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Evaluation of Antidiabetic Drug Prescribing Practices in Primary Care Clinics in Rural South India

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ABSTRACT

The use of antidiabetic medications by patients with type-2 diabetes mellitus at primary care clinics in the Erode district of Tamil Nadu, India, a rural south Indian province, was investigated in a cross-sectional study. A standardized and validated questionnaire was used for the study, which lasted for one year. This medicine use assessment included 480 diabetic people who resided in a southern Indian state's rural districts. Women (n = 279; 57.28%), married (n = 463; 95%), unemployed (n = 272; 55.85%), uneducated (n = 180; 36.96%), and between the ages of 51-60 years (175; 35.93%) constituted the majority of the diabetic participants in this study. In addition, 328 patients (67.35%) had a history of type 2 diabetes. T2DM was identified in all of them (n = 487; 100%). Oral hypoglycemic drugs (OHA) were administered to the majority of the diabetes patients (n = 433; 88.91%); 125 (25.66%) of these patients received monotherapy with a single anti-diabetic agent, 208 (42.71%) received two-drug regimens, and 136 (27.92%) received three-drug treatments. Diabetes was on the rise among people living in rural areas. It was mostly brought on by the impoverished general populace of this district's improper lifestyle choices and ignorance of diabetes and its repercussions. Patients with diabetes often experience polypharmacy, with most using more than two anti-diabetic drugs. A well-designed health intervention program is essential to reduce the rising prevalence of diabetes and to lessen adverse health consequences.

Keywords: Comorbidities, Complications, Hyperglycemia, Lifestyle, Quality of life

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Introduction

Over the past few decades, the prevalence of diabetes mellitus (DM) has rapidly increased by two to three times worldwide. As per the 2022 study by the International Diabetes Federation, there are 537 million diabetics worldwide, with 90 million of them residing in the Southeast Asian (SEA) region. By 2045, this number is expected to increase to 151.5 million. Adults with diabetes accounted for 774,194,700 cases overall, with an 8.3% prevalence [1]. Due to changes in lifestyle and obesity, Indians are more likely to get diabetes. Approximately 90 percent of people with diabetes have type 2 diabetes, whereas 8% of people with diabetes have type 1 diabetes. Although type-2 DM symptoms are comparable to those of type-1 DM, they are frequently less noticeable. As a result, after complications have emerged, the disease may be recognised years after it first manifests [2, 3]. Chronic consequences, such as microvascular and macrovascular problems, may result from noncompliance with diabetes treatment [4-6]. The majority of diabetes patients exhibit several co-morbidities, including high BP, dyslipidaemia, coronary artery disease, and other comorbidities, along with comparatively poor glycaemic control [7-9].

The authorised, systematic, continuous review of patient medication use, chemist dispensing, and healthcare provider prescriptions is known as drug utilisation evaluation (DUE). To guarantee effective pharmaceutical decision-making and favourable patient outcomes, DUE entails a thorough examination of patients' prescriptions and drug data before, during, and following dispensing [10, 11]. DUE studies are effective instruments for determining how medications function in society. Adoption of drug use indicators in drug utilisation studies is

specified by the World Health Organisation (WHO). Studies on drug use can objectively assess and examine the work of medical professionals and offer them feedback to encourage reflection on their methods and search for methods to perform better. International organisations like the WHO and the International Network for the Rational Use of Drugs (INRUD) have worked to produce standard drug usage indicators to reduce drug use generally, particularly in poor nations. In primary healthcare as well as other healthcare settings, drug therapy is a key part of patient management. The introduction of potent medications with a greater likelihood of side effects, the high cost of medication, and a focus on drug use outcomes and clinical misuse of drugs can all lead to avoidable death or disability among patients, costly remedial care, additional costs for the identification and management of iatrogenic diseases, and unnecessary waste of health resources. Given this issue, DUE has been suggested as a way to spot needless or inappropriate drug usage while tracking, assessing, and encouraging sensible medication use [12, 13].

