OPEN ACCESS

ORIGINAL ARTICLE

Cost Variation Analysis of Oral Hypoglycaemic Agents in Type 2 Diabetes Mellitus in Tertiary Care Hospital in Nepal

Laxmi Shrestha[1], Ambika Basnet[2], Anjan Palikhey[1], Amit Kumar Shrivastava[1,2], Bishal Joshi[3]

[1] Department of Pharmacology, Universal College of Medical Sciences, Rupandehi, Bhairahawa, Nepal
[2] Department of Pharmacy, Universal College of Medical Sciences, Rupandehi, Bhairahawa, Nepal
[3] Department of Physiology, Universal College of Medical Sciences, Rupandehi, Bhairahawa, Nepal

Article Info:

Received Date: Oct, 2024

Acceptance Date: Jan, 2025

Corrosponding Author:

Laxmi Shrestha
Department of Pharmacology,
Universal College of Medical Sciences,
Ranigaon, Bhairahawa,
Rupandehi, Nepal
Email: drshresthalaxmi@gmail.com

Funding sources: None

Conflict of interest: None

Access the article online

DOI: doi.org/10.70027/jrahs42

Abstract

Introduction: Diabetes Mellitus is a chronic metabolic condition affecting millions of individuals worldwide. The cost of drug therapy plays a significant role in the treatment of chronic disorders like type 2 diabetes mellitus, where lifelong medication is required. Understanding the cost variations of oral hypoglycemic agents is essential for optimizing treatment and improving patient compliance. This study was aimed at identifying the affordable treatment strategies for the management of type 2 diabetes mellitus.

Methods: A hospital-based cross-sectional study was conducted at the outpatient department of Medicine at UCMS-TH, Bhairahawa, Nepal, from December 2022 to May 2023. The cost of a drug manufactured by various companies, in the same strength and dosage form, was obtained. The difference in maximum and minimum price of the same drug manufactured by different companies and percentage price variation was calculated.

Results: Among 250 prescriptions, the percentage price variation was highest in Voglibose (0.3 mg), 454.4%, followed by Metformin (500 mg) 260%, and least with Sitagliptin (50 mg) and Linagliptin (5 mg), i.e., 4.16% and 3.89%, respectively in monotherapy. In combination therapy, Metformin+Glimepiride (500 mg+1 mg) 285.71%, followed by Metformin+Linagliptin (500 mg+2.5 mg) 52.3%, showed maximum price variation. The least variation (3.84%.) was seen in the combination of Metformin+Linagliptin (850 mg+5 mg).

Conclusion: A huge difference in the prices of different brands was observed. It is essential to educate prescribers regarding the significant price variation. Prescribing a cost-effective drug by the physician improves the patient's adherence to the treatment regimen and minimizes the financial burden.

Keywords: Oral hypoglycaemic agents; Price variation; Type 2 Diabetes Mellitus

Introduction

Diabetic Mellitus is a chronic metabolic disorder resulting in persistent hyperglycemia due to inadequate insulin production, its efficacy, or a combination of both.[1] The prevalence of type 2 diabetes mellitus (T2DM) is tremendously increasing in Nepal.[2,3] The Nepal Diabetes Association (NDA) reports that among adults aged 20 and over, the prevalence of diabetes is 14.6% in urban areas and 2.5% in rural areas.[4]

Diabetes mellitus is a long-term illness leading to morbidity and mortality and poses a serious health risk. The cost of the medication has a significant impact on the patient's long-term compliance and adherence to therapy.[5] The pharmaceutical industry and the disparity in price across brands of the same formulation have been growing quickly in Nepal.[6] In Nepal, the economic burden is increasing along with the prevalence of diabetes.[7]

Citation:

Shrestha L, Basnet A, Palikhey A, Shrivastava AK, Joshi B. Cost variation analysis of oral hypoglycaemic agents in type 2 diabetes mellitus in tertiary care hospital in Nepal. J. Rapti A. Health Sci. 2024;1(3):67-71.

Understanding the cost variation of oral hypoglycemic agents (OHA) is essential for developing a cost-effective treatment regimen that can decrease complications and enhance patient compliance. Hence, the percentage price variation is a useful tool for determining the cost difference among various OHA brands. Limited research has been done on the cost analysis of various OHA. The aim of this study was to determine the percentage difference in price between different brands of oral hypoglycaemic medications that are available on the market and to identify the economical and affordable treatment strategies for the management of type 2 diabetes.

