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Original Article

Prevalence of Dyslipidemia, Drug Therapy Problems, and Medication Adherence in Type 2 Diabetes Mellitus Patients in North Central Nigeria

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Abstract

Background Patients with diabetes mellitus have an increased risk of developing dyslipidemia, predisposing them to macro- and microvascular consequences such as coronary heart disease.

Aim The aim of this study was to assess the prevalence of dyslipidemia, drug therapy problems (DTPs), and medication adherence in type 2 diabetes mellitus (T2DM) patients in a tertiary hospital in North Central Nigeria.

Method This study was a cross-sectional convenient sampling of eligible patients conducted in the General Outpatient Department of General Hospital, Ilorin, from March to May 2022. A validated questionnaire was administered to obtain all relevant information on sociodemographic information, and blood samples were collected in a medium plain heparinized tube and sent to the laboratory where fasting blood sugar, high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C) values were calculated as appropriate. Morisky's Medication Adherence Scale 8 (MMAS-8) was used to capture patient's adherence level, and DTP was assessed using the Pharmaceutical Care Network Europe (PCNE) Criteria version 7. Ethical approval was obtained from the Ministry of Health, Ilorin. Statistical Package for Social Sciences was used to analyze the data collected for descriptive and inferential statistics.

Results The mean age of the respondents was 60 ± 0.7 years. Of the 60 respondents, 25 (41.67%) were males and 35 (58.33%) were females. All the respondents had dyslipidemia, 30% respondents were identified with a DTP of nonadherence, 16.7% needed additional drug/monitoring, dosage was too low in 11.7%, and 11.6% could not afford their medication due to high cost. In all, 45 (75%) respondents had poor sugar control and 33 (55%) had poor blood pressure control. Using MMAS-8, the majority (41, [68.30%]) of the respondents were found to have poor adherence to their diabetic medications.

Conclusion High prevalence of dyslipidemia, poor medication adherence, and DTPs were found in the T2DM patients in this study.

Keywords
- dyslipidemia
- type 2 diabetes mellitus
- medication adherence
- drug therapy problem
- Framingham risk score

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ملخص المقال باللغة العربية

انتشار اضطراب شحميات الدم (دسليبيدميا)، ومشاكل العلاج الدوائي، والالتزام بالأدوية لدى مرضى السكري من النوع 2 في شمال وسط نيجيريا

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الخلفية: عادة ما يكون للمرضى الذين يعانون من داء السكري خطر متزايد للاضطراب شحوم الدم (دسليبيدميا)، مما يجعل المرضى عرضة لعواقب أمراض الأوعية الدموية الكبرى والصغرى والتي ينتج عنها أمراض مختلفة مثل أمراض القلب التاجية.

الهدف: الهدف من هذه الدراسة هو تقييم مدى انتشار دسليبيدميا، ومشاكل العلاج الدوائي (DTP) والالتزام بالأدوية. في مرضى السكري من النوع 2 (T2DM) في مستشفى ثالثي في شمال وسط نيجيريا.

الطريقة: كانت هذه دراسة مقطعية للمرضى المؤهلين أجريت في قسم العيادات الخارجية العامة بالمستشفى العام، إيلورين، في الفترة من مارس 2022 إلى مايو 2022م. تم إجراء استبيان للحصول على جميع المعلومات ذات الصلة بالمعلومات الاجتماعية والديموغرافية وعينات الدم. تم جمع عينات الدم في أنبوب هيبارين متوسط الحجم، وتم إرسالها إلى المختبر حيث تم حساب قيم سكر الدم الصائم، وكوليسترول البروتين الدهني عالي الكثافة (HDL-C) وكوليسترول البروتين الدهني منخفض الكثافة (LDL-C) . تم استخدام مقياس مورسكي الثامن للالتزام بالأدوية (MMAS-8) Morisky 8 لتحديد مستوى التزام المريض، وتم تقييم مشكلات العلاج الدوائي باستخدام الإصدار 7 من معايير شبكة الرعاية الصيدلانية في أوروبا.(PCNE) . تم الحصول على الموافقة الأخلاقية من وزارة الصحة في إيلورين. تم استخدام الحزمة الإحصائية للعلوم الاجتماعية لتحليل البيانات المجمعة للإحصاء الوصفي والاستنتاجي