At present, a wide variety of oral antidiabetic medications (OADs) exist for managing diabetes. Contrary, among the most widely utilised OADs were sulfonylureas (SUs) and biguanides (BGs). In 1999, OADs with various mechanisms of action were introduced, including glinides, a-glucosidase inhibitors (aGIs), and thiazolidinediones (TZDs). 2009 saw the introduction of dipeptidyl peptidase-4 inhibitors (DPP4is), and 2014 saw the introduction of sodium-glucose transporter 2 inhibitors (SGLT2is); however, selecting OADs might be challenging for general practitioners who are not diabetes specialists [14-16]. To provide adequate treatment, countries are creating their own DM treatment recommendations. According to the existence of diabetes complications, all guidelines—aside from the Japanese guidelines—positioned BGs, particularly metformin, as the first-line OAD and other OADs as the second-line agents for add-on therapy [17, 18]. Although the usage of medications to treat diabetes varies throughout several nations, the appropriate use of medications is still debatable [19, 20]. Therefore, a study was conducted to examine how antidiabetic medications were used by patients with type-2 diabetes mellitus in primary care clinics located in the Erode district of Tamil Nadu, India, a rural region in South India.

Materials and Methods

A cross-sectional study was conducted for one year among the rural population who visited the rural primary care clinic for the treatment of T2DM. A convenience sampling method was adopted to recruit the study participants. There were 487 T2DM patients enrolled in this study. Patients who were above the age of 18 years, diagnosed with T2DM for more than a year, received at least one oral hypoglycemic agent (OHA) and or insulin therapy, and were willing to participate in this study were included. The patients who did not meet the inclusion criteria were excluded. Patients who visited the primary care clinic were approached, and written informed consent was obtained before being included in this study. A structured and validated questionnaire was used to collect the participants' demographic details, history of diabetes, diagnosis, laboratory parameters, comorbidities, complications of diabetes, and treatments provided. This study was approved by the Institutional Review Board of Vivekanandha Medical Care Hospital, Elayamabalayam, Tiruchengode (No. SVCP/IEC/JAN/2021/15), and the study was performed following the principles of the Declaration of Helsinki.

Results and Discussion

Analysing the use of antidiabetic medications by patients with type-2 diabetes mellitus in primary care clinics in the Erode district of Tamil Nadu, India, a rural South Indian province, was the goal of this prospective cross-sectional study. Among 487 indvidual presnt in the current were mostly were women (n = 279; 57.28%), married (n = 463; 95%), unemployed (n = 272; 55.85%), illiterate (n = 180; 36.96%), abstained from alcohol and tobacco (n = 332; 68.17%), and followed a non-vegetarian diet (n = 304; 62.42%). The demographic information is displayed in **Table 1**.

Table 1. Participants' demographic details (n = 487)

Description	Number	Percentage	P-value
Gender			
Male	208	42.71	0.000*
Female	279	57.28	
Marital status			
Married	463	95.07	0.000*
Unmarried	24	4.92	

Educational status			
Primary	122	25.05	0.001*
Secondary	100	20.53	
Graduate	85	17.45	
Illiterate	180	36.96	
Social habits			
Smoking	50	10.26	0.000*
Drinking	33	6.77	
Both	72	14.78	
None	332	68.17	
Dietary pattern			
Vegetarian	183	37.57	0.000*
Non-vegetarian	304	62.42	

* When P is less than 0.05, it is deemed statistically significant.

The majority of the diabetic patients were between the ages of 51 and 60 years (n = 175; 35.93%), had at least one stressful life event in the past (n = 299; 61.39%), had T2DM for 5–10 years (n = 223; 45.79%), and had a family history of the disease (n = 245; 50.30%). **Table 2** presents the specifics.

