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ORIGINAL ARTICLE

Prescription patterns of oral antidiabetic agents in management of T2DM by doctors in Punjab

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Abstract

Background Prevalence T2DM has been exponentially increasing worldwide. Prescription patterns are of immense importance to study and promote rational use of anti-diabetic agents. The present study was conducted to evaluate the drug utilisation prescription pattern of oral anti-diabetic drugs in Punjab.

Objective The present study was conducted to evaluate the drug utilisation prescription pattern of oral anti-diabetic drugs in Punjab.

Methods In a cross-sectional, prospective, observational study all prescriptions of T2DM patients on oral medications were studied for class and combination anti-diabetic drug treatment and doctors qualification. Results were analysed by descriptive statistics of percentages.

Results Patient prescription data consisted of 1613 valid prescriptions, 19.3% by MBBS doctors, 44.6% by MD doctors, and 36.1% by DM doctors. Metformin was most prescribed by 71.6% of doctors, sulfonylureas by 57.8% doctors, DDP-4i by 37.6%, SGLT2i by 22.1%, AGIs by 9.8%, and least was 6.4% TZDs. Results show an increasing trend from MBBS doctors to MD doctors and maximum by DM doctors of prescribing TZDs, DPP-4i, AGIs, and SGLT2i, whereas MBBS doctors mostly prescribed metformin (76.2%), followed by DM doctors (75.6%), and metformin was least prescribed by MD doctors (66.3%). Similarly, MBBS doctors mostly prescribed sulfonylureas (92.9%), followed by MD doctors (53.7%), and least by DM doctors (44.3%).

Conclusion The present study shows that prescription pattern vary among MBBS, MD, and DM doctors which necessitates the education of all health care professionals for standard guidelines for management of T2DM so that a uniform prescription pattern is achieved in pursuit of effective control of DM and its complications.

Keywords Prescription patterns · Oral antidiabetic agents · Type 2 diabetes mellitus · Punjab

Introduction

The prevalence of type 2 diabetes (T2DM) has been exponentially increasing [1] worldwide making it one of the most important public health issue of the current century. T2DM accounts for about 90% of all diabetes patients and an estimated 463 million adults were reported to have diabetes in 2019, which is expected to increase to about 700 million by 2045 [2]. The International Diabetes Federation report in 2020 suggested 8.9% prevalence of diabetes in Indian adults [3, 4].

Morbidity and mortality impact of T2DM is well known. Management of T2DM has substantial effects on the physical and psychological health and well-being of individual patients and society, with significant effect on quality of life, as well as economic repercussions. Clinical practice guidelines for diabetes management are tools for health care

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professionals to provide standardised treatment protocols in order to improve diabetes health care across populations, but improved outcomes also need individualised diabetes care for each patient [5].

Evidence suggests that despite efficacious anti-diabetic drug availability and standard non-pharmacologic and pharmacologic recommendations for T2DM intervention by all the international and national diabetes guidelines, the majority of people with diabetes have poor glycemic control and increased prevalence of diabetic complications. Currently, oral anti-diabetic drugs used include biguanides, sulfonylureas, meglitinides, thiazolidinediones (TZDs), α-glucosidase inhibitors (AGIs), dipeptidyl peptidase-4 inhibitors (DPP-4i), sodium/glucose cotransporter 2 inhibitors (SGLT2i) and glucagon-like peptide-1 (GLP-1a) agonists (oral GLP-1a were not available at the time of study) [6, 7].

Management of T2DM using oral antidiabetic agents has become complex with the introduction of newer drugs and treatment guidelines. WHO defined drug utilisation as marketing, prescription, distribution, and use of drugs in a society with special emphasis on the resulting social, medical, and economic consequences. Drug utilisation or prescribing patterns studies are important to facilitate rational use, cost-effectiveness, and optimization of pharmacotherapy in population with monitoring, evaluation, and necessary modifications in the prescribing practices to control T2DM. Prescription pattern reflects the prescriber's attitude towards the disease and the role of pharmacotherapy in treatment along with insight into the nature of the health care delivery system [7].

