ischemic episodes, and revascularization rates (Panagiotakos and Toutouzas, 2003).

Conclusion

In conclusion, our study sheds light on lipid profile disparities between CHD patients and controls, with significant variations noted in TC and TG levels across certain age groups. Specifically, TC levels were markedly higher in CHD cases, particularly among those under 40 and over 60 years old, while TG levels were notably elevated in CHD patients aged 40-60 years. These findings underscore the importance of targeting TC and TG levels to mitigate CHD risk, particularly among young individuals. While further

targeted intervention trials are necessary to establish the efficacy of reducing TG levels in older patients, our study emphasizes the importance of lifestyle modifications and, if needed, cholesterol-lowering medications like statins, even if lipid levels fall within recommended ranges. This highlights the imperative of proactive measures to manage lipid profiles, particularly in vulnerable populations, to effectively combat CHD risk.

Interest Conflict

The authors have no conflict of interest to declare.

Consent for publications

The author read and approved the final manuscript for publication.

Ethics approval and consent to participate

The study was carried out by the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving human subjects. The Ethical Committee of Salahaddin University-Erbil (SUE) (Approval number: R02-023; 84 approved on April 9, 2019), and written informed consent was obtained from each subject before his enrolment in the study.

Availability of data and material

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Authors' contributions

Dler hussein kadir and Karzan Abdullah: conceptualization, data curation, methodology, formal analysis, project administration, writing, original draft, and writing review and editing. Aziz Muazafar jafaar and Rebaz Hamza Salih: data curation, statistical analysis. Gashaw Qasim Rahman and Harem Khdir Awla, and Zhikal Omar Khudhur: Conceptualization, formal analysis, and writing—review and editing. Shukur Wasman Smail: Conceptualization, methodology, data curation, formal analysis, visualization, resources, software, supervision, and writing—review and editing.

Funding

None.

Acknowledgement

Our sincere appreciation goes to Zanko Hospital, Erbil, Iraq for their invaluable assistance in data collection and study implementation.

REFERENCES

ACARTÜRK, E., CAYLI, M., AKPINAR, O., ATTILA, G. & DEMIR, M. 2004. Relation between age and gender differences in plasma triglyceride concentrations and coronary artery disease in Southern Turkey. *Clin Chim Acta,* 339**,** 123-8.

BANDERALI, G., CAPRA, M. E., BIASUCCI, G., STRACQUADAINO, R., VIGGIANO, C. & PEDERIVA, C. 2022. Detecting Familial hypercholesterolemia in children and adolescents: potential and challenges. *Ital J Pediatr,* 48**,** 115.

BJÖRNSON, E., ADIELS, M., TASKINEN, M. R., BURGESS, S., RAWSHANI, A., BORÉN, J. & PACKARD, C. J. 2023. Triglyceride-rich lipoprotein remnants, low-density lipoproteins, and risk of coronary heart disease: a UK Biobank study. *Eur Heart J,* 44**,** 4186-4195.

BONOW, R. O., CARABELLO, B. A., CHATTERJEE, K., DE LEON, A. C., FAXON, D. P., FREED, M. D., GAASCH, W. H., LYTLE, B. W., NISHIMURA, R. A. & O'GARA, P. T. 2006. ACC/AHA 2006

guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing Committee to Revise the 1998 guidelines for the management of patients with valvular heart disease) developed in collaboration with the Society of Cardiovascular Anesthesiologists endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons. *Journal of the American College of Cardiology,* 48**,** e1-e148.

BOUDOULAS, K. D., TRIPOSCIADIS, F., GELERIS, P. & BOUDOULAS, H. 2016. Coronary Atherosclerosis: Pathophysiologic Basis for Diagnosis and Management. *Prog Cardiovasc Dis,* 58**,** 676-92.

CASTELLI, W. P., ANDERSON, K., WILSON, P. W. & LEVY, D. 1992. Lipids and risk of coronary heart disease The Framingham Study. *Annals of epidemiology,* 2**,** 23-28.

COLLABORATION, A. P. C. S. 2005. Joint effects of systolic blood pressure and serum cholesterol on cardiovascular disease in the Asia Pacific region. *Circulation,* 112**,** 3384-90.

DAI, L., LI, R., HAO, Q., BAO, Y., HU, L., ZHANG, Y., KANG, H., WU, H., MA, X. & SONG, Y. 2023. Breast cancer is associated with coronary heart disease: a cross-sectional survey of NHANES 1999-2018. *Front Cardiovasc Med,* 10**,** 1274976.

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**,** 499-502.

GAZIANO, T. A., BITTON, A., ANAND, S., ABRAHAMS-GESSEL, S. & MURPHY, A. 2010. Growing epidemic of coronary heart disease in low-and middle-income countries. *Current problems in cardiology,* 35**,** 72-115.

IUNG, B., VAHANIAN, A., NKOMO, V. T., GARDIN, J. M. & SKELTON, T. N. 2006. Burden of valvular heart diseases: a population-based study. Commentary. *Lancet (British edition),* 368.

KHUDHUR, A. M. & KADIR, D. H. 2022. An application of logistic regression modeling to predict risk factors for bypass graft diagnosis in Erbil. *Cihan University-Erbil Scientific Journal,* 6**,** 57-63.

KUSTERS, D. M., WIEGMAN, A., KASTELEIN, J. J. & HUTTEN, B. A. 2014. Carotid intima-media thickness in children with familial hypercholesterolemia. *Circ Res,* 114**,** 307-10.