Table 2. Details on the participants' age group, length of diabetes, family history, and stressful life events (n= 487)

Description	Number	Percentage	Mean ± SD	P-value
Age group (in years)				
< 30	09	1.84	27.89 ± 3.37	0.002*
31-40	35	7.18	36.94 ± 2.78	
41-50	114	23.40	46.69 ± 2.69	
51-60	175	35.93	55.92 ± 2.93	
61-70	120	24.64	65.00 ± 2.57	
> 70	34	6.98	73.41 ± 2.38	
Duration of diabetes (in years)				
< 5	147	30.18	2.90 ± 0.83	0.005*
5-10	223	45.79	7.32 ± 1.76	
11-15	107	21.97	12.63 ± 1.30	
16-20	10	2.05	18.20 ± 1.99	
> 20	Nil	0	0.00 ± 0.00	
Family history of diabetes				
Yes	245	50.30		0.126*
No	242	49.69		
History of stressful life events				
Yes	299	61.39		0.001*
No	188	38.60		

* When P is less than 0.05, it is deemed statistically significant.

Normal body weight (n = 235; 48.25%) and excess body weight (n = 201; 41.27%) were equally represented among the study subjects. Most of them had elevated HbA1c (n = 320; 65.70%), FBS (n = 476; 97.74%), and postprandial blood sugar (n = 485; 99.58%). 178 (36.54%) and 232 (47.52%) of the respondents, respectively, had high diastolic and systolic blood pressures. Approximately 15 (3.08%) of the participants had higher total cholesterol (TC), 17 (3.47%) had elevated triglycerides (TG), 5 (1.02%) had elevated low-density lipoprotein (LDL), and 15 (3.08%) had elevated very-low-density lipoprotein (VLDL), whereas 21 (4.31%) subjects had low levels of HDL. In **Table 3**, the data are presented.

Table 3. Laboratory results and the research participants' body mass index (n = 487)

Description	Number	Percentage	Mean±SD	P-value#
BMI				
Underweight (< 18.5)	02	0.41	17.88 ± 0.29	0.002*
Normal (18.5-24.9)	235	48.25	22.53 ± 1.56	
Overweight (25.0-29.9)	201	41.27	27.33 ± 1.51	
Obese (> 30)	49	10.06	31.69 ± 2.74	
Blood glucose measurement				
FBS				

70-110 mg/dl (Normal)	11	2.25	100.00 ± 12.77	0.000*
>110 mg/dl (Elevated)	476	97.74	233.95 ± 71.33	
PPBS				
100-140 mg/dl (Normal)	02	0.41	133.50 ± 0.71	0.000*
>140 mg/dl (Elevated)	485	99.58	335.45 ± 87.05	
HbA1C				
< 7.5 (Normal)	167	34.29	6.62 ± 0.64	0.005*
> 7.5(Elevated)	320	65.70	9.56 ± 1.58	
Blood pressure measurement				
JNC-8 guidelines (systolic)				
< 120 mm/Hg (Normal)	33	6.77	109.39 ± 2.42	0.061
120-139 mm/Hg (Pre–hypertension)	162	33.26	126.31 ± 4.83	
140-149 mm/Hg (Stage I)	67	13.75	147.15 ± 4.76	
≥ 160 (Stage II)	03	0.61	176.67 ± 5.77	
Non-hypertensive	222	45.58	0.00 ± 0.00	
JNC-8 guidelines (diastolic)				
<80 mm/Hg (Normal)	21	4.31	69.52 ± 1.50	0.082
80-89 mm/Hg (Pre-hypertension)	84	17.24	81.96 ± 2.46	
90-99 mm/Hg (Stage I)	49	10.06	90.06 ± 0.32	
≥ 100 mm/Hg (Stage II)	45	9.24	103.33 ± 4.77	
Non-hypertension	288	59.13	0.00 ± 0.00	
Lipid profile				
Total cholesterol				
150-200 mg/dl (Normal)	11	2.25	173.55 ± 22.00	0.062
> 200 mg/dl (Elevated)	15	3.08	234.67 ± 45.46	
Unknown	461	94.66	0.00 ± 0.00	
Triglyceride				
40-150 mg/dl (Normal)	09	1.84	127.00 ± 11.43	0.025*
>150 mg/dl (Elevated)	17	3.49	307.42 ± 146.10	
Unknown	461	94.66	0.00 ± 0.00	
HDL				
> 40 mg/dl (Normal)	05	1.02	54.80 ± 17.61	0.041*
< 40 mg /dl (Low)	21	4.31	34.57 ± 3.12	
Unknown	461	94.66	0.00 ± 0.00	
LDL				
< 175 mg/dl (Normal)	21	4.31	109.40 ± 35.37	0.000*
> 175 mg/dl (Elevated)	05	1.02	212.08 ± 51.62	
Unknown	461	94.66	0.00 ± 0.00	
VLDL				
< 35 mg/dl (Normal)	11	2.25	27.85 ± 3.86	0.063
> 35 mg/dl (Elevated)	15	3.08	76.41±25.64	
Unknown	461	94.66	0.00 ± 0.00	