Methods

A descriptive cross-sectional study was conducted at the outpatient department of medicine of Universal College of Medical Sciences-Teaching Hospital (UCMS-TH) over six months, from December 2022 to May 2023. Ethical approval was obtained from the Institutional Review Committee (IRC) of the Universal College of Medical Sciences, Teaching Hospital (Regd. No. UCMS/IRC/197/22). The patients diagnosed with type 2 diabetes mellitus with age ≥ 18 years of either gender visiting the outpatient department of medicine and under medication with oral hypoglycaemic agents for at least six months were included in the study. Patients with cognitive impairment, type 1 diabetes mellitus, and gestational diabetes were excluded. Both verbal and written consent was taken from the patient.

The required sample size was calculated by using Cochran's formula, $n = [z^2 \times p (1-p)] / d^2$

Where,

P = prevalence of type 2 diabetes under oral hypoglycaemic agents =11.7%=0.117.[8]

q = (1- p) = (1- 0.117) =0.883

Z = confidence interval level = 95%

d = acceptable error = 4%

So, $n = [z^2 \times p (1-p)] / d^2 = 1.96^2 \times 0.117 \times 0.883/0.04^2 = 248.049 = 250$

The calculated minimum sample size was 248. Finally, a total of 250 participants were taken into the study. A non-probability purposive sampling was used till the desired final sample was obtained. Data was collected by reviewing the prescription sheet, and required information was recorded on a study-specific structured data collection sheet in the Department of Medicine at UCMS-TH, Bhairahawa. The structured form contained the patient demographic profile along with (name, age, sex), followed by prescribed drugs.

The statistical program for social sciences (SPSS version 20) was used to enter and analyze the collected data. Tables and figures were used as appropriate to display the data. The cost of a particular drug (cost per 10 tablets) in the same strength and dosage forms manufactured by different companies was obtained from various pharmacies around the hospital and sold at printed maximum retail price (MRP). The MRP of selected oral hypoglycemic agents of the same strength and dose manufactured by different companies was noted from the strips themselves. For the cost variation analysis, the price percentage difference in the cost of the same medication from different brands produced by different pharmaceutical companies was determined. The cost variation was assessed by comparing the maximum and minimum costs of various medications. Price percentage variation was calculated using the formula: [(Maximum Cost – Minimum Cost) x 100] / Minimum Cost.[9,10]

Results

A total of 250 participants with type 2 diabetes mellitus were included in the study, out of which 58% were males and 42% were females. The age group of 51–70 years old accounted for the largest population (51.2%) of these individuals (51.2%). Similarly, 35.2%, 13.2%, and 0.4% of the patients were in the 31–50, 71–80, and ≤ 30 age groups, respectively (Table 1).

Figure 1 illustrates the comorbidities present in patients with type 2 diabetes mellitus. Among comorbidities, hypertension was the most prevalent (28%), followed by hypothyroidism (11.6%) and dyslipidemia (9.6%).

This study includes five monotherapy groups (n=222; 57.96%) and three combinations (n=161; 42.04%) of oral hypoglycaemic agents. Among patients receiving monotherapy, Metformin was mostly prescribed, accounting for 36.5%. Other drugs included Linagliptin (21.2%), Glimepiride (17.5%), Voglibose (10.4%), and Empagliflozin (6.8%). The least prescribed drugs among monotherapies were Gliclazide (3.6%), Sitagliptin (2.2%), and Acarbose (1.8%). Among combined therapies, Metformin and Glimepiride were the most often administered, accounting for 46.6% of diabetic patients. 27.9% of patients were administered Metformin with Linagliptin, whereas 25.5% were prescribed Metformin with Sitagliptin (Table 2).

Table 3 represents the percentage price variation of oral hypoglycaemic agents used as monotherapy. Voglibose 0.3 mg showed the highest percentage price variation at 454.4%, followed by metformin 500 mg (260%). Other variations included 94.24% for 850 mg metformin, 66.66% for 1000 mg Metformin and 62.26% for 2 mg glimepiride. Drugs like Sitagliptin (50 mg) and Linagliptin (5 mg) showed minimal price variation of 4.16% and 3.89%, respectively.

