Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

Journal of University Studies for Inclusive Research

Vol.2, Issue 24 (2023), 12107- 12121

USRIJ Pvt. Ltd

# Prevalence and pattern of dyslipidemia in Saudi Arabia individuals with type 2 diabetes at King Khalid university hospital , in Riyadh city- Saudi Arabia - 2023

**Prepared by**

Khalid Saeed Oudah Alahmari - Lab specialist - King Khalid university hospital

Basem Ahmed Nasser Shebayli - Lab technician

Mohammed Cajbur Ali Awaji - Lab technician - King Khalid university hospital

Emad Ayidh B Almutairi - Lab specialist - Riyadh Regional Lab

Mohammed Mansour Mohammed Oudah -Lab specialist -Ministry of Health - Alnaqaha hospital

**Abstract**

**Background:** Atherogenic dyslipidemia is an important modifiable risk factor for cardiovascular disease among patients of type 2 diabetes mellitus. Timely detection and characterization of this condition help clinicians estimate future risk of cardiovascular disease and take appropriate preventive measures. The aim of this study was to determine the prevalence, pattern and predictors of dyslipidemia in a cohort of Saudi patients with type 2 diabetes.

**Results:** We found mixed dyslipidemia as the most prevalent (88.1%) and isolated dyslipidemia (10.1%) as the least prevalent forms of dyslipidemia in our patients. The most prevalent form of single dyslipidemia was high LDL-C (73.8%) and combined dyslipidemia was high TG, high LDL-C and low HDL-C (44.7%). Prevalence of all single and mixed dyslipidemia was higher in patients with poor glycemic control and

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

hypertension. The glycemic status of patients correlated with their fasting serum lipid profile. Dyslipidemia was associated mainly with male gender, poor glycemic control and hypertension.

**Conclusions**: Atherogenic dyslipidemia is associated mainly with male gender, poor glycemic control and hyperten- sion. It is highly prevalent in Saudi patients with type 2 diabetes. Urgent lifestyle modification, sustained glycemic control and aggressive lipid lowering treatment plans are necessary to minimize the future risk of cardiovascular disease in this population.

**Keywords:** Type 2 diabetes, Dyslipidemia, Cardiovascular disease, Prevalence, Riyadh, Saudi Arabia

## Introduction

Dyslipidemia is defined as an abnormal lipid profile characterized by the imbalance of lipids such as low high-density lipoprotein cholesterol (HDL-C), high low-density lipoprotein cholesterol (LDL-C), high total cholesterol (TC), and high triglycerides (TGs) levels.1 Dyslipidemia and T2DM are growing public health problem, particularly in developing countries, including Saudi arabia.2–5 A recent study from Saudi indicated that hypercholesterolemia and hypertriglyceridemia patterns of dyslipidemia approximately doubled from 23.0% and 23.8%, in 1994 to 44.3% and 41.9% in 2017, respectively.2

Non-communicable diseases (NCDs) such as cardiovascular diseases (CVD) are highly prevalent and considered the leading cause of death in developing countries.6,7 Dyslipidemia significantly contributes to CVD, T2DM and atherosclerosis development.2–4 Even mild lipid profile abnormalities may increase the risk of CAD significantly in the presence of other CAD risk factors such as T2DM.8

Different dyslipidemia patterns have been linked with gender and patients age groups. Besides T2DM, hypertension and obesity were found to be an independent factors for dyslipidemia.2–4 The relationship between T2DM and dyslipidemia could be bidirectional. While the risk of coronary artery disease (CAD)

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

is two to four-fold higher in subjects with T2DM,9 several studies have shown a significant correlation between glycated Hemoglobin (HbA1c) and multiple lipid profile parameters in patients with T2DM s.10–12 Thus, effective control of one could positively affect the other.