* When P is less than 0.05, it is deemed statistically significant.

According to the evaluation of prior medical history, 328 patients (67.35%) had pre-existing type 2 diabetes, 127 patients (26.07%) had hypertension, 15 patients (3.08%) had hyperlipidaemia, and 2 patients (0.41%) had asthma, either by itself or in conjunction with other illnesses. At the time of study enrolment, all participants (n = 487; 100%) had type 2 diabetes. According to the present diagnosis, 265 (54.41%) patients had hypertension, 32 (6.57%) had both hypertension and hyperlipidaemia, 15 (3.08%) had both, 12 (2.46%) had both hypertension and stroke, and 9 (1.84%) had both angina pectoris and hypertension. Of the 487 individuals with diabetes, 114 (23.40%) had microvascular problems and 55 (11.29%) had macrovascular issues. **Table 4** presents the specifics.

Table 4. The research investigated the participants' comorbidities, diabetes problems, past medical history, and current diagnosis (n = 487)

Description	Number	Percentage
Past medical history		
Type II diabetes mellitus	487	100
Hypertension	127	26.07
Hyperlipidemia	15	3.08
Asthma	02	0.41
Rheumatoid arthritis	01	0.20
Tuberculosis	02	0.41

Hyperthyroidism	01	0.20
Hypothyroidism	05	1.02
CVA & hypertension	01	0.20
Angina pectoris & hypertension	01	0.20
Hyperlipidemia & hypertension	11	2.25
Current medical diagnosis		
Type-2 diabetes	487	100
Hypertension	265	54.41
Hyperlipidemia	15	3.08
Hypothyroidism	05	1.02
Hyperthyroidism	01	0.20
Myocardial infarction	01	0.20
Angina pectoris	02	0.41
CVA & hypertension	12	2.46
Angina Pectoris & hypertension	09	1.84
Hyperlipidemia & hypertension	32	6.57
Pre-existing comorbidities		
Hypertension	265	54.41
Hyperlipidemia	47	9.65
Myocardial infarction	02	0.41
Angina pectoris	11	2.25
Stroke	12	2.46
Nil	150	30.80
Complications of diabetes		
Microvascular complications	114	23.40
Diabetic neuropathy	82	16.83
Diabetic nephropathy	23	4.72
Diabetic retinopathy	09	1.84
Macrovascular complications	55	11.29
Coronary artery disease	22	4.51
Congestive cardiac failure	16	3.28
Myocardial infarction	02	0.41
Angina pectoris	11	2.25
Both macro- and micro-vascular complications	04	0.82

Most of the diabetes individuals in the current research (n = 433; 88.91%) received treatment with oral antidiabetic medication or oral hypoglycemic agents (OHA), according to the drug utilisation evaluation; nevertheless, 49 patients (10.06%) received treatment with insulin plus OHA. Remarkably, only 5 individuals (1.02%) received parenteral monotherapy of insulin alone. Among the patients with diabetes, 208 (42.71%) received two-drug regimens, 136 (27.92%) received three-drug regimens, and 125 (25.66%) received monotherapy with a single antidiabetic medication. **Tables 5** and **6** provide a thorough explanation of the medications used to treat diabetes.