النتائج: كان متوسط عمر المشاركين 60 ± 0.7 سنة. ومن بين المشاركين، كان 41.67% (25) ذكورًا بينما 58.33% (35) إناثًا. كان جميع المشاركين (60) يعانون من اضطراب شحوم الدم، وكانت مشاكل العلاج الدوائي التي تم تحديدها هي عدم الالتزام (30٪)، والحاجة إلى مراقبة إضافية للدواء / (16.7٪)، والجرعة منخفضة جدًا (11.7٪)، و11.6٪ لا يستطيعون تحمل تكاليف الدواء بسبب ارتفاع السعر. 75% (45.0) لديهم تحكم ضعيف في مستوي السكر في الدم، و55% (33.0) لديهم تحكم ضعيف في ضغط الدم. باستخدام مقياس مورسكي للالتزام بالأدوية وجد أن لأغلبية 68.30% (41.0) لديهم التزام ضعيف لتناول أدوية مرض السكري.

الاستنتاج: إن معدل انتشار اضطراب شحوم الدم والالتزام بالأدوية ومشاكل العلاج الدوائي مرتفع في هذه الدراسة لمرضى الداء السكري.

الكلمات المفتاحية: اضطراب شحوم الدم، داء السكري من النوع 2، الالتزام بالأدوية، مشكلة العلاج الدوائية.

Introduction

There is an irrefutable proof that diabetes mellitus increases the risk of cardiovascular disease (CVD).[1] Patients with diabetes mellitus have a two- to fourfold increased risk of dying from cardiovascular causes compared with those without diabetes.[2] Diabetes mellitus was upgraded to the highest risk group by the Adult Treatment Panel III (ATP III), which is the third report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults.[3] Different dyslipidemia patterns are linked to type 2 diabetes mellitus (T2DM), predisposing patients to macrovascular consequences such coronary heart disease (CHD).[4] Moderate hypertriglyceridemia, low levels of high-density lipoprotein-cholesterol (HDL-C), and high levels of low-density lipoprotein cholesterol (LDL-C) are all components of the metabolic syndrome that is seen in people with type 2 diabetes.[5]

Dyslipidemias are brought on by metabolic disturbances, which in type 2 diabetic patients are mostly brought on by insulin resistance, which results in a malfunction in lipid metabolism. Hypertriglyceridemia, low serum HDL-C concentrations, and sporadically high serum LDL-C and lipoprotein(a) values are related with insulin resistance, relative insulin insufficiency, and obesity.[6,7]

The risk of CHD is further increased by atherogenic dyslipidemia, hypertension, excessive plasma glucose, and prothrombotic condition, all of which are frequently linked to raised serum triglycerides.[8] With inadequate management of diabetes mellitus, glycemic control deteriorates leading to lipid and lipoprotein abnormalities; particularly total and LDL-C is raised.[9] In a study in south eastern Nigeria, the prevalence of dyslipidemia in T2DM patients was 90.7%.[10] Patients with diabetes who have suboptimal (poor) glycemic control due to poor adherence to treatment guidelines are at an increased risk of micro- and macrovascular complications, disease progression, morbidity, and death, as well as higher health care expenditures.[11,12] Numerous reasons for nonadherence have been identified by studies, including forgetfulness, drug costs and side effects, as well as a perceived lack of benefit from ongoing therapy.[13] Drug therapy problems (DTPs) are events or circumstances involved or thought to be involved during medication administration, may actually or potentially interfere with the desired health outcomes,[14,15] and are particularly common in diabetic patients.[16] DTPs can be divided into several groups. The Cipolle et al classification method is the most popular method of classification. DTPs can be classified into seven different categories. These are unnecessary drug therapy, need for additional drug therapy, ineffective drug therapy, dosage too low, dosage too high, adverse drug reaction, and nonadherence.[15]

There are currently no studies to collectively assess the prevalence of dyslipidemia, DTPs, medication adherence, and a 10-year risk of developing CVD in T2DM in north central Nigeria. The aim of this study was to assess the prevalence of dyslipidemia, DTPs, and medication adherence in T2DM patients attending General Hospital, Ilorin (GHI).

