Biomedical Research and Therapy 2024, 11(4):6297-6304

Open Access Full Text Article

Research article

Assessing LDL Cholesterol Management and Statin Use in Diabetic Patients: Disparities and Outcomes in a Vietnamese Tertiary Hospital Setting

Si Van Nguyen[1,2,*], Dung Hoang Nguyen[1], Vuong Van Dang[1], Binh Duc Doan[2], Bao Quoc Dinh[1], Tung Thien Nguyen[1], Canh Quang Nguyen[3], Dung Truong My Pham[2]

ABSTRACT

Introduction: The control of low-density lipoprotein (LDL) cholesterol is a critical concern, especially for patients with diabetes, where the use of statins is essential. Despite this necessity, actual treatment practices and the achievement of LDL cholesterol targets are often suboptimal. This study aimed to assess the rate of LDL cholesterol goal attainment and examine statin prescribing habits within the cardiology and endocrinology departments of a tertiary hospital in Ho Chi Minh City, Vietnam. **Methods**: This retrospective study encompassed 515 diabetic patients. We performed cardiovascular risk stratification to set appropriate LDL cholesterol goals for each patient. Through both univariate and multivariate analyses, we identified factors that influence LDL cholesterol management. Additionally, we reviewed patients' statin prescriptions before and after LDL cholesterol evaluation to understand prescribing patterns. **Results**: Our study found that all included patients were categorized as having high or very high cardiovascular risk. A significant majority, 88.2%, were prescribed statins at an intermediate intensity. However, only 15.3% achieved their LDL cholesterol targets—21.7% in the high-risk category and a mere 9.4% in the very high-risk group. Factors conducive to effective LDL cholesterol management included being female, belonging to the very high cardiovascular risk group, and concurrent use of fibrates. Noticeably, among patients not meeting their LDL cholesterol goals, only 10.1% had their statin dosage increased post-evaluation. It was also observed that endocrinologists tended to reduce or discontinue statin dosages more often than cardiologists. **Conclusions**: The rate at which diabetic patients in Vietnam meet their LDL cholesterol targets is alarmingly low. Priority should be given to female patients and those at very high cardiovascular risk to improve target attainment rates. There is a clear need for targeted interventions to enhance statin prescribing practices and, by extension, the management of LDL cholesterol in this population.

Key words: Diabetes, LDL cholesterol, statins, therapeutic inertia

[1]*University of Medicine and Pharmacy at Ho Chi Minh City, Viet Nam*

[2]*Nhan Dan Gia Dinh Hospital, Ho Chi Minh City, Viet Nam*

[3]*Military Hospital 7A, Ho Chi Minh City, Viet Nam*

Correspondence

Si Van Nguyen, University of Medicine and Pharmacy at Ho Chi Minh City, Viet Nam

Nhan Dan Gia Dinh Hospital, Ho Chi Minh City, Viet Nam

Email: si.nguyen@ump.edu.vn

History

- Received: Jan 06, 2024
- Accepted: Apr 03, 2024
- Published Online: Apr 30, 2024

DOI : 10.15419/bmrat.v11i4.876

Check for updates

INTRODUCTION

Dyslipidemia significantly increases the risk of cardiovascular diseases; therefore, effective management, specifically in controlling low-density lipoprotein (LDL) cholesterol, is imperative. Statins are the primary treatment for lowering LDL cholesterol due to their proven efficacy in reducing cardiovascular events. Recent guidelines emphasize the need for stricter LDL cholesterol targets for individuals at high or very high cardiovascular risks - a category that diabetic patients almost invariably fall into. This underscores the need for rigorous LDL cholesterol management in these individuals [1,2].

Despite clear guidelines, reaching LDL cholesterol targets often remains a challenge in clinical practice, even in developed countries. It is reported that only 35% and 14% of patients have met the LDL cholesterol targets recommended by the 2016 and 2019 ESC-EASD (European Society of Cardiology/European Association for the Study of Diabetes) guidelines, respectively [3]. This shortfall is attributed to various factors, including the prescription habits across different medical specialties.