Table 5. Antidiabetic medication use as a monotherapy among research participants (n = 487)

Name of the drug	Number	Percentage
a. Parenteral formulation		
Huminsulin 30/70	2	0.41
Huminsulin 50/50	1	0.21
Isophane basel insulin	2	0.41
b. Oral formulation		
Acarbose	16	3.29
Glibenclamide	2	0.41
Glyburide	4	0.82
Glimepiride	4	0.82
Glipizide	1	0.21
Metformin	74	15.20
Teneligliptin	8	1.64
Voglibose	11	2.26

Table 6. Antidiabetic medication use as a combo treatment among research participants (n = 487)

Name of the drug	Number	Percentage
a. Parenteral and oral formulations		
Biphasic insulin + metformin	1	0.21

Biphasic insulin + metfomin+ alogliptin	1	0.21
Biphasic insulin + metfomin+ glibenclamide	1	0.21
Biphasic insulin + metfomin+ voglibose	2	0.41
Biphasic insulin + metformin + glibenclamide + voglibose	1	0.21
Biphasic insulin + vildagliptin	1	0.21
Biphasic insulin + vildagliptin+ voglibose	1	0.21
Huminsulin 30/70 + acarbose	1	0.21
Huminsulin 30/70 + alogliptin	1	0.21
Huminsulin 30/70 + glipizide + dapagliflozin	1	0.21
Huminsulin 30/70 + metformin	1	0.21
Huminsulin 30/70+ metformin + dapagliflozin	1	0.21
Huminsulin30/70 + metformin + glibenclamide + dapagliflozin	1	0.21
Huminsulin 30/70 + metformin + gliclazide + alogliptin	1	0.21
Huminsulin 30/70 + metformin + voglibose	3	0.62
Huminsulin 30/70 + tenegliptin	3	0.62
Huminsulin 30/70 + voglibose	2	0.41
Huminsulin 50/50 + acarbose	1	0.21
Huminsulin 50/50 + gliclazide + metformin	1	0.21
Huminsulin 50/50 + gliclazide + metformin + acarbose	1	0.21
Huminsulin 50/50 + glimepride + metformin + acarbose	1	0.21
Huminsulin 50/50 + metformin	3	0.62
Huminsulin 50/50 + metformin + acarbose	1	0.21
Huminsulin 50/50 + metformin + gliclazide + voglibose	1	0.21
Huminsulin 50/50 + tenegliptin	1	0.21
Huminsulin 50/50 + vildagliptin	1	0.21
Huminsulin 50/50 + voglibose	3	0.62
Isophane basel insulin + alogliptin + acarbose	1	0.21
Isophane basel insulin + metformin	2	0.41
Isophane basel insulin + metformin + acarbose	4	0.82
Isophane basel insulin + metformin + alogliptin	1	0.21
Isophane basel insulin + metformin + gliclazide	1	0.21
Isophane basel insulin + voglibose	1	0.21
Isophane basel insulin + metformin + pioglitazone + acarbose	1	0.21
Isophane basel insulin + tenegeliptin	1	0.21
b. Oral formulation		
Acarbose + alogliptin	4	0.82
Acarbose + alogliptin + metformin	1	0.21
Acarbose + glimepride + metformin	2	0.41
Acarbose + metformin	2	0.41
Acarbose + pioglitazone	1	0.21
Acarbose + tenegliptin	1	0.21
Acarbose + vildagliptin	3	0.62
Alogliptin + pioglitazone	1	0.21
Alogliptin + pioglitazone + voglibose	1	0.21
Dapagliflozin + metformin	1	0.21
Dapagliflozin + metformin + voglibose	1	0.21
Glibenclamide + alogliptin	2	0.41
Glibenclamide + metformin	30	6.16
Glibenclamide + metformin + acarbose	22	4.52
Glibenclamide + metformin + alogliptin	2	0.41
Glibenclamide + metformin + alogliptin + voglibose	1	0.21
Glibenclamide + metformin + dapagliflozin + pioglitazone	1	0.21
Glibenclamide + metformin + tenegliptin	4	0.82
Glibenclamide + metformin + vildagliptin	2	0.41
Glibenclamide + metformin + voglibose	13	2.67
Glibenclamide + metformin + voglibose + vildagliptin	3	0.62
Glibenclamide + voglibose	3	0.62
Gliclazide + metformin	4	0.82
Gliclazide + metformin + acarbose	1	0.21
Gliclazide + metformin + alogliptin	3	0.62
Gliclazide + metformin + dapagliflozin	3	0.62
Gliclazide + metformin + tenegliptin	2	0.41
Gliclazide + metformin + vildagliptin	1	0.21
Gliclazide + metformin + vildagliptin + voglibose	2	0.41