Rational use of drugs means the use of appropriate medications according to clinical needs, in doses according to individual requirements of the patient for an adequate time at low cost. Rational use of drugs can be effectively evaluated by drug prescription or utilisation studies [8]. Drug utilisation or prescription studies evaluating the use anti-diabetic agents are of immense importance to study and promote rational use of anti-diabetic agents and to provide evidence-based information to the health care professionals [9]. Therefore, the present study was conducted to evaluate the drug utilisation prescription pattern of oral anti-diabetic drugs in Punjab.

Materials and methods

Study design

A cross-sectional, observational study was undertaken from 1st January 2023 to 31st January 2024 at a private urban primary health care centre after approval from the Institutional Ethic Committee of Kishori Ram Hospital vide letter no IEC/01/2023 dated 22.12.2022. All prescriptions of already on treatment T2DM patients visiting outpatient department (OPD) of a private primary care hospital from 1st January 2023 to 31st January 2024 were included in the study after verbal informed consent.

Inclusion criteria

Prescriptions of patients diagnosed with T2DM of both sexes on only oral anti-diabetic medications and who were willing to participate in the study were included.

Exclusion criteria

Prescriptions of patients with type 1 diabetes mellitus (T1DM)/gestational diabetes/diabetes due to specific causes/patients on insulin were excluded.

Prescription data of age, gender, and region (urban or rural) of the patient, class, and combination anti-diabetic drug treatment and prescribing doctor qualification (MBBS, MD or DM) written on the prescription slip was entered into Microsoft Excel master chart. Patients' and doctors' names and identities were not recorded nor was the copy of the prescription slip retained by the researchers because of ethical considerations. In the current study, we opted for descriptive statistics to present and summarize the data on prescription patterns of oral antidiabetic agents in the management of T2DM. The primary objective was to observe and report the frequency and distribution of drug prescription patterns across different doctor qualifications (MBBS, MD, DM) without making inferential comparisons or establishing cause-and-effect relationships.

Statistical analysis

Descriptive statistics, such as percentages and frequency distributions, were deemed appropriate as the study aimed to provide a snapshot of current prescription practices rather than to test hypotheses or draw generalized conclusions. Given the nature of the data and the study's observational design, no formal statistical tests were required to fulfil the study's objectives. The focus was on identifying trends and variations in drug usage, which can inform further research but does not necessitate inferential statistical analysis in this context.

Help of artificial intelligence or chatGPT was not taken in any way for the present study.

Results

Patient prescription data consisted of 1613 valid prescriptions including 20.3% of patients in the age group of < 40 years, 59.6% in the age group of 40 to 60 years,

and 20.1% in the age group of > 60 years. A total of 61.3% of patients were males and 38.7% were females, 69.2% of patients belonged to urban areas and 37.8% to rural areas. A total of 19.3% prescriptions were issued by MBBS doctors, 44.6% by MD doctors, and 36.1% by DM doctors.

The prescribing pattern of class of anti-diabetic drugs according to the qualification of the doctor is shown in Table 1. Metformin was most prescribed by 71.6% of doctors, whereas sulfonylureas were prescribed by 57.8% doctors, DDP-4i by 37.6%, SGLT2i by 22.1%, AGIs by 9.8%, and least was 6.4% TZDs. Results show an increasing trend from MBBS doctors to MD doctors and maximum by DM doctors of prescribing TZDs, DPP-4i, AGIs, and SGLT2i, whereas MBBS doctors mostly prescribed metformin (76.2%), followed by DM doctors (75.6%) and metformin was least prescribed by MD doctors (66.3%). Similarly, MBBS doctors mostly prescribed sulfonylureas (92.9%), followed by MD doctors (53.7%), and least by DM doctors (44.3%).