Analysis shows a significantly lower rate of statin use among patients with type 2 diabetes in endocrinology departments compared to their counterparts in cardiology departments. Notably, the achievement of LDL cholesterol targets is significantly higher in patients managed within cardiology departments than those in endocrinology departments [4]. Hence, this study aims to investigate the real-world management of LDL cholesterol and the statin prescription patterns among diabetic patients attending cardiology and endocrinology outpatient clinics at a tertiary hospital

Cite this article : Nguyen S V, Nguyen D H, Dang V V, Doan B D, Dinh B Q, Nguyen T T, Nguyen C Q, Pham D T M. **Assessing LDL Cholesterol Management and Statin Use in Diabetic Patients: Disparities and Outcomes in a Vietnamese Tertiary Hospital Setting**. *Biomed. Res. Ther.* 2024; 11(4):6297-6304.

Table 1: Baseline characteristics of the participants

	Total (N = 515)	Cardiology clinic (N = 331)	Endocrinology clinic (N = 184)	P -value
Demographic features				
Female	290 (56.3)	186 (56.2)	104 (56.5)	0.943
Age	66 (60-72)	67 (61-73)	64 (59-70)	< 0.05
Comorbidities				
Hypertension	500(97.1)	318 (96.1)	182 (98.9)	0.066
CCS	246 (47.8)	198 (59.8)	48 (26.1)	< 0.05
Heart failure	25 (4.9)	25 (7.6)	0	< 0.05
Atrial fibrillation	30 (5.9)	29 (8.8)	1 (0.5)	< 0.05
Stroke	13 (2.5)	9 (2.7)	4 (2.2)	0.779
PAD	3 (0.6)	3 (0.9)	0	0.556
CKD	48 (9.3)	21 (6.3)	27 (14.7)	< 0.05
Thyroid disease	12 (2.4)	7 (2.1)	5 (2.7)	0.664
Lung disease	5 (1.0)	3 (0.9)	2 (1.1)	1.000
Joint disease	44 (8.5)	19 (5.7)	25 (13.6)	< 0.05
Laboratory results				
Hemoglobin (g/L)	135 (124-144)	135 (124-143)	135 (123-145)	0.253
HbA1C (%)	6.6 (6-7.6)	6.4 (5.9-7.5)	6.9 (6.1-8.1)	0.016
Creatinine (umol/L)	88.5 (76-104.4)	88.9 (76.1-105)	88.2 (75.5-104.2)	0.125
AST (IU/L)	26 (21.8-32)	26.2 (22-32)	25 (21.4-31.6)	0.644
ALT (IU/L)	25.6 (18.5-37.6)	25.4 (19-36)	25.6 (17.5-39.4)	0.499
Cholesterol (mmol/L)	4.0 (3.4-4.9)	4.0 (3.4-4.9)	4.0 (3.3-4.8)	0.305
Triglyceride (mmol/L)	1.8 (1.3-2.6)	1.6 (1.3-2.6)	1.8 (1.3-2.6)	0.679
HDL cholesterol (mmol/L)	1.1 (1.0-1.3)	1.2 (1-1.3)	1.1 (1.0-1.3)	0.349
LDL cholesterol (mmol/L)	2.2 (1.9-3.0)	2.3 (1.9-3.0)	2.2 (1.8-2.8)	0.476
TG/HDL	1.7 (1.1-2.5)	1.7 (1.0-2.5)	1.7 (1.1-2.5)	0.858
TG/LDL	0.8 (0.6-1.1)	0.8 (0.5-1.1)	0.8 (0.6-1.1)	0.381
Cardiovascular risk				
High	249 (48.4)	118 (35.7)	131 (71.2)	< 0.05
Very high	266 (51.6)	213 (64.3)	53 (28.8)	
Medications				
ARNI	2 (0.4)	2 (0.6)	0	0.540
ACE inhibitors	98 (19.0)	66 (19.9)	32 (17.4)	0.480
ARBs	321 (62.3)	227 (68.6)	94 (51.1)	< 0.05
BBs	360 (69.9)	263 (79.5)	97 (52.7)	< 0.05
CCBs	264 (51.3)	180 (54.4)	84 (45.6)	0.934
Diuretics	122 (23.7)	92 (27.8)	30 (16.3)	< 0.05
MRA	25 (4.9)	25 (7.6)	0	< 0.05
Aspirin	73 (14.17)	46 (13.9)	27 (14.7)	0.809
P2Y12 inhibitors	126 (24.5)	101 (30.5)	25 (13.6)	< 0.05
VKAs	10 (1.9)	10 (3.0)	0	< 0.05
DOACs	20 (3.9)	20 (6.0)	0	< 0.05
Insulin	70 (13.6)	11 (3.3)	59 (32.1)	< 0.05
Metformin	314 (61.0)	160 (48.3)	154 (83.7)	< 0.05
SGLT2 inhibitors	3 (0.58)	1 (0.3)	2 (1.1)	0.291