Gliclazide + metformin + voglibose	1	0.21
Glimepride + acarbose	2	0.41
Glimepride + metformin	12	2.46
Glimepride + metformin + acarbose	3	0.62
Glimepride + metformin + acarbose + alogliptin	1	0.21
Glimepride + metformin + alogliptin + voglibose	1	0.21
Glimepride + metformin + dapagliflozin	1	0.21
Glimepride + metformin + tenegliptin	2	0.41
Glimepride + metformin + voglibose	2	0.41
Glimepride + pioglitazone + dapagliflozin	2	0.41
Glimepride + pioglitazone + tenegliptin	1	0.21
Glimepride + tenegliptin	1	0.21
Glipizide + alogliptin	3	0.62
Glipizide + dapagliflozin	1	0.21
Glipizide + metformin	13	2.67
Glipizide + metformin + acarbose	6	1.23
Glipizide + metformin + aloglitptin	2	0.41
Glipizide + metformin + dapagliflozin	1	0.21
Glipizide + metformin + pioglitazone + voglibose	1	0.21
Glipizide + metformin + tenegliptin	3	0.62
Glipizide + metformin + vildagliptin	1	0.21
Glipizide + metformin + voglibose	7	1.44
Glipizide + tenegliptin	1	0.21
Glipizide + tenegliptin + acarbose	1	0.21
Glipizide + vildagliptin	1	0.21
Glipizide + voglibose	1	0.21
Metformin + acarbose	33	6.78
Metformin + acarbose + dapagliflozin	1	0.21
Metformin + alogliptin	10	2.05
Metformin + alogliptin + acarbose	5	1.03
Metformin + alogliptin + voglibose	4	0.82
Metformin + dapagliflozin	15	3.08
Metformin + glibenclamide + tenegliptin	3	0.62
Metformin + glicalzide + voglibose	1	0.21
Metformin + gliclazide	1	0.21
Metformin + glimepride + tenegliptin	1	0.21
Metformin + glimepride + voglibose	2	0.41
Metformin + glipizide	1	0.21
Metformin + glipizide + voglibose + alogliptin	1	0.21
Metformin + pioglitazone + acarbose	1	0.21
Metformin + pioglitazone + vildagliptin	1	0.21
Metformin + pioglitazone + voglibose	1	0.21
Metformin + tenegliptin	11	2.26
Metformin + tenegliptin + voglibose	3	0.62
Metformin + tenegliptin + acarbose	1	0.21
Metformin + vildagliptin	6	1.23
Metformin + voglibose	19	3.90
Metformin + voglibose + vildagliptin	2	0.41
Voglibose + alogliptin	1	0.21
Voglibose + vildagliptin	1	0.21

An exploratory cross-sectional research done amongst the diabetic population in the rural parts of Tamil Nadu province of South India demonstrated that both the prevalence and occurrence of T2DM are more prevalent among women of this locality. These results are consistent with other earlier research showing that women make up the majority of the diabetic population in Klang Valley, Malaysia (n = 234,58.5%) [21], Turaif, Saudi Arabia (n = 249,61.9%) [22], and Bangladesh (n = 10,901,58%) [23]. In line with earlier research in Bangladesh and India, where the majority of the senior population had diabetes (n = 495; 42.1%, and n = 624; 71.8%, respectively), the majority of study participants were over 50 [24, 25]. These results demonstrate that older women are more likely to get diabetes. This might be the result of the province's female population being obese and having had at minimum 1 traumatic life experience. These issues directly affect the development of diabetes and are closely linked to quality of life.