Table 2 shows prescription patterns according to the class and combination of drugs where sulfonylureas + metformin was the most commonly prescribed combination by total number of doctors (29.1%) including 54.3% by MBBS doctors, 28.8% by MD doctors. Whereas, DDP-4i + metformin was most commonly prescribed by DM doctors (32.4%). The second most common prescription was of sulfonylureas by MBBS doctors (33.1%), 19.2% of total prescriptions were of DPP-4i + metformin out of which 14.0% were by MD doctors and SGLT2i was the second most commonly prescribed drug among DM doctors (23.0%).

Table 3 shows the prescribing pattern of monotherapy and combination therapy of anti-diabetic drugs according to the qualification of doctor. One thousand forty-two prescriptions in total contained one, two, or three single-drug prescriptions including 180 monotherapy prescriptions by MBBS doctors, 454 by MD doctors and 408 by DM doctors, whereas a total of 1091 prescriptions contained a combination of drugs, which may be in addition to a single drug in

Table 1 Prescribing pattern of class of anti-diabetic drugs according to the qualification of doctor. *n* (%)

Prescriptions by		MBBS doctors	MD doctors	DM doctors	Total
Number of prescriptions		311 (19.3)	719 (44.6)	583 (36.1)	1613
Class of drugs	Metformin	237 (76.2)	477 (66.3)	441 (75.6)	1155 (71.6)
	Sulfonylureas	289 (92.9)	386 (53.7)	258 (44.3)	933 (57.8)
	TZDs	10 (3.2)	47 (6.5)	47 (8.1)	104 (6.4)
	DPP-4i	42 (13.5)	270 (37.6)	294 (50.4)	606(37.6)
	AGIs	11 (3.5)	68 (9.5)	79 (13.6)	158 (9.8)
	SGLT2i	36 (11.6)	128 (17.8)	193 (33.1)	357 (22.1)

TZDs thiazolidinediones, *AGIs* α-glucosidase inhibitors, *DPP-4i* dipeptidyl peptidase IV inhibitors, *SGLT2i* sodium-glucose cotransporter-2 inhibitors

Table 2 Prescribing pattern of class and combination of anti-diabetic drugs according to the qualification of doctor. *n* (%)

Class and combination of drugs	Prescriptions by			
	MBBS doctors (*n*-311)	MD doctors (*n*-719)	DM doctors (*n*-583)	Total (*n*-1613)
Metformin	24 (7.7)	66 (9.2)	85 (14.6)	175 (10.8)
Sulfonylureas	103 (33.1)	97 (13.5)	64 (11.0)	264 (16.4)
Sulfonylureas + metformin	169 (54.3)	207 (28.8)	93 (16.0)	469 (29.1)
TZDs + metformin	1 (0.32)	8 (1.1)	5 (0.9)	14 (0.9)
TZDs + sulfonylureas	2 (0.64)	18 (2.5)	13 (2.2)	33 (2.0)
DPP-4i	23 (7.4)	169 (23.5)	105 (18.0)	297 (18.4)
DPP-4i + metformin	19 (6.1)	101 (14.0)	189 (32.4)	309 (19.2)
Sulfonylurea + metformin + TZDs	7 (2.3)	21 (2.9)	29 (5.0)	57 (3.5)
AGIs	3 (0.96)	25 (3.5)	20 (3.4)	48 (3.0)
Sulfonylurea + metformin + AGIs	8 (2.6)	43 (5.9)	59 (10.1)	110 (6.8)
SGLT2i	27 (8.7)	97 (13.5)	134 (23.0)	258 (16.0)
SGLT2i + metformin	9 (2.9)	31 (4.3)	59 (10.1)	99 (6.1)

TZDs thiazolidinediones, *AGIs* α-glucosidase inhibitors, *DPP-4i* dipeptidyl peptidase IV inhibitors, *SGLT2i* sodium-glucose cotransporter-2 inhibitors