Continued on next page

Table 1 continued

	Total (N = 515)	Cardiology clinic (N = 331)	Endocrinology clinic (N = 184)	P -value
DPP4 inhibitors	3 (0.58)	0	3 (1.6)	< 0.05
Sulfonylureas	197 (38.3)	102 (30.1)	95 (51.3)	< 0.05
Acarbose	65 (12.6)	13 (3.9)	52 (28.3)	< 0.05
Lipid-lowering agents				
Statins				
Atorvastatin	345 (70.7)	211 (65.3)	134 (81.2)	< 0.05
Rosuvastatin	141 (28.9)	112 (34.7)	29 (17.6)	
Simvastatin	2 (0.4)	0	2 (1.2)	
Statin intensity				
High	34 (6.6)	33 (10.0)	1 (0.5)	< 0.05
Intermediate	454 (88.2)	290 (87.6)	164 (89.1)	0.671
Others				
Fibrates	30 (5.8)	9 (2.7)	21 (11.4)	< 0.05
Ezetimibe	6 (1.2)	2 (0.6)	4 (2.17)	0.194

Abbreviations: **ACE**: angiotensin-converting enzyme, **ALT**: alanine transaminase, **ARB**: angiotensin receptor blocker, **ARNI**: sacubitril/valsartan, **AST**: aspartate transaminase, **BB**: beta blocker, **CCB**: calcium channel blocker, **CCS**: chronic coronary syndrome, **CKD**: chronic kidney disease, **DOAC**: direct oral anticoagulant, **DPP4**: dipeptidyl peptidase 4, **HDL**: high-density lipoprotein, **LDL**: low-density lipoprotein, **MRA**: mineralocorticoid receptor antagonist, **PAD**: peripheral arterial disease, **SGLT2**: sodium-glucose cotransporter 2, **TG**: triglyceride, **VKA**: vitamin K antagonists.

in Vietnam. By identifying potential disparities between these specialties, the study seeks insights that could lead to enhanced management strategies. Additionally, it explores the risk factors that hinder the achievement of optimal LDL cholesterol control, aiming to find solutions to improve patient outcomes.

Table 2: LDL cholesterol target achievement

	Total (N = 515)	Cardiology clinic (N = 331)	Endocrinology clinic (N = 184)	P-value
Total	79 (15.3)	45 (13.6)	34 (18.5)	0.141
High risk	54 (21.7)	28 (23.7)	26 (19.8)	0.458
Very high risk	25 (9.4)	17 (8.0)	8 (15.1)	0.112

METHODS

Study Design and Participants

This retrospective study encompassed 515 type 2 diabetes patients aged 18 and above who were receiving treatment at the cardiology (N = 331) and endocrinology (N = 184) clinics of Nhan Dan Gia Dinh Hospital in Ho Chi Minh City, Vietnam. Data collection was a part of regular clinical care, negating the need for separate patient consent for this process.

Data were gathered from May 2021 to May 2022, with analysis occurring from May to June 2023. During analysis, patients' personal information was anonymized to ensure confidentiality. Exclusion criteria included those not treated with lipid-lowering medications for a minimum of three months, individuals with conditions that affect lipid absorption/metabolism, and pregnant women. Detailed characteristics of the study population are delineated in **Table 1** and **Table S1**.

Outcome Definition and Data Collection

Cardiovascular risk levels and LDL cholesterol objectives were established according to Nhan Dan Gia Dinh Hospital's protocols, aligning with contemporary international guidelines. Goals for LDL cholesterol levels were set at <1.8 mmol/L for high-risk and <1.4 mmol/L for very high-risk groups. Statin treatment intensity categories were defined as: low (atorvastatin <10 mg, rosuvastatin <5 mg), moderate (atorvastatin 10–20 mg, rosuvastatin 5–10 mg), and high (atorvastatin 40–80 mg, rosuvastatin 20–40 mg).