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Methodology

Study Site Description

The study was conducted at General Outpatient Department (GOPD) clinic, GHI, Kwara State, Nigeria.

Study Design

This was a cross-sectional study among outpatients with T2DM attending the GOPD of GHI. The study was performed between March and May 2022.

Study Population

The patients studied were those with T2DM attending the medical outpatient ward.

Sample size determination: The minimum sample size of T2DM patients attending GOPD GHI was determined by using the statistical formula of Fisher's exact test. Thus, $\boldsymbol{n = Z^2pq/d^2}$, where Z = standard normal deviate usually set at 1.96 corresponding to 95% confidence interval, p = proportion in the target population (T2DM with dyslipidemia) estimated to have a particular characteristic set at 96%,[17] that is, 0.96, $q = 1 - p$ (proportion in the target population not having the particular characteristics), and d = degree of accuracy required, usually set at 0.05 level. The total sample size used in this study was 60 patients.

The inclusion criteria included male and female patients with T2DM patients who gave their consent to participate and age older than 18 years. The exclusion criteria included emergency patients and pregnant women.

Data Collection

Patient recruitment was done at the GOPD clinic, after their scheduled appointments with the doctors. All those who met the inclusion criteria were selected. Informed consent was obtained and patients were counseled appropriately. A validated questionnaire was administered to obtain all relevant information with section A on sociodemographic information, section B on medical and medication history, section C on Morisky's Medication Adherence Scale 8 (MMAS-8), section D on DTPs using the Pharmaceutical Care Network Europe (PCNE) Criteria Version 7 (costs of drugs too high, adherence, needs additional monitoring, dosage too high, adverse medication effect, dosage too low, unnecessary medication therapy), and section E on social history. With the help of a phlebotomist, blood samples were collected on the same day the patients were recruited, in a medium plain heparinized tube, after which the blood samples were sent to Beacon Health diagnostic center, where fasting blood sugar, HDL, and LDL values were calculated as appropriate.

Definitions: HDL-C value: less than 40 mg/dL = risk of heart disease; 41 to 59 mg/dL = good; greater than 60 mg/dL = considered protective against heart disease.

LDL-C: less than 100 mg/dL = optimal, considered protective; 100 to 129 mg/dL = above optimal; 130 to 159 mg/dL = borderline high, risk of heart disease; 160 to 189 mg/dL = high, risk of heart disease; greater than 190 = very high.

FBS: less than 7.0 mmol/L = good, controlled; greater than 7.0 mmol/L = poor, uncontrolled.

BP: less than 140 mm Hg = controlled; ≥140 mm Hg = uncontrolled.

MMAS-8: less than 6 = poor adherence; ≥6 = good adherence.[18–20]

Ten-year Framingham CVD risk score: less than 10 = low risks of developing CVD within 10 years; 10 to 20 = moderate to high risk of developing CVD within 10 years; greater than 20 = high risks of developing CVD within 10 years.[21]

Data Analysis

For continuous measurements such as age, the mean, median, standard deviation, and range were tabulated. For categorical measurements such as gender, the frequencies were computed. Data were analyzed using the SPSS version 25. Descriptive statistics using chi-squared test with p-value ≤0.05 was considered statistically significant.

Ethical Consideration

Ethical approval was obtained from the Ethical Review Committee of GHI with assigned number: GHI/ADM/134/Vol. II/420.

Results

Sociodemographic Characteristics

►**Table 1** shows the sociodemographic features of the T2DM patients in this study; 41.67% of the respondents were males, while 58.33% were females, with a mean age of 60 ± 0.7 years. In all, 33.3% of the respondents had nonformal education and 54% of the respondents had low monthly income.