Table 3 Prescribing pattern of monotherapy and combination therapy of anti-diabetic drugs according to the qualification of doctor. *n* (%)

Class and combination of drugs	Prescriptions by			
	MBBS doctors (*n*-311)	MD doctors (*n*-719)	DM doctors (*n*-583)	Total (*n*-1613)
Metformin	24 (7.7)	66 (9.2)	85 (14.6)	175 (10.8)
Sulfonylureas	103 (33.1)	97 (13.5)	64 (11.0)	264 (16.4)
DPP-4i	23 (7.4)	169 (23.5)	105 (18.0)	297 (18.4)
AGIs	3 (0.96)	25 (3.5)	20 (3.4)	48 (3.0)
SGLT2i	27 (8.7)	97 (13.5)	134 (23.0)	258 (16.0)
Monotherapy prescriptions	**180**	**454**	**408**	**1042**
Sulfonylureas + metformin	169 (54.3)	207 (28.8)	93 (16.0)	469 (29.1)
TZDs + metformin	1 (0.32)	8 (1.1)	5 (0.9)	14 (0.9)
TZDs + sulfonylureas	2 (0.64)	18 (2.5)	13 (2.2)	33 (2.0)
DPP-4i + metformin	19 (6.1)	101 (14.0)	189 (32.4)	309 (19.2)
Sulfonylurea + metformin + TZDs	7 (2.3)	21 (2.9)	29 (5.0)	57 (3.5)
Sulfonylurea + metformin + AGIs	8 (2.6)	43 (5.9)	59 (10.1)	110 (6.8)
SGLT2i + metformin	9 (2.9)	31 (4.3)	59 (10.1)	99 (6.1)
Combination therapy prescriptions	**215**	**429**	**447**	**1091**

TZDs thiazolidinediones, *AGIs* α-glucosidase inhibitors, *DPP-4i* dipeptidyl peptidase IV inhibitors, *SGLT2i* sodium-glucose cotransporter-2 inhibitors

the same prescription. Two hundred fifteen prescriptions contained a combination of drugs were by MBBS doctors, 429 by MD doctors, and 447 by DM doctors.

A total of 33.1% MBBS doctors prescribed sulfonylureas, 23.5% MD doctors prescribed DPP-4i, and 23.0% DM doctors prescribed SGLT2i. Combination of sulfonylureas + metformin was the most prescribed combination by MBBS doctors (54.3%) and MD doctors (28.8%), and the combination of DPP-4i + metformin was the most prescribed combination by DM doctors.

Discussion

Indian Council of Medical Research (ICMR) defined diabetes mellitus (DM) as a syndrome of multiple etiologies characterised by chronic hyperglycemia [10]. It is one of the most important public health issues of India [2]. T2DM is the most common form of DM in India, and its impact on patients and the society is manifold. While the patients suffer from the psychological and physiological impact of the disease, the society is affected by its related morbidity and the economic repercussions. To add more to the problem, the prevalence of DM in India is expected to increase exponentially from the present levels [11].

Clinical characteristics of the study subjects

The present study was conducted in a private urban primary health care centre including 1613 T2DM patients. In the present study, T2DM was found to be most prevalent, 59.6% in the age group of 40–60 years, followed by 20.3% in the < 40 years age group, and 20.1% in the age group of > 60 years. These findings were similar to data documented in the previous Indian studies showing maximum prevalence of DM in the 40–60 years age group, followed by the < 40 years age group and the least in the > 60 years age group [9, 12, 13]. This is most likely due to the decreasing insulin secretion and increasing insulin resistance in peripheral tissues with age [14], and an increase in sedentary lifestyle and stress levels with age [12].

In the present study, DM was more common in males (61.3%) as compared to females (38.7%) similar to the findings found in the National Family Health Survey of India-5 (NFHS-5) conducted between 2019 and 2021 [15], and the Indian Council of Medical Research–India Diabetes (ICMR-INDIAB) study published in 2023 [16]. It is postulated that the gender difference is due to the increased visceral fat mass in men as compared to women [17]. The present study also indicated that more people in urban areas (69.2%) have DM as compared to their rural counterparts (37.8%), which was comparable to the findings of ICMR-INDIAB and NFHS-5 data [15, 16].