Although dyslipidemia is a modifiable CAD risk factor and its effective management could reduce morbidity and mortality rates,13,14 dyslipidemia remains widely undiagnosed and uncontrolled in high-risk populations such as subjects with T2DM.15

This study aimed to determine the prevalence and pattern of dyslipidemia and its associated factors among patients with T2DM. Assessing the prevalence and pattern of dyslipidemia and its associated risk factors among patients with T2DM would help achieve the desired lipid parameters control, promote health, and, thus, reduce diabetic dyslipidemia incidence, prevalence, and complications.

## Methods

### Study design

We conducted a cross-sectional study on patients with type 2 diabetes aged 30–74 years from December 2022 to July 2023.

### Study setting

The study was carried out at the King Khalid university hospital , in Riyadh city which is one of the largest multi-specialty tertiary care hospital .

This hospital provides clinical trainings to both Nursing and Medical students in addition to providing comprehensive health- care services to the general public.

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

**Sample size and selection criteria**

We enrolled a total of 497 diabetic patients originat- ing mainly from riyadh city . They were randomly selected from the list of outpatients who were clinically examined in medicine and other outpatient.

departments and approached the sample collection unit ofKing Khalid university hospital to have their blood glucose, HbA1c, lipid pro- file and other parameters measured. All those randomly selected diabetic patients who provided informed con- sent were enrolled in the study without regard to their treatment for dyslipidemia. The presence of diabetes was confirmed based on their previous medical records, clini- cal examination and past or current laboratory results. Repeated inclusion of the same patients was avoided by using a filter that consisted of their unique hospital number, full name and age.

**Results**

A total of 497 type 2 diabetes patients, 36.2% female and 63.8% male, were enrolled in this study, and their mean age was 52.7 ± 10.5 years while the mean duration of diabetes was 5.1 ± 3.8 years. Of these, 176 (35.4%) patients were not taking any antidiabetic medications, 282 (56.7%) were taking oral hypoglycemic medications only, 26 (5.2%) were taking oral hypoglycemic medications and insulin, and the remaining 13 ( 2.6%) were taking insulin only to control blood glucose levels. Their demographic, anthropometric, and biochemical characteristics are shown in Table 1. Males were significantly older ($P < 0.010$) or overweight or obese compared to females. The majority of patients were urban residents (74.2%), non-smokers (72.8%) and non-vegetarians (92.8%). The prevalence of smoking habit (36.9%), general obesity (36.3%), and central obesity (51.7%) was significantly higher in males than in females ($P < 0.010$). There were 24.1% of patients with poor glycemic control (HbA1c > 7.0%). Fasting plasma glucose level, duration of diabetes,

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

hypertension, glycemic status, and blood pressure did not differ significantly between males and females (P > 0.050).

Age- and sex-specific values of serum lipid parameters are shown in Figure 1. Among all lipid parameters measured, serum TG level was higher in males (P < 0.050). Serum TG and HDL-C levels decreased while other lipid parameters increased with age. Analysis by sex showed that this age-specific variation in blood lipid parameters was more pronounced in males than in females. Blood lipid levels and percentages did not change or decrease with age in female patients. One-way analysis of variance between groups was performed to explore the effect of age on blood lipid parameters. The difference in concentrations and ratios of blood lipid parameters for the three age groups (30-44, 45-59, 60-74 years) was statistically significant except for TG. Post hoc comparisons using Tukey's test indicated that the mean serum levels of TC, HDL-C, LDL-C, non-HDL-C, ApoB, and TC/HDL-C ratio for the age group 30–44 years were significantly different. ent (p < 0.050) from the age groups 45-59 and 60-64 years. Serum LDL-C concentration and TC/HDL-C ratio for the 45-59 year age group differed from either age group while serum TC and non-HDL-C concentrations differed only with the 30-44 year age group. No age-group specific difference in serum lipid parameters was found for females. In males, serum concentrations of TC, LDL-C, non-HDL-C, ApoB, and TC/HDL-C for the 30-44 age group differed significantly from those for the 45-59 age group.