Lipid analyses and other laboratory evaluations were conducted at Nhan Dan Gia Dinh Hospital under stringent adherence to the Vietnamese Ministry of Health's guidelines. Also assessed was the statin prescription practice, focusing on adjustments in statin dosage or the incorporation of other lipid-lowering agents based on serum lipid outcomes.

Statistical Analysis

Descriptive data are presented as the mean ± SD, median, or percentage (%), as appropriate. The Shapiro-Wilk test assessed the normality of data distribution. Continuous variables, showing non-normal distribution, are reported as median with interquartile ranges (25^{th} and 75^{th} percentiles).

Group comparisons for categorical variables utilized the Chi-squared test, while differences in continuous variables between two groups were analyzed using the Mann-Whitney U test. The exploration of associated factors made use of univariate or multivariate logistic regression analyze, drawing on variables identified from preceding research [5–7]. Variables moving to multivariate analysis exhibited a P-value of <0.2 in univariate scrutiny.

Significance levels for all tests were set at a two-tailed P-value of <0.05, with confidence intervals calculated at the 95% level. Analyses were conducted utilizing STATA software version 17.0 (StataCorp, College Station, TX, USA).

RESULTS

Baseline Characteristics of Participants

Upon comparing patient groups, those at the cardiology clinic were found to be older, had a higher prevalence of cardiovascular complications and atrial fibrillation, but showed fewer cases of joint diseases than their counterparts at the endocrinology clinic. This aligns with the observation that the cardiology clinic housed a greater number of patients classified as very high cardiovascular risk. Consequently, medications associated with very high cardiovascular risk—such as P2Y12 inhibitors, anticoagulants, angiotensin receptor blockers, beta blockers, diuretics, and mineralocorticoid receptor antagonists (MRAs)—were more commonly prescribed in the cardiology group. Conversely, the endocrinology group more frequently used insulin, metformin, dipeptidyl peptidase 4 (DPP4) inhibitors, sulfonylureas, and acarbose. Additionally, chronic kidney disease was more prevalent among patients in the endocrinology clinic (refer to **Table 1**).

No significant differences were observed in the lipid profile, specifically LDL cholesterol levels, between the two groups. The levels of triglycerides (TG), high-density lipoprotein (HDL) cholesterol, as well as the ratios of TG/HDL, and TG/LDL, were comparable across both specialties. However, in patients with uncontrolled LDL, the TG/LDL ratio was notably higher (refer to **Table S1**). Markers indicating liver injury, such as aspartate transaminase (AST) and alanine transaminase (ALT), did not present elevated levels. Notably, the endocrinology group exhibited higher HbA1C levels.

Regarding dyslipidemia treatment, statins were predominantly prescribed to the vast majority of patients. Only two individuals received simvastatin, and both were from the endocrinology group. Rosuvastatin and high-intensity statins were more frequently used in the cardiology group. Although fibrates were prescribed more in the endocrinology group, this difference did not reflect significant divergence in triglyceride levels between the two clinics (refer to **Table 1**).

Table 3: Univariate and multivariate analyses for LDL cholesterol control

Variables	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Cardiology clinic	0.69 (0.43-1.13)	0.142	0.85 (0.49-1.47)	0.568
Age	0.85 (0.52-1.38)	0.515	–	–
Female gender	0.64 (0.39-1.03)	0.066	0.59 (0.36-0.97)	< 0.05
Fibrates	0.20 (0.02-1.51)	0.119	0.12 (0.02-0.95)	< 0.05
High intensity statin	1.78 (0.77-4.08)	0.175	2.16 (0.89-5.24)	0.090
Very high cardiovascular risk	0.37 (0.22-0.62)	< 0.05	0.35 (0.20-0.61)	< 0.05
Chronic kidney disease	1.99 (0.99-4.02)	0.055	1.96 (0.93-4.12)	0.078