LEWINGTON, S., WHITLOCK, G., CLARKE, R., SHERLIKER, P., EMBERSON, J., HALSEY, J., QIZILBASH, N., PETO, R. & COLLINS, R. 2007. Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55,000 vascular deaths. *Lancet,* 370**,** 1829-39.

NAVAR-BOGGAN, A. M., PETERSON, E. D., D'AGOSTINO, R. B., SR., NEELY, B., SNIDERMAN, A. D. & PENCINA, M. J. 2015. Hyperlipidemia in early adulthood increases long-term risk of coronary heart disease. *Circulation,* 131**,** 451-8.

OTHMAN, G. Q., SAEED, R. S., KADIR, D. H. & TAHER, H. J. Relation of angiography to

hematological, hormonal and some biochemical variables in coronary artery bypass graft patients. Journal of Physics: Conference Series, 2019. IOP Publishing, 062110.

PANAGIOTAKOS, D. B. & TOUTOUZAS, P. K. 2003. Importance of LDL/HDL cholesterol ratio as a predictor for coronary heart disease events in patients with heterozygous familial hypercholesterolaemia: a 15-year follow-up (1987-2002). *Current medical research and opinion,* 19**,** 89-94.

SATOH, M., OHKUBO, T., ASAYAMA, K., MURAKAMI, Y., SUGIYAMA, D., WAKI, T., TANAKA-MIZUNO, S., YAMADA, M., SAITOH, S., SAKATA, K., IRIE, F., SAIRENCHI, T., ISHIKAWA, S., KIYAMA, M., OKAYAMA, A., MIURA, K., IMAI, Y., UESHIMA, H. & OKAMURA, T. 2021. A Combination of Blood Pressure and Total Cholesterol Increases the Lifetime Risk of Coronary Heart Disease Mortality: EPOCH-JAPAN. *J Atheroscler Thromb,* 28**,** 6-24.

SINGH, I. M., SHISHEHBOR, M. H. & ANSELL, B. J. 2007. High-density lipoprotein as a therapeutic target: a systematic review. *Jama,* 298**,** 786-798.

TIROSH, A., RUDICH, A., SHOCHAT, T., TEKES-MANOVA, D., ISRAELI, E., HENKIN, Y., KOCHBA, I. & SHAI, I. 2007. Changes in triglyceride levels and risk for coronary heart disease in young men. *Ann Intern Med,* 147**,** 377-85.

TSAO, C. W., ADAY, A. W., ALMARZOOQ, Z. I., ALONSO, A., BEATON, A. Z., BITTENCOURT, M. S., BOEHME, A. K., BUXTON, A. E., CARSON, A. P., COMMODORE-MENSAH, Y., ELKIND, M. S. V., EVENSON, K. R., EZE-NLIAM, C., FERGUSON, J. F., GENEROSO, G., HO, J. E., KALANI, R., KHAN, S. S., KISSELA, B. M., KNUTSON, K. L., LEVINE, D. A., LEWIS, T. T., LIU, J., LOOP, M. S., MA, J., MUSSOLINO, M. E., NAVANEETHAN, S. D., PERAK, A. M., POUDEL, R., REZK-HANNA, M., ROTH, G. A., SCHROEDER, E. B., SHAH, S. H., THACKER, E. L., VANWAGNER, L. B., VIRANI, S. S., VOECKS, J. H., WANG, N. Y., YAFFE, K. & MARTIN, S. S. 2022. Heart Disease and Stroke Statistics-2022 Update: A Report From the American Heart Association. *Circulation,* 145**,** e153-e639.

TSENG, C. H., TSENG, C. P., CHONG, C. K., CHENG, J. C. & TAI, T. Y. 2006. Independent association between triglycerides and coronary artery disease in Taiwanese type 2 diabetic patients. *Int J Cardiol,* 111**,** 80-5.

UMEMURA, S., ARIMA, H., ARIMA, S., ASAYAMA, K., DOHI, Y., HIROOKA, Y., HORIO, T., HOSHIDE, S., IKEDA, S., ISHIMITSU, T., ITO, M., ITO, S., IWASHIMA, Y., KAI, H., KAMIDE, K., KANNO, Y., KASHIHARA, N., KAWANO, Y., KIKUCHI, T., KITAMURA, K., KITAZONO, T., KOHARA, K., KUDO, M., KUMAGAI, H., MATSUMURA, K., MATSUURA, H., MIURA, K., MUKOYAMA, M., NAKAMURA, S., OHKUBO, T., OHYA, Y., OKURA, T., RAKUGI, H., SAITOH, S., SHIBATA, H., SHIMOSAWA, T., SUZUKI, H., TAKAHASHI, S., TAMURA, K., TOMIYAMA, H., TSUCHIHASHI, T.,

UEDA, S., UEHARA, Y., URATA, H. & HIRAWA, N. 2019. The Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2019). *Hypertens Res,* 42**,** 1235-1481.

ZVINTZOU, E., KARAMPELA, D. S., VAKKA, A., XEPAPADAKI, E., KARAVIA, E. A., HATZIRI, A., GIANNOPOULOU, P. C. & KYPREOS, K. E. 2021. High density lipoprotein in atherosclerosis and coronary heart disease: Where do we stand today? *Vascul Pharmacol,* 141**,** 106928.