**Table 1 General and biochemical characteristics of the diabetic patients**

| Characteristics | Female (n = 180) | Male (n = 317) | p value | Total (n = 497) |
|---|---|---|---|---|
| Age (year) | 55.6 ± 9.2 | 51.2 ± 10.9 | 0 | 52.7 ± 10.5 |
| BMI (kg/m$^2$) | 23.9 ± 2.7 | 24.3 ± 2.2 | 0.069 | 24.2 ± 2.4 |
| Overweight | 68 (37.8) | 126 (39.7) | 0.003 | 194 (39.0) |
| Obese | 45 (25.0) | 115 (36.3) | 160 (32.2) | |
| Waist | 90.2 ± 8.0 | 94.5 ± 6.7 | 0 | 92.9 ± 7.5 |

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

| | | | | |
|---|---|---|---|---|
| circumference (cm) | | | | |
| Centrally obese | 170 (94.4) | 257 (81.1) | 0 | 427 (85.9) |
| Residence | | | | |
| Village | 47 (26.1) | 81 (25.6) | 0.886 | 128 (25.8) |
| Urban | 133 (73.9) | 236 (74.4) | 369 (74.2) | |
| Current smokers | 18 (10.0) | 117 (36.9) | 0 | 135 (27.2) |
| Diet | | | | |
| Vegetarian | 19 (10.6) | 17 (5.4) | 0.032 | 36 (7.2) |
| Non-vegetarian | 161 (89.4) | 300 (94.6) | 461 (92.8) | |
| Fating plasma glucose (mg/dl) | 138.2 ± 40.6 | 134.2 ± 44.0 | 0.314 | 135.7 ± 42.8 |
| DM duration (year) | 5.3 ± 3.8 | 4.9 ± 3.9 | 0.224 | 5.1 ± 3.8 |
| HbA1c (%) | 6.4 ± 0.9 | 6.4 ± 0.9 | 0.932 | 6.4 ± 0.9 |
| Glycemic control | | | | |
| Good (HbA1c<7%) | 138 (76.7) | 239 (75.4) | 0.75 | 377 (75.9) |
| Poor (HbA1C>7%) | 42 (23.3) | 78 (24.6) | 120 (24.1) | |
| SBP (mmHg) | 125.1 ± 14.0 | 125.8 ± 11.6 | 0.562 | 125.5 ± 12.5 |
| DBP (mmHg) | 80.9 ± 9.2 | 82.2 ± 7.6 | 0.107 | 81.7 ± 8.2 |
| Hypertension | 75 (41.7) | 130 (41.0) | 0.003 | 205 (41.2) |
| Duration of HTN (year) | 1.9 ± 3.6 | 1.6 ± 3.6 | 0.345 | 1.7 ± 3.6 |

The results are presented as mean ± SD for continuous variables and n (%) for categorical variables

[a] $p < 0.001$

[b] $p < 0.05$

[c] $p > 0.05$ (two tailed); groups were compared using Students t test for quantitative variables and Chi square test for categorical variables

and 60–74 years. Only LDL-C concentration of age group 45–59 years differed significantly from age groups 30–44 and 60–74 years. Serum TC, non-HDL-C, ApoB concen- trations and TC/HDL-C ratio of

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

age group 45–59 years differed significantly only from age group 30–44 years.

Prevalence of single and mixed dyslipidemia has been presented in Table 2. The most prevalent single lipid dis- order was increased non-HDL-C (75.5%) while the least prevalent was hypercholesterolemia (43.7%). Prevalence of mixed dyslipidemia was 88.1%. Prevalence of high LDL-C, non-HDL-C, ApoB and mixed dyslipidemia was significantly higher among males ($p < 0.05$).