Table 4: Lipid-lowering treatment modification in not-at-target patients

	Total (N = 436)	Cardiology clinic (N = 286)	Endocrinology clinic (N = 150)	P -value
Increase	44 (10.1)	29 (10.1)	15 (10.0)	0.963
Unchange	306 (70.2)	211 (73.8)	95 (63.3)	< 0.05
Decrease/stop	86 (19.7)	46 (16.1)	40 (26.7)	< 0.05
Drug modification				
Change to fibrates	21 (4.8)	11 (3.6)	10 (6.7)	0.191
Combination	3 (0.7)	1 (0.4)	2 (1.3)	0.238

LDL Cholesterol Achievement Rates and Associated Factors

The overall control rate for LDL cholesterol stood at 15.3%, with no observable difference between the cardiology and endocrinology clinics. The group at very high cardiovascular risk demonstrated a significantly lower success rate in achieving LDL cholesterol objectives compared to the high-risk group (refer to **Table 2**). Analyses, both univariate and multivariate, identified female gender, fibrate prescription, and a classification of very high cardiovascular risk as factors adversely affecting LDL cholesterol management (refer to **Table 3**).

Lipid-lowering Treatment Modification in Patients Not Meeting LDL Cholesterol Targets

An in-depth investigation was conducted among patients who failed to meet the LDL cholesterol target (N = 436), focusing on clinicians' prescription practices. The increase of statin doses was conducted at a rate of 10.1%, distributed uniformly across both specialties. It is worth noting that endocrinologists showed a greater propensity to either reduce statin doses or discontinue their use altogether compared to cardiologists (refer to **Table 4**).

DISCUSSION

Nhan Dan Gia Dinh Hospital, a tertiary general facility, adheres to the ESC/EASD 2019 guidelines, which specify lower LDL cholesterol targets for diabetic patients at high and very high cardiovascular risk [1,2]. Our findings indicate a notably low success rate in meeting these LDL cholesterol goals, particularly among the very high-risk individuals. This trend aligns with recent studies focusing on the Asian demographic [8,9], suggesting that setting lower LDL cholesterol targets is a significant factor behind the low achievement rates [10]. A surprising finding from our study is that higher cardiovascular risk correlates with lesser success in LDL cholesterol management. Factors such as female gender were linked to suboptimal LDL cholesterol control, attributed to lower treatment adherence, lipid metabolism differences, and potential societal barriers affecting women [11].

When examining other lipid parameters, such as the TG/HDL and TG/LDL ratios, no significant differences emerged between the two clinics studied. However, a noteworthy distinction was seen in patients with managed LDL cholesterol levels, where the TG/LDL ratio was substantially elevated compared to those with uncontrolled levels. This ratio is indicative of small, dense LDL particles in diabetic patients and suggests residual risk in dyslipidemia management. Therefore, attention to the TG/LDL ratio, along with other lipid markers, could enhance dyslipidemia control post-LDL cholesterol target achievement.

Regarding statin therapy, our analysis indicated a preference for moderate over high-intensity statin therapy among our patient cohort. Notably, we recorded neither complaints nor diagnoses pertaining to statin adverse effects. Some patients were on fibrates, either alone or in conjunction with statins. Our analysis revealed that fibrate use negatively impacted LDL cholesterol goal attainment. Given the atherogenic lipid profile commonly seen in diabetic patients—marked by prominent hypertriglyceridemia [12] —fibrates' efficacy in reducing triglycerides does not translate well to lowering LDL cholesterol. Their benefits, particularly when compared to statins, remain debatable or marginally inferior [13]. While combining fibrates with statins is deemed safe, the evidence supporting outcome benefits is unconvincing [14]. This observation led us to speculate on the hesitancy in prescribing high-intensity statins alongside fibrates.

Moreover, our study highlighted a substantial oversight in statin dose adjustment among patients not meeting their lipid targets, with only 10.1% receiving an increase in their statin dosage. This reluctance to intensify treatment, known as clinical inertia, is linked to poor management of cardiometabolic conditions [15]. We observed a variation in therapeutic inertia across different clinical specialties; both clinics exhibited high rates of unchanged statin doses, whereas endocrinologists were more likely to reduce or discontinue statin therapy. This finding underscores the need for more aggressive statin therapy across specialties to combat inertia.