Prescription by doctors according to qualifications

Results of the present study suggest that of the valid prescription data of 1613 prescriptions; most of the prescriptions 44.6% were issued by MD doctors, 36.1% by DM doctors, and at least 19.3% of prescriptions were issued by

MBBS doctors. This could be because the present study was done in a private urban primary health care centre, the number of MD doctors is more as compared to the DM doctors and MD doctors charge less consultation fee as compared to DM doctors so more number of patients consulted MD doctors. Since people in urban areas are considered to be more aware and educated, so more number of patients consulted MD or DM doctors as compared to MBBS doctors, thus the prescriptions in the present study were more from MD doctors as compared to DM doctors and least from MBBS doctors.

Prescription of different classes of drug

In the present study, the prescribing pattern shows that metformin was the most commonly prescribed drug in 71.6% of total prescriptions, and the second most common class of drug was sulfonylureas in 57.8%, DDP-4i in 37.6%, SGLT2i in 22.1%, AGIs in 9.8%, and least prescribed at 6.4% was TZDs. Metformin is the most commonly prescribed drug probably because it is cost-effective, weight neutral so attractive for obese patients, and it rarely leads to hypoglycemia and favourable side effect profile [9].

A 2019 study from government tertiary care hospitals in Eastern India documented that 92.44% of patients were prescribed metformin, 57.55% glimeperide, a sulfonylurea, and 40.69% prescribed pioglitazone, a TZDs [7]. This was thought to be because the medicines were provided free of cost at government hospital and more over SGLT2i were not available at that time in government hospitals. Less prescriptions for pioglitazone in the present study as compared to the study from Eastern India may be because the present study was conducted in a private urban primary health centre whereas the study from Eastern India was done in a government hospital where the medicines were provided free of cost. A study from Pakistan also showed metformin as the most frequently prescribed anti-diabetic drug, followed by sulfonylureas [18].

Prescription of class of drug according to the qualification of doctor

Results show an increasing trend from MBBS doctors to MD doctors and a maximum by DM doctors prescribing TZDs, DPP-4i, AGIs, and SGLT2i, whereas MBBS doctors mostly prescribed metformin (76.2%), followed by DM doctors (75.6%) and least by MD doctors (66.3%). Similarly, MBBS doctors mostly prescribed sulfonylureas (92.9%), followed by MD doctors (53.7%) and least by DM doctors (44.3%). The latest American Diabetes Association (ADA) guidelines for the management of T2DM [19], considered the gold standard for treatment guidelines for DM [20], states that metformin is the first-line non-insulin therapy for the management of T2DM. The 2022 ADA guidelines, which were the most recent during our study period, further mention that if glycemic control is not achieved solely on metformin, then DPP-4i, SGLT2i, TZDs, and GLP-1 receptor agonists are suitable first-line additions to metformin [21]. Our data shows that these guidelines were followed mostly by DM doctors and the least by MBBS doctors. Thus, reflecting the need for proper education and training of ever-changing guidelines to the MBBS doctors to ensure optimal management of DM in the patients.

Combination therapy vs. monotherapy

The present study showed that the maximum number of patients were on combination therapy of sulfonylureas + metformin (29.1%), while the most common monotherapy was DPP-4i (18.4%). This preference of combination therapy as compared to monotherapy has also been demonstrated by other studies. In the study by Ashutosh et al., only 30% of the total prescriptions for DM were monotherapy, while the rest 70% were combination therapy with average drugs prescribed per prescription were 2.03 [9]. Similar results were seen in the study by Sivasankari et al., which showed that the percentages of monotherapy and combination therapy were 21.7%, and 78.3%, respectively [8]. These results favour the latest ADA guidelines [19] and the ICMR guidelines [10], both of which advocate early initiation of dual therapy if glycemic control is not achieved on metformin alone.