Many of the participants in this study lacked formal employment, had only an elementary education, and were illiterate. Similarly, in research by Fasil *et al.* [26] (n = 127, 34.6%; n = 44, 34.6%, correspondingly) and Suwannaphant *et al.* [27] (n = 13440, 78.8%; n = 4677, 27.4%, respectively), the majority of the diabetes population lacked formal education and employment. This result contrasts with earlier research where most participants had at least a high school education (n = 1110, 55.53%; n = 73, 73%, respectively) [28, 29]. These results unequivocally demonstrate that unemployment and low levels of education have a major impact on the onset of diabetes.

Diet and social behaviours are important factors that influence the development of diabetes. Over a third of the participants in the current research were non-vegetarians, and the majority of the diabetes patients did not engage in any social behaviours like drinking alcohol or smoking cigarettes. These results are consistent with a prior research investigation in which the vast majority of people with diabetes ate fatty foods but didn't smoke or drink alcohol (n = 387, 96.3%; n = 269, 66.9%; n = 183, 96.3%, respectively) [30]. This contrasts with a prior study that found that the majority of people with diabetes routinely smoked or drank alcohol (n = 118, 84.9%; n = 54, 38.8%, respectively) [31]. These results demonstrate that people who do not smoke, drink alcohol, and eat non-vegetarian food are most likely to have type 2 diabetes.

In addition, as the proportion of patients with and without a family history of diabetes is comparable, a family record of diabetes in the rural population has a partial impact on the rise of type 2 diabetes. These results contrasted with earlier research that found 68.8% and 43.7%, respectively, of participants had a family history of diabetes [32, 33]. In addition, 83% of patients in another study had no family history of diabetes [34]. A family history of diabetes is a significant risk factor for type 2 diabetes development and is linked to a variety of metabolic abnormalities.

Every diabetes group in this study had a history of type 2 diabetes, followed by hypertension. This is in line with a prior study that found that 84% of participants had a history of type 2 diabetes, and 62% had a history of hypertension [35]. This result contrasted with another study that found that 7.6% of participants had a history of diabetes, and 26.5% had a history of hypertension [36].

Over 80% of the patients in this study had diabetes for longer than five years, and 50% also had hypertension. They also had increased FBS, PPBS, and HbA1c. Few people in this trial, meanwhile, had high cholesterol. These results are in line with those of Pati *et al.* [35], who found that 84% of patients had diabetes and 62% had hypertension. Furthermore, according to a study by Jelinek *et al.* [37], hyperlipidaemia (n = 18, 4.11%) is the second most common condition after diabetes (68.80%), lasting more than five years. This demonstrates that diabetes is a chronic metabolic disorder that often coexists with high Bp and hyperlipidaemia at the same time. This may be due to the detrimental health effects of chronic illnesses, which include metabolic and cardiovascular problems.

A significant fraction of the study population was impacted by micro- and macrovascular problems. Among those with diabetes, coronary artery disease, diabetic neuropathy, and diabetic nephropathy were common. This is comparable to the study by Mantro *et al.* [38], where the most often detected issues related to diabetes were macrovascular complications (n = 11, 16.66%), diabetic neuropathy (n = 41, 62.10%), and diabetic nephropathy (n = 28, 42.42%). Diabetic neuropathy, diabetic nephropathy, diabetic retinopathy, and macrovascular problems are among the consequences that can arise from long-term diabetes. These issues could lead to increased morbidity and mortality and negatively affect the diabetic population's quality of life [39].