Factors contributing to clinical inertia include gaps in provider knowledge, discomfort with diagnostic ambiguities or treatment goals, and safety concerns. Patient-related factors such as male gender, older age, limited life expectancy, multiple comorbidities (especially psychiatric), medication load, and nearly achieved clinical targets (*e.g.*, LDL cholesterol levels) also play a role [16]. The challenges of high patient volumes and time constraints, particularly prevalent in Vietnamese tertiary hospitals, exacerbate this issue [16]. Addressing clinical inertia necessitates a comprehensive approach that includes education for both clinicians and patients, team-based care, and population health management strategies [17]. Emphasizing guideline familiarity among physicians, especially regarding total cholesterol interpretation in the context of other cardiovascular risk factors, and integrating clinical information into healthcare systems are vital for improving prescribing practices [18].

This study's limitations are its single-center, two-specialty focus, lack of investigation into lifestyle modifications impacting LDL cholesterol control, and the absence of data on patient treatment adherence. Addressing these gaps is crucial for future research initiatives.

CONCLUSIONS

The rate at which diabetic patients managed to reach their LDL cholesterol targets was notably low across two principal departments of a tertiary hospital in Vietnam. Special attention is needed for female patients and those at very high cardiovascular risk to enhance control over LDL cholesterol levels. To achieve better outcomes, it is crucial to implement targeted interventions aimed at refining clinicians' prescription practices. This includes a focus on the use of high-intensity statins, making proper dose adjustments, and avoiding the premature use of fibrates.

ABBREVIATIONS

LDL - Low-Density Lipoprotein, **ESC-EASD** - European Society of Cardiology/European Association for the Study of Diabetes, **TG** - Triglycerides,

HDL - High-Density Lipoprotein, **AST** - Aspartate Transaminase, **ALT** - Alanine Transaminase, **HbA1C** - Hemoglobin A1c, **DPP4** - Dipeptidyl Peptidase 4, **MRAs** - Mineralocorticoid Receptor Antagonists, **SD** - Standard Deviation

ACKNOWLEDGMENTS

None.

AUTHOR'S CONTRIBUTIONS

SVN and DTMP were involved in the initial idea and design of this study. BDD, BQD and NTT collected the data. DHN and VVD analyzed the data. SVN, DHN, VVD, CQN and DTMP worked on the subsequent revisions and all authors contributed to the intellectual content of the paper. All authors have read and approved the final version of this manuscript.

FUNDING

None.

AVAILABILITY OF DATA AND MATERIALS

Data are available upon reasonable request. To request access to the underlying research data, please contact Si Van Nguyen at si.nguyen@ump.edu.vn.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethics Committee of Nhan Dan Gia Dinh Hospital (37/NDGD-HDDD on March 3, 2022).

CONSENT FOR PUBLICATION

Not applicable.

COMPETING INTERESTS

The authors declare that they have no competing interests.