Prevalence of Dyslipidemia, Clinical, and Biochemical/Metabolic Variables among Respondents

The prevalence of dyslipidemia in this study was 100% (►**Table 2**). In total, 95% had a single dyslipidemia (i.e., at least one abnormal lipid fraction with either high LDL-C or low HDL-C), while 5% had multiple dyslipidemias (both high LDL-C and low HDL-C). In all, 81.67% (49.0) of the respondents had a good HDL value, which is considered to be protective against CVDs. Thirty patients (50%) had a high LDL-C value, which is considered to be a major risk factor for developing CVD. Forty-five (75.0%) respondents had poor FBS levels, while 15 (25.0%) had good sugar control. Thirty-three (55%) respondents had poor BP control (►**Table 2**).

Distribution of Dyslipidemia Based on Gender and Socioeconomic Status among Respondents

As can be seen from the results shown in ►**Table 3**, there was no association between dyslipidemia and gender, level of education, area of residence, or socioeconomic status ($p > 0.05$).

Drug Therapy Problem and MMAS-8 among Respondents

Using the PCNE DTP classification (►**Table 4**), the majority of the respondents (30%) were nonadherent to their medications, 16.7% (10.0) of the respondents needed additional drug/monitoring, 11.7% had dosage too low, 11.6% could

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Table 1 Sociodemographic characteristics

Variable		Frequency, *n* (%) (*n* = 60)
Gender	Male	25 (41.67)
	Female	35 (58.33)
Age (y)	35–45	6 (10.0)
	46–50	4 (6.67)
	51–55	10 (16.67)
	56–60	8 (13.33)
	61–65	10 (16.67)
	66–70	17 (28.33
	>70	5 (8.33)
Mean age (y)	60 ± 0.7	
Residence	Urban	25 (41.65)
	Rural	35 (58.33)
Highest educational qualification	Nonformal	20 (33.33)
	Primary	17 (28.33)
	SSCE	16 (26.67)
	Tertiary	5 (8.33)
	Adult education	1 (1.67)
Marital status	Single	1 (1.67)
	Married	54 (90.00)
	Divorced	5 (8.33)
Religion	Islam	39 (65.00)
	Christianity	19 (31.67)
	Traditional	2 (3.33)
Monthly income	Low	32 (54.00)
	Medium	20 (33.00)
	High	8 (13.00)

Abbreviation: SSCE, Senior Secondary Certificate Examination.

Table 2 Prevalence of dyslipidemia, clinical, and biochemical/metabolic variables among respondents

	Frequency (*n* = 60)	Percentage
Dyslipidemia		
Single	57	95.00
Multiple	3	5.00
Total	60	100.00
HDL (mg/dL)		
<40	4	6.67
41–59	7	11.67
>60	49	81.67
Total	60	100.00
LDL (mg/dL)		
<100	30	50.00
100–129	2	3.30
130–159	7	11.70
160–189	9	15.00
>190	12	20.00
Total	60	100.00
FBS (mmol/L)		
<7.0	15	25.00
≥7.0	45	75.00
Systolic BP (mm Hg)		
<140	27	45
≥140	33	55
Total	60	100

Abbreviations: BP, blood pressure; FBS, fasting blood sugar level; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

not afford their medication due to high cost, and 6.70% (4.0) had an unnecessary medication therapy. Further using the MMAS-8 to class respondent as having good adherence or poor adherence, 31.7% (19) of the respondents had good adherence, while 68.30% (41) of the respondents had poor adherence to their diabetic medications.

The 10-year Framingham risk score (FRS) for CVD, distribution of the 10-year FRS for CVD based on gender among respondents, and the correlation between the 10 years FRS for CVD, and MMAS-8 among respondents are shown in ►**Table 5**.

Fifty percent (30) of the respondents had a high risk of developing CVD (stroke, heart failure, angina, etc.) within 10 years, 26.7% (16) of the respondents had moderate risk of developing CVD within 10 years, and 23.3% (14) of the respondents had low risk of CVD. Based on gender, female patients had a higher CVD risk compared with their male counterparts ($p < 0.05$). There is also a statistical significance in relation to the risks of CVD and adherence ($p < 0.05$; ►**Table 5**).