Most of those with diabetes participating in the current research were given OHA, according to the antidiabetic drug utilisation evaluation. The majority of commonly given monotherapy for T2DM was metformin, while the most frequently prescribed dual OHA therapy was metformin plus acarbose. The research population's recommended triple OHA treatment was glibenclamide plus metformin plus acarbose. Huminsulin 30/70 and isophane basal insulin were the most popular parenteral antidiabetic medication formulations among those administered to the research population. But isophane basal insulin + metformin plus acarbose was the recommended option in the mixed parenteral and oral medication combination. These results were in line with a previous study by Sharma et al., where the majority of the population was treated with biguanide plus sulphonylureas as dual drug therapy (n = 233, 74.92%), metformin as monotherapy (n = 230, 85.19%), and biguanide plus sulphonylureas plus thiazolidinedione as triple antidiabetic therapy [40]. In line with present research, prior research has only administered insulin as monotherapy for a small percentage of the diabetes population (n = 129, 31.46%, and n = 28, 20.17%) [41, 42]. The majority of the current study population selected OHA as their preferred option since they are not familiar with parenteral formulations and insulin injections,

which need to be administered with assistance. To control high blood sugar, the majority of people received treatment using various antidiabetic medications, particularly metformin and other OHAs. Additionally, biguanides have a low hypoglycemic effect (unless combined with a sulfonylurea) due to their glucose-dependent mechanism of action. Because of its inexpensive cost, good safety profile (such as reduced risk of hypoglycemia), and possible cardiovascular advantages, metformin is recommended as first-line therapy in diabetic treatment recommendations [43–45].

The study population also frequently uses recently developed medications that target incretin hormones (dipeptidyl peptidase 4 [DPP-4] inhibitor and glucagon-like peptide-1 receptor agonist [GLP-1 RA]) and renal glucose reabsorption (sodium and glucose co-transporter 2 [SGLT2] inhibitors). These medications do not result in hypoglycemia or weight gain, and the outcomes of extensive clinical trials support their beneficial effects on the risk of cardiovascular events [46, 47].

To better comprehend, interpret, and prescribe, administer, and use drugs, managed health care systems greatly benefit from DUE programs. Since the outcomes are utilised to promote more effective use of limited health care resources, DUE programs are valued by employers and health insurance. Because of their knowledge of pharmaceutical treatment, chemists are essential to this process. The managed care chemist can use DURs to find patterns in prescription patterns for patient groups, including those with chronic illnesses like HIV, cancer, asthma, diabetes, high blood pressure, etc. Following that, chemists can work with the remainder of the medical team to enhance the use of drugs for both covered populations and specific patients. By lowering unnecessary pharmaceutical spending, increasing therapeutic results, and improving patient care quality, DURs help to lower total healthcare expenses [48].

Limitation

There are various restrictions on this study. The respondents' responses may not have been accurate due to recall bias, especially when they were questioned concerning social habits, life stresses, and family history of diabetes. Nevertheless, another reply is trustworthy because it was recorded in the patient's medical notes and prescription. This result might not accurately represent the state's or the nation's whole DM population because the study sample is smaller, and the majority are illiterate.

Conclusion

Drug utilisation reviews are crucial in helping patients change how they take their medications, particularly those who are using long-term medications like antihypertensives or antidiabetics. In this rural province, diabetes was the most prevalent metabolic condition among the populace, with type 2 diabetes predominating over other metabolic disorders. T2DM was more prevalent in the overweight group and was frequently diagnosed in females. Metformin was the most often given monotherapy for diabetes, whereas OHA was the most popular option for antidiabetic treatment. Among the elderly population with numerous concomitant illnesses, polypharmacy was prevalent. The triggering variables that increased the incidence and prevalence of diabetes and its concomitant disorders among this population were incorrect lifestyle modifications and a lack of knowledge about diabetes and its sequelae. This is a major health issue that, if left untreated, could increase the rate of morbidity and mortality. To lower negative health outcomes and enhance their quality of life, this rural group needs to participate in a well-designed health intervention program.

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