The pattern of dyslipidemia is shown in Fig. 2. Among dyslipidemic patients, there were 36 (8.2%) cases of isolated hypertriglyceridemia, 49 (11.2%) cases of isolated high LDL-C and 13 (3.0%) cases of isolated low HDL-C and no cases of isolated hypercholester- olemia. Likewise, there were 53 (12.1%) cases of com- bined hypertriglyceridemia and high LDL-C, 21 (4.8%) cases of combined hypertriglyceridemia and low HDL- C, 25 (5.7%) cases of combined high LDL-C and low HDL-C, 24 (5.5%) cases of combined hypertriglyceri- demia, low HDL-C and high LDL-C and 119 (27.2%) cases of combined hypertriglyceridemia, hypercholes- terolemia, low HDL-C and high LDL-C. Additionally, there were 63 (14.4%) cases of hypercholesterolemia, hypertriglyceridemia and high LDL-C, 16 (3.7%) cases of hypercholesterolemia and high LDL-C, 18 (4.1) case of hypercholesterolemia, low HDL-C and high LDL-C, and 1(0.2%) case of hypercholesterolemia, hypertriglyc- eridemia and low HDL-C. Prevalence of all single and mixed dyslipidemia was significantly higher ($p < 0.001$ for all) in patients with poor glycemic control and hypertension. Table 3 presents the prevalence of sin- gle and mixed dyslipidemia in diabetic patients based on their characteristics such as duration of diabetes, place of residence, smoking habit, glycemic status and blood pressure. Prevalence of low HDL-C and high TC/HDL-C ratio was significantly higher ($p < 0.050$) in patients with longer duration of diabetes. Only the prevalence of hypertriglyceridemia was significantly higher ($p < 0.050$) in non-smoker patients.

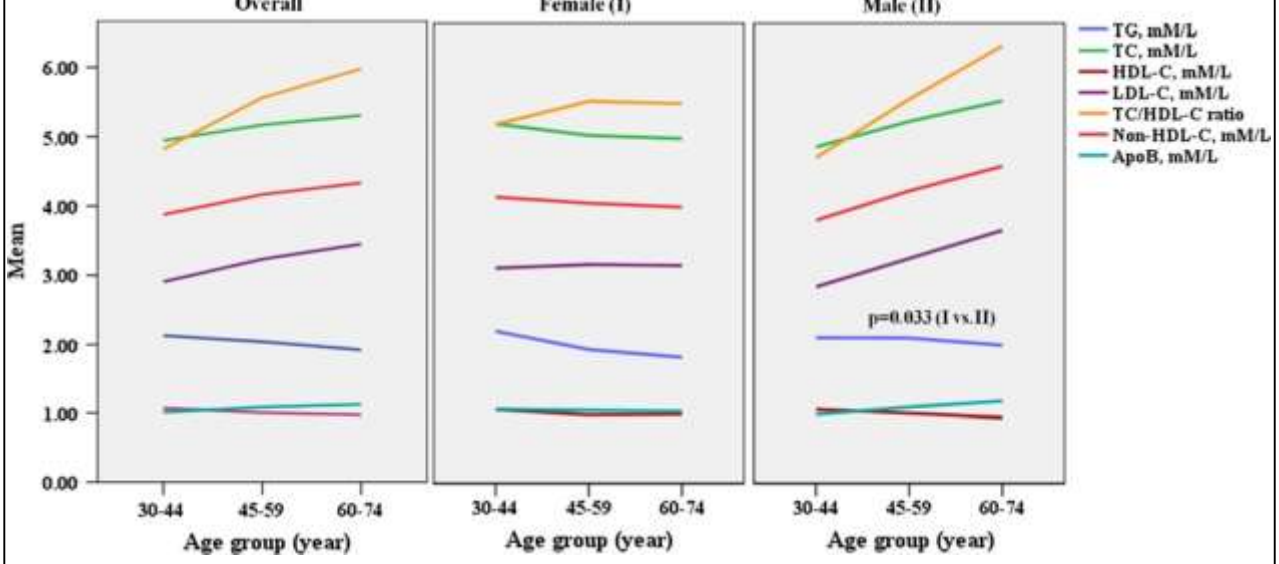


**Fig. 1** Age- and sex specific mean values of serum lipid parameters and their ratio in diabetic patients. Student's t-test was used to compare the group means of female (I) and male (II) patients. One-way ANOVA was used for comparing serum levels of single lipid parameter within three different age groups (30–44, 45–59 and 60–74). ***p for trend <0.001, **p for trend <0.010 *p for trend <0.05 (two tailed). TG, triglycerides; TC, total cholesterol; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; ApoB, apolipoprotein B. Mean refers to the serum mean concentrations and ratio of lipid parameters