REFERENCES

1. Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. European Heart Journal. 2020;41(1):111–88. PMID: 31504418. Available from: https://doi.org/10.1093/eurheartj/ehz455.
2. Cosentino F, Grant PJ, Aboyans V, Bailey CJ, Ceriello A, Delgado V, et al. 2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD. European Heart Journal. 2020;41(2):255–323. PMID: 31497854. Available from: https://doi.org/10.1093/eurheartj/ehz486.
3. Morieri ML, Avogaro A, Fadini GP, the DARWIN-T2D Network of the Italian Diabetes Society. Cholesterol lowering therapies and achievement of targets for primary and secondary cardiovascular prevention in type 2 diabetes: unmet needs in a large population of outpatients at specialist clinics. Cardiovascular Diabetology. 2020;19(1):190. PMID: 33172454. Available from: https://doi.org/10.1186/s12933-020-01164-8.
4. Chen Z, Wang X, Ding Z, Fan P, Ma G. Differences in statin usage and target-goal achievement between departments at the same hospital. PLoS One. 2012;7(12). PMID: 23251371. Available from: https://doi.org/10.1371/journal.pone.0050466.
5. Kim S, Han S, Rane PP, Qian Y, Zhao Z, Suh HS. Achievement of the low-density lipoprotein cholesterol goal among patients with dyslipidemia in South Korea. PLoS One. 2020;15(1). PMID: 31999714. Available from: https://doi.org/10.1371/journal.pone.0228472.
6. Danchin N, Almahmeed W, Al-Rasadi K, Azuri J, Berrah A, Cuneo CA, et al. Achievement of low-density lipoprotein cholesterol goals in 18 countries outside Western Europe: The International ChoLesterol management Practice Study (ICLPS). European Journal of Preventive Cardiology. 2018;25(10):1087–94. PMID: 29771156. Available from: https://doi.org/10.1177/2047487318777079.
7. Zhang S, Li ZF, Shi HW, Zhang WJ, Sui YG, Li JJ. Comparison of Low-Density Lipoprotein Cholesterol (LDL-C) Goal Achievement and Lipid-Lowering Therapy in the Patients With Coronary Artery Disease With Different Renal Functions. Frontiers in Cardiovascular Medicine. 2022;9. PMID: 35620524. Available from: https://doi.org/10.3389/fcvm.2022.859567.
8. Yang YS, Yang BR, Kim MS, Hwang Y, Choi SH. Low-density lipoprotein cholesterol goal attainment rates in high-risk patients with cardiovascular diseases and diabetes mellitus in Korea: a retrospective cohort study. Lipids in Health and Disease. 2020;19(1):5. PMID: 31926562. Available from: https://doi.org/10.1186/s12944-019-1158-5.
9. Wang X, He Y, Wang T, Li C, Ma Z, Zhang H. Lipid-Lowering Therapy and Low-Density Lipoprotein Cholesterol (LDL-C) Goal Achievement in High-Cardiovascular-Risk Patients in Fuzhou, China. Journal of Cardiovascular Pharmacology and Therapeutics. 2020;25(4):307–15. PMID: 31918567. Available from: https://doi.org/10.1177/1074248419899298.
10. Vintila AM, Horumba M, Cimpu C, Dumitrescu D, Miron P, Alucai A. Target achievement in very high risk patients in light of the new dyslipidemia guidelines. Journal of Hypertension. 2021;39. Available from: https://doi.org/10.1097/01.hjh.0000748880.95364.6c.
11. Russo G, Pintaudi B, Giorda C, Lucisano G, Nicolucci A, Cristofaro MR. Age- and Gender-Related Differences in LDL-Cholesterol Management in Outpatients with Type 2 Diabetes Mellitus. International Journal of Endocrinology. 2015;2015. PMID: 25873960. Available from: https://doi.org/10.1155/2015/957105.
12. Hirano T. Pathophysiology of Diabetic Dyslipidemia. Journal of Atherosclerosis and Thrombosis. 2018;25(9):771–82. PMID: 29998913. Available from: https://doi.org/10.5551/jat.RV17023.
13. Kim NH, Kim SG. Fibrates Revisited: Potential Role in Cardiovascular Risk Reduction. Diabetes & Metabolism Journal. 2020;44(2):213–21. PMID: 32347023. Available from: https://doi.org/10.4093/dmj.2020.0001.
14. Ginsberg HN, Elam MB, Lovato LC, Crouse JR, Leiter LA, Linz P, et al. Effects of combination lipid therapy in type 2 diabetes mellitus. The New England Journal of Medicine. 2010;362(17):1563–74. PMID: 20228404. Available from: https://doi.org/10.1056/NEJMoa1001282.
15. Yan X, Mudiganti S, Husby H, Hudnut A, Gbotoe M, Jones JB. Medication non-adherence and therapeutic inertia independently contribute to poor disease control for cardiometabolic diseases. Scientific Reports. 2022;12(1):18936. PMID: 36344613. Available from: https://doi.org/10.1038/s41598-022-21916-8.
16. Usherwood T. Therapeutic inertia. Australian Prescriber. 2024;47(1):15–9. PMID: 38444892. Available from: https://doi.org/10.18773/austprescr.2024.001.

17. Dixon DL, Sharma G, Sandesara PB, Yang E, Braun LT, Mensah GA. Therapeutic Inertia in Cardiovascular Disease Prevention: time to Move the Bar. Journal of the American College of Cardiology. 2019;74(13):1728–31. PMID: 31558257. Available from: https://doi.org/10.1016/j.jacc.2019.08.014.

18. Irawati S, Prayudeni S, Rachmawati R, Wita IW, Willfert B, Hak E. Key factors influencing the prescribing of statins: a qualitative study among physicians working in primary healthcare facilities in Indonesia. BMJ Open. 2020;10(6). PMID: 32540888. Available from: https://doi.org/10.1136/bmjopen-2019-035098.