Discussion

In this study, 41.67% (25) of the patients with T2DM were males and 58.33% (35) were females, similar to several studies[5,10,22] that showed that diabetes mellitus was more prevalent in females than in males. The prevalence of dyslipidemia in T2DM was high in this study (100%) with 95% having single dyslipidemia and 5% having multiple dyslipidemias. Our results appeared relatively higher compared with other studies in Nigeria that report a prevalence of 90.7%[10] and in south Africa[23] that report a prevalence of in 90.3%, with 24% having a single dyslipidemia and 66.6% having multiple dyslipidemias.[10] This can be partially explained by the poor glycemic control seen in respondents, where the hypercholesterolemia was hypothesized to be caused by an increase in non enzymatic glycation of LDL.[24] Lack of insulin prevents LDL cholesterol from being degraded by a reduction in LDL receptor binding, which raises LDL cholesterol levels.[25]

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Table 3 Distribution of dyslipidemia based on gender, socioeconomic status among respondents

Variables	Dyslipidemia		Total	χ^2	*p*-value
	Single	Multiple			
Gender					
Male	25	0	25	2.26	0.13
Female	32	3	35		
Level of education					
Nonformal	20	0	20	8.68	0.06
Primary	17	0	17		
SSCE	13	3	16		
Tertiary	6	0	0		
Adult education	1	0	1		
Residence					
Rural	32	3	35	2.26	0.13
Urban	25	0	25		
Monthly income					
Low	31	1	32	1.71	0.42
Medium	18	2	20		
High	8	0	0		

Abbreviation: SSCE, Senior Secondary Certificate Examination.

Table 4 Drug therapy problem and MMAS-8 among respondents

Drug therapy problem	Frequency (%) ($n = 60$)	
Costs	11.60	
Adherence	30.00	
Needs additional monitoring	16.70	
Dosage too high	8.30	
Adverse medication effect	15.00	
Dosage too low	11.70	
Unnecessary medication therapy	6.70	
MMAS-8	**Frequency ($n = 60$)**	**Percentage**
<6	41	68.30
≥ 6	19	31.70
Total	60	100.00

Notes: <6 = poor adherence; ≥ 6 = good adherence.
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The most common lipid abnormality in this study was a high LDL-C (50%), while low HDL-C was found in only 6.67% patients. This is in contrast to several studies in Nigeria[10,26] that showed low HDL-C as the predominant lipid abnormality. Our study also found dyslipidemia to occur more frequently in women than in men (32, 53.3%). A meta-analysis of hypercholesterolemia in Nigeria showed a slightly higher rate in women than in men. This higher rate may be due to physical inactivities and increasing patronage of processed foods. The reports show that women adopt this lifestyle to increase weight as they erroneously think that a higher weight indicates a better living standard and higher social class.[27] The assessment of DTP was solely by review of the medical and biochemical parameters. The DTP identified in this study was dosage too low in 11.7% respondents, 11.6% respondents could not purchase their medications due to high costs, 15% experienced adverse effects with their medications, 16.7% needed additional monitoring, while 30% were not adherent with their medications. In contrast Zaman Huri et al reported drug choice problem (26.1%) as the most common DTP experienced in T2DM patients with dyslipidemia, followed by potential drug interaction (18%), dosing problem (14.3%), and drug use problem (14.3%).[28] Several studies also show DM patients to be nonadherent to their medications. The MMAS-8,[18–20] which has a sensitivity of 93% and is used to identify patients with poor adherence to their medications, was used in this study. It was found that 68.30% respondents were nonadherent to their medications. In contrast, Jemal et al, while using a four-item Morisky scale, reported 70.4% adherence and 29.6% nonadherence.[29] Adherence to medication is crucial to decrease micro- and macrovascular complications in hypertension and DM patients as nonadherence can cause dyslipidemia and higher HbA1c levels,[30] stroke, heart failure, and kidney dysfunction, leading to morbidity and mortality. Several studies have linked lower socioeconomic status with nonadherence.[30]