The results of bivariate correlation analysis are pre- sented in Table 4. All correlations were significant at the level of $p < 0.001$. Both fasting plasma glucose and HbA1c showed significant ($p < 0.001$) positive correlations with TG, TC, LDL-C, TC/HDL-C ratio, non-HDL-C, ApoB and mixed dyslipidemia except for HDL-C in which case the correlation was negative. TC, LDL, TC/HDL-C ratio and non-HDL-C showed strong positive correlation with ApoB. TC, HDL-C and LDL-C also showed strong cor- relation with TC/HDL-C ratio. Non-HDL-C and ApoB showed the highest correlation with mixed dyslipidemia.

Multivariate logistic regression models were used to identify the independent predictors of dyslipidemia in the diabetic patients (Table 5). High LDL-C, high non- HDL-C, high ApoB and mixed dyslipidemia were asso- ciated with male gender. Only low HDL-C and high TC/ HDL-C ratio were associated with central obesity. Like- wise, only hypertriglyceridemia and high TC/HDL-C was associated with current smoking habit. Hypercholester- olemia, low HDL-C, high LDL-C, high TC/HDL-C, high non-HDL-C and high ApoB were associated with fasting hyperglycemia. Hypertriglyceridemia, hypercholester- olemia, high LDL-C, high TC/HDL-C, high non-HDL-C, high ApoB and mixed dyslipidemia were associated with poor

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

glycemic control. Likewise, all forms of dyslipidemia except high LDL-C and mixed dyslipidemia were associ- ated with hypertension. Only hypercholesterolemia was found to be associated with duration of hypertension. All associations between dyslipidemia and risk factors were positive except for duration of diabetes in which case the association was negative.

**Discussion and Conclusion**

**Discussion**

The aim of our study was to determine the prevalence, pattern and predictors of atherogenic dyslipidemia in a cohort of type 2 diabetic patients from a the King Khalid university hospital in saudi arabia. We found that the majority of the patients had higher levels of serum TG, TC, non-HDL-C, ApoB and TC/HDL-C ratio and lower level of serum HDL-C than the cut off values recom- mended by the NCEP ATP III [2]. Abnormal lipid pro- files in our diabetic patients were not surprising. Insulin resistance or deficiency leads to increased rate of lipolysis in adipocytes and influx of free fatty acids into the liver resulting into overproduction of triglyceride rich lipo- proteins. Moreover there is delayed clearance of such lipoproteins due to decreased activity of the endothe- lial bound enzyme lipoprotein lipase [19]. There was no significant difference between the serum levels of these lipid parameters between males and females except for serum TG, which is in agreement with previous hospital and population based studies in Asian, African, Euro- pean and North American type 2 diabetic populations [11–20]. Some studies have also shown higher levels of atherogenic lipid profile in women [22–24] but such dif- ferent outcomes may have resulted from differences in age distribution, treatment status for diabetes and dyslip- idemia, glycemic status, duration of diabetes and nature of study population.

Age is a non-modifiable risk factor for CVD [2]. We next analyzed the effect of age on serum lipid profile