Socioeconomic effect

With the rising prevalence of DM in India [2], its associated burden on the economy is also increasing [22]. Early diagnosis and appropriate management of DM is targeted to have adequate glycemic control to prevent and control complications of DM. The complications of DM increase patients' morbidity and mortality leading to exponential increase in cost of management. This increased cost of treatment is one of the causes of non-adherence to the treatment of DM [7] further adversely compromising its management. Thus, following the management guidelines by health care professionals is essential to have optimal management results. With the penetration of medical insurance still low in the Indian population, the cost of managing chronic diseases like DM is entirely the responsibility of the patient [5]. The Research Society for Study of Diabetes in India (RSSDI)-Endocrine Society of India (ESI) Clinical Practice Recommendation 2020 [5] considers the economic impact of the management of DM and suggests using sulfonylureas, TZDs or cheaper SGLT2i, or DPP-4i in patients who are unable to afford the expensive drugs.

Need for standardised method

The present study has clearly brought forward the inconsistency in the management of DM in Punjab, which can also be applied to India. One of the factors that our study has been able to elucidate is that the prescriptions for DM vary by the education status of a doctor. This can be due to the fact that the guidelines for the management of DM have changed dramatically over the past few years [12] and doctors with DM endocrinology tend to be more updated with the latest guidelines since they manage more patients with DM, and probably even more in a special diabetes clinic. The present study, thus, brings forth the importance of educating the health care professionals of the latest management guidelines so that they can provide appropriate evidence-based management care to their patients. Given the economic impact of diabetes, its complications, and the cost of treatment, it is important formulate India-specific uniform national management guidelines for DM and educate the health care professionals especially primary health care professionals about India-specific evidence-based diabetes management guidelines to help health care professionals manage DM appropriately and effectively. Such guidelines are essential to promote the rational use of drugs used in the management of DM as advocated by the WHO [23].

Limitations

The limitations of the research are that the present study did not look into the reasons for differences in the prescription patterns, and to ascertain whether the doctors were aware of the guidelines or not including the cost of medicines as factors for influencing the prescription pattern. Small size of data is also considered to be the weakness of the study. The results of the present study apprised us about the differences in the prescription pattern depending on the qualification of the doctor that is considered to the strength of the study. Results of the study will encourage the researchers to explore this idea among larger number of doctors along with analysing the reasons for differences in prescription patterns if any. The lack of inferential analysis is a limitation, and future research is recommended to examine any statistically significant differences or relationships.

Conclusion

DM is a grave public health problem which should be managed effectively and properly by following evidence-based diabetes management guidelines in a common pursuit to reduce diabetes-related morbidity and mortality. The study of existing prescription patterns is of paramount importance to understand the drug utilisation patterns which showcase the implementation of management guidelines and help improve the overall management of DM. The present study contributes to the Indian data on drug utilization research. The present study shows that prescription pattern varies among MBBS, MD, and DM doctors which necessitates the education of all health care professionals for standard guidelines for the management of T2DM so that a uniform prescription pattern is achieved in pursuit of effective control of DM and its complications which has become most serious public health issue adverse affecting peoples health as well as the national economy.

Declarations

Ethical clearance A cross-sectional, observational study was undertaken from 1st January 2023 to 31st January 2024 at a private urban primary health care centre after approval from the institutional ethic committee of Kishori Ram Hospital vide letter no IEC/01/2023 dated 12.5.2022. Patients and doctors name and identity was not recorded nor the copy of prescription slip retained by the researchers because of ethical considerations. Ethical committee so recommended only verbal informed consent explaining to the patient that only prescription data is being noted for survey purposes.

Consent of patients Ethical committee so recommended only verbal informed consent explaining to the patient that only prescription data is being noted for survey purposes.

Conflict of interest No conflict of interest.

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