The FRS, a common and simplified tool used to assess the risks of developing coronary artery diseases within 10 years, was used in this study with six FRS coronary risk scores: age, gender, low HDL-C, high LDL-C, high systolic blood pressure, and presence of diabetes.[21] Fifty percent of the respondents had a high risk of developing CVD (stroke, angina, etc.) within 10 years, while the chi-squared test showed that the females had a higher risk of CVD when compared with males ($p < 0.05$) and the chi-square test also showed that lower adherence to medication increases the risk of CVD. Identifying men and women at higher risk of future cardiovascular events can be helpful for physicians and patients to decide whether lifestyle adjustment and preventive medical care are necessary, as well as for patient education.[21]

Conclusion

The study revealed a high prevalence of dyslipidemia, DTPs, and medication nonadherence. All the respondents had high LDL-C, low HDL-C, or both. Multiple DTPs were identified, including nonadherence, need for additional drug/monitoring, low dosage, and inability to afford medication due to high cost. The majority of patients had poor sugar and blood pressure control. According to MMAS-8, most respondents had poor adherence to their diabetic medications, and half of the respondents were at high risk of developing CVD within 10 years.

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Table 5 Ten-year Framingham risk score (FRS) for CVD, distribution of 10-year FRS for CVD based on gender, and correlation between 10-year FRS for CVD and MMAS-8 adherence score among respondents

CVD risk scores	Frequency ($n = 60$)	Percentage			
< 10	14	23.30			
10–20	16	26.70			
> 20	30	50.00			
Total	60	100.00			
CVD risk score	Gender		Total ($N = 60$)	χ^2	*p*-value
	Male	Female			
< 10	7	7	14	10.3	0.0057
10–20	15	10	15		
> 20	3	18	21		
Total	25	35	60		
CVD risk score	MMAS-8 <6	MMAS-8 ≥ 6	Total ($N = 60$)	χ^2	*p*-value
< 10	12	2	14	6.2	0.04
10–20	9	7	16		
> 20	26	4	30		
Total	47	13	60		

Abbreviations: CVD, cardiovascular disease; MMAS-8, Morisky Medication Adherence Scale 8.
Notes: FRS: <10 = low risk of developing CVD; 10–20 = moderate high of developing CVD; >20 = high risk of developing CVD).
MMAS: <6 = poor adherence; >6 = good adherence.
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Conflict of Interest
None declared.

References

1 Chahil TJ, Ginsberg HN. Diabetic dyslipidemia. Endocrinol Metab Clin North Am 2006;35(03):491–510, vii–viii
2 Centers for Disease Control and Prevention. National diabetes fact sheet. 2011 Accessed November 20, 2022 at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf
3 National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) 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; 106:3143–3421
4 Betteridge DJ. Diabetic dyslipidaemia. Diabetes Obes Metab 2000; 2(Suppl 1):S31–S36
5 Naheed T, Khan A, Masood G, Yunus BB, Chaudry MA. Dyslipidemias in type II diabetes mellitus patients in a teaching hospital of Lahore, Pakistan. Pak J Med 2003;19(04):283–286
6 Garg A, Grundy SM. Management of dyslipidemia in NIDDM. Diabetes Care 1990;13(02):153–169
7 O'Brien T, Nguyen TT, Zimmerman BR. Hyperlipidemia and diabetes mellitus. Mayo Clin Proc 1998;73(10):969–976
8 Ginsberg HN. Identification and treatment of hypertriglyceridemia as a risk factor for coronary heart disease. Curr Cardiol Rep 1999;1(03):233–237
9 Grundy SM. Hypertriglyceridemia, insulin resistance, and the metabolic syndrome. Am J Cardiol 1999;83(9B):25F–29F
10 Jisieike-Onuigbo NN, Unuigbe EI, Oguejiofor CO. Dyslipidemias in type 2 diabetes mellitus patients in Nnewi South-East Nigeria. Ann Afr Med 2011;10(04):285–289
11 Pladevall M, Williams LK, Potts LA, Divine G, Xi H, Lafata JE. Clinical outcomes and adherence to medications measured by claims data in patients with diabetes. Diabetes Care 2004;27(12):2800–2805
12 Krapek K, King K, Warren SS, et al. Medication adherence and associated hemoglobin A1c in type 2 diabetes. Ann Pharmacother 2004;38(09):1357–1362
13 Horne R, Weinman J. Predicting treatment adherence: an overview of theoretical models. In: Myers L, Midence K, eds. Adherence Treatment in Medical Conditions. London: CRC Press; 2020: 26–31
14 Pharmaceutical Care Network Europe PCNE Classification for Drug-Related Problems V8.01. 2017. Accessed November 20, 2022 at: http://wwwpcneorg/working-groups/2/drug-related-problem-classification:1-3
15 Cipolle RJ, Strand LM, Morley PC. Pharmaceutical Care Practice: The Patient-Centered Approach to Medication Management. New York, NY: McGraw Hill; 2012
16 Zaman Huri H, Fun Wee H. Drug related problems in type 2 diabetes patients with hypertension: a cross-sectional retrospective study. BMC Endocr Disord 2013;13(01):2
17 Basit A, Sabir S, Riaz M, Fawwad ANDSP members. NDSP 05: Prevalence and pattern of dyslipidemia in urban and rural areas of Pakistan; a sub analysis from second National Diabetes Survey of Pakistan (NDSP) 2016-2017. J Diabetes Metab Disord 2020;19 (02):1215–1225
18 Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. J Clin Hypertens (Greenwich) 2008;10(05):348–354