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

of our patients. We observed a rise in the serum levels of TC, LDL-C, non-HDL-C, ApoB and TC/HDL-C ratio with increasing age of patients and a gradual fall in serum TG and HDL-C levels. Several cross-sectional and lon- gitudinal studies conducted elsewhere have also shown similar results [18–20]. The plasma level of lipids is deter- mined by the balance between synthesis and removal of lipoprotein particles. Ageing causes increased TC and LDL-C levels due to impaired clearance from plasma through reduced expression of hepatic LDL-C recep- tor [8]. Similarly, age-associated rise in ApoB has been shown to be the result of an increased production of VLDL ApoB-100 and decreased clearance rate of LDL-C ApoB-100 [29]. Plasma TG levels were expected to be higher in older patients, but this was not observed in our study. The unexpected decline of plasma TG level with the advancing age could partly be due to masking effect of treatment of certain old age patients with insulin and lipid lowering drugs. Moreover, menopause has been shown to be an additional risk factor in older women that significantly decreases plasma HDL-C and increases LDL-C levels [16]. Age related decline in HDL-C lev- els likely results from insulin resistance, inflammation, hormonal decline, cellular senescence and ageing of the HDL-C particle itself, affecting HDL-C formation [17]. This explains the increased prevalence of atherogenic dyslipidemia and risk of CVD with age. Our study has confirmed previous findings that serum lipid param- eters are highly correlated with fasting blood glucose and HbA1C, irrespective of the population studied. We further observed moderate to strong correlation of pri- mary lipid parameters such as TC, HDL-C, and LDL-C with derived or secondary lipid parameters such as TC/ HDL-C ratio, non-HDL-C and ApoB which are regarded as better predictors of insulin resistance, metabolic syn- drome and CVDs [20].

There are some studies from other parts of saudi arabia that have reported varying prevalence and pattern of dyslipi- demia in type 2 diabetic patients [20, 33, 34]. The latest prevalence of mixed dyslipidemia was

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

63.8% in eastern Saudi Arabia, 61.0% in central Saudi Arabia and 90.7% in mid-western Saudi Arabia. The most prevalent single dyslipidemia in both central and mid-western Saudi Arabia was low HDL-C. The least prevalent single dyslipidemia was hypercholester- olemia in Saudi Arabia

Our study provides the first detailed report on the prevalence and pattern of dyslipidemia in diabetic population from the riyadh city zones . We found high prevalence of dyslipidemia in our patients, with mixed dyslipidemia being the predominant type. The most prevalent primary single dyslipidemia was high LDL-C while hypercho- lesterolemia was the least prevalent. Three quarters of the patient population showed high non-HDL-C. High LDL-C was the only isolated dyslipidemia present in our patients. The typical atherogenic dyslipidemia was pre- sent in about half of the patients. Males had significantly higher prevalence of high LDL-C, high non-HDL-C, high ApoB and mixed dyslipidemia than females, while other lipid parameters were similar. This is in agreement with previous reports from saudi arabia and elsewhere.

**Conclusions**

Our study provides the first detailed report of preva- lence, pattern and predictors of atherogenic dyslipidemia in type 2 diabetic patients attending at King Khalid university hospital region of riyadh. It has shown an alarmingly high prevalence of dyslipidemia. Mixed dys- lipidemia is more prevalent than combined or single dys- lipidemia. The prevalence of dyslipidemia was found to be strongly associated with various co-variate risk factors of CVD such as old age, male gender, smoking, poor gly- cemic control, obesity and hypertension suggesting high risk of future CVD. Our study therefore contributes to the epidemiology of diabetic dyslipidemia from the West- ern hilly

region of Saudi Arabia and serves as supportive data for health policy planners to formulate and implement poli- cies that aim to increase public awareness about diabetic dyslipidemia, healthy diet and life-style among diabetic patients and health care providers. It also highlights the need of regular monitoring of blood glucose and lipid profile, aggressive lifestyle changes such as weight reduc- tion and physical exercise and effective medication with anti-diabetic and lipid lowering drugs to obtain proper glycemic control and lipid profile. However, a population based nationwide survey is still warranted to reflect the actual epidemiology of diabetic dyslipidemia in Saudi Arabia as no such studies has been carried out so far.