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19 Berlowitz DR, Foy CG, Kazis LE, et al; SPRINT Study Research Group. Effect of intensive blood-pressure treatment on patient-reported outcomes. N Engl J Med 2017;377(08):733–744
20 Bress AP, Bellows BK, King JB, et al; SPRINT Research Group. Cost-effectiveness of intensive versus standard blood-pressure control. N Engl J Med 2017;377(08):745–755
21 Jahangiry L, Farhangi MA, Rezaei F. Framingham risk score for estimation of 10-years of cardiovascular diseases risk in patients with metabolic syndrome. J Health Popul Nutr 2017;36(01):36
22 de Souza LJ, Souto Filho JT, de Souza TF, et al. Prevalence of dyslipidemia and risk factors in Campos dos Goytacazes, in the Brazilian state of Rio de Janeiro. Arq Bras Cardiol 2003;81(03):249–264
23 Vezi ZB, Naidoo DP. Dyslipidaemia among black patients with type 2 diabetes. Cardiovasc J S Afr 2005;16(04):194–198
24 Steinbrecher UP, Witztum JL. Glucosylation of low-density lipoproteins to an extent comparable to that seen in diabetes slows their catabolism. Diabetes 1984;33(02):130–134
25 Al-Nuaim AR, Famuyiwa O, Greer W. Hyperlipidemia among Saudi diabetic patients: pattern and clinical characteristics. Ann Saudi Med 1995;15(03):240–243
26 Odenigbo CU, Oguejiofor OC, Odenigbo UM, Ibeh CC, Ajaero CN, Odike MA. Prevalence of dyslipidaemia in apparently healthy professionals in Asaba, South South Nigeria. Niger J Clin Pract 2008;11(04):330–335
27 Adeloye D, Abaa DQ, Owolabi EO, et al. Prevalence of hypercholesterolemia in Nigeria: a systematic review and meta-analysis. Public Health 2020;178:167–178
28 Zaman Huri H, Chai Ling L. Drug-related problems in type 2 diabetes mellitus patients with dyslipidemia. BMC Public Health 2013;13(01):1192
29 Jemal A, Abdela J, Sisay M. Adherence to oral antidiabetic medications among type 2 diabetic (T2DM) patients in Chronic Ambulatory Wards of Hiwot Fana Specialized University Hospital, Harar, Eastern Ethiopia: a cross sectional study. J Diabetes Metab 2017;8(01):8–40
30 Wabe NT, Angamo MT, Hussein S. Medication adherence in diabetes mellitus and self management practices among type-2 diabetics in Ethiopia. N Am J Med Sci 2011;3(09): 418–423

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