**References**

1. Pappan N, Rehman A. Dyslipidemia. StatPearls; 2022.

2. Abujbara M, Batieha A, Khader Y, Jaddou H, El-Khateeb M, Ajlouni K. The Prevalence of Dyslipidemia among Jordanians. J Lipids.2018;2018:6298739. doi:10.1155/2018/6298739

3. Qi L, Ding X, Tang W, Li Q, Mao D, Wang Y. Prevalence and risk factors associated with Dyslipidemia in Chongqing, China. Int J Environ Res Public Health. 2015;12(10):13455–13465. doi:10.3390/ijerph121013455

4. Khader YS, Batieha A, El-Khateeb M, Al Omari M, Ajlouni K. Prevalence of dyslipidemia and its associated factors among Jordanian adults. J Clin Lipidol. 2010;4(1):53–58. doi:10.1016/j.jacl.2009.12.004

5. Ajlouni K, Batieha A, Jaddou H, et al. Time trends in diabetes mellitus in Jordan between

1994 and 2017. Diabet Med. 2019;36(9):1176–1182.

6. Raffee LA, Alawneh KZ, Ibdah RK, et al. Prevalence, clinical characteristics, and risk among patients with ischemic heart disease in the young Jordanian population. Open Access Emerg Med. 2020;12:389–397.

7. Islam SM, Purnat TD, Phuong NT, Mwingira U, Schacht K, Froschl G. Non-communicable diseases (NCDs) in developing countries: a symposium report. Global Health. 2014;10:81. doi:10.1186/s12992-014-0081-9

8. Bloomgarden ZT. American Diabetes Association Annual Meeting, 1999: more on cardiovascular disease. Diabetes Care. 2000;23(6):845–852.doi:10.2337/diacare.23.6.845

9. Murray CJ, Lopez AD. Mortality by cause for eight regions of the world: global Burden of Disease Study. Lancet. 1997;349(9061):1269–1276.doi:10.1016/S0140-6736(96)07493-4

10. Zagrebin EA, Shevchenko EA, Ivanchenko EY, et al. Correlation of lipid profile and glycated hemoglobin as a new prognostic criterion for Type 2 diabetes mellitus development and progression. Sovrem Tekhnologii Med. 2020;12(2):87–91. doi:10.17691/stm2020.12.2.11

11. Ozder A. Lipid profile abnormalities seen in T2DM patients in primary healthcare in Turkey: a cross-sectional study. Lipids Health Dis.2014;13:183. doi:10.1186/1476-511X-13-183

12. Artha I, Bhargah A, Dharmawan NK, et al. High level of individual lipid profile and lipid ratio as a predictive marker of poor glycemic control in

type-2 diabetes mellitus. Vasc Health Risk Manag. 2019;15:149–157. doi:10.2147/VHRM.S209830

13. Costa J, Borges M, David C, Vaz Carneiro A. Efficacy of lipid lowering drug treatment for diabetic and non-diabetic patients: meta-analysis of

randomised controlled trials. BMJ. 2006;332(7550):1115–1124. doi:10.1136/bmj.38793.468449.AE

14. Heart Protection Study Collaborative G. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk

individuals: a randomised placebo-controlled trial. Lancet. 2002;360(9326):7–22.

15. Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. JAMA. 2004;291(3):335–342. doi:10.1001/jama.291.3.335

16. American Diabetes A. Standards of medical care in diabetes-2016 abridged for primary care providers. Clin Diabetes. 2016;34(1):3–21.

17. American Diabetes Association. Summary of revisions: standards of medical care in diabetes-2020. Diabetes Care. 2020;43(Suppl1):S4–S6.

18. Haffner SM, American Diabetes A. Dyslipidemia management in adults with diabetes. Diabetes Care. 2004;27(Suppl 1):S68–S71. doi:10.2337/

19. National Cholesterol Education Program Expert Panel on Detection E, Treatment of High Blood Cholesterol in A. 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. 2002;106(25):3143–3421.

Journal of University Studies for inclusive Research (USRIJ)
مجلة الدراسات الجامعية للبحوث الشاملة
ISSN: 2707-7675

doi:10.1161/circ.106.25.3143

20. Report of a WHO Expert Committee. Physical status: the use and interpretation of anthropometry. World Health Organ Tech Rep Ser. 1995;854:1–452.