Table 4 represents the percentage price variation of combined therapy of oral hypoglycaemic agents. Among combination therapies, Metformin+Glimepiride (500 mg+1 mg) exhibited the highest percentage of price variation (285.71%), followed by Metformin+Linagliptin (500 mg+2.5 mg) at 52.3%. The lowest price variation was observed in Metformin+Linagliptin (850 mg+5 mg) at 3.84%.

Table 1: Sociodemographic characteristics of patients with type 2 diabetes mellitus

Variables	Frequency	
Age of Patients (Years) (N=250)		
≤ 30	1	0.4
31-50	88	35.2
51-70	128	51.2
71-80	33	13.2
Gender		
Male	145	58
Female	105	42

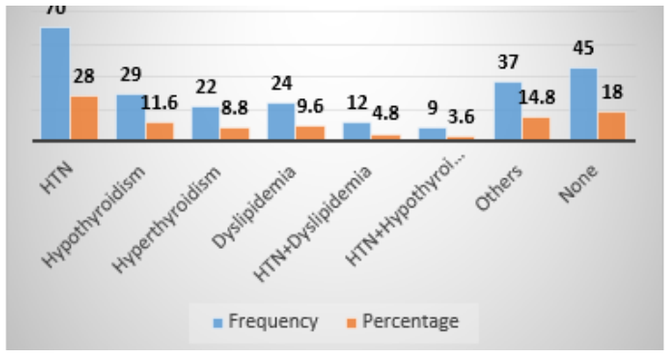

Figure 1: Comorbidities prevalent in patients with type 2 diabetes

Table 2: Oral hypoglycaemic agents used in type 2 diabetes mellitus

Drugs	Frequency (%)
Monotherapy (N=222)	
Biguanides	
Metformin	81 (36.5%)
Sulfonylureas	
Glimepiride	39 (17.5%)
Gliclazide	8 (3.6%)
DPP4-Inhibitors	
Linagliptin	47 (21.2%)
Sitagliptin	5 (2.2%)
Alpha-glucosidase inhibitors	
Acarbose	4 (1.8%)
Voglibose	23 (10.4%)
SGLT2 Inhibitors	
Empagliflozin	15 (6.8%)
Combined Therapy (N= 161)	
Metformin + Glimepiride	75 (46.6%)
Metformin + Linagliptin	45 (27.9%)
Metformin + Sitagliptin	41 (25.5%)

Table 3: Percentage price variation of single (monotherapy) oral hypoglycaemic agents

Drugs	Strength (mg)	Frequency	Maximum Price (per 10 tablets)	Minimum Price (per 10 tablets)	Price Variation (%)
Metformin	500	45	45	12.5	260
	850	15	48.56	25	94.24
	1000	21	62.5	37.5	66.66
Glimepiride	1	13	53	33.13	59.97
	2	21	86	53	62.26
	3	5	112	70	60
Gliclazide	40	6	60	40	50
	80	2	130	90	44.44
Linagliptin	2.5	28	130	93	39.78
	5	19	200	192.5	3.89
Sitagliptin	50	5	250	240	4.16
Acarbose	50	4	150	130.2	15.20
Voglibose	0.2	11	112	93.5	19.78
	0.3	12	182.4	32.9	454.4
Empagliflozin	10	8	390	320	21.87
	25	7	700	500	40

Table 4: Percentage price variation of combined therapy of oral hypoglycaemic agents

Drugs	Strength (mg)	Frequency	Maximum Price (per 10 tablets)	Minimum Price (per 10 tablets)	Price Variation (%)
Metformin+ Glimepiride	500+1	18	270	70	285.71
	500+2	37	204.8	103.67	97.5
	1000+1	11	124.24	86.5	43.63
	1000+2	11	159	105.6	50.56
Metformin+ Sitagliptin	500+50	31	280	240	16.66
	1000+50	2	280	250	12
Metformin+ Linagliptin	500+2.5	29	198	130	52.3
	850+2.5	9	130	90	44.44
	850+5	7	270	260	3.84
	1000+2.5	6	160	130	23.07

Discussion

Diabetes mellitus is a chronic endocrine and metabolic condition that necessitates lifelong treatment. It affects the patient's quality of life and economic burden. High price differences across brands of the same medication have been shown in the literature to contribute to an increase in the burden of diabetes.[11-13] Drug cost has an impact on

patient compliance; the greater the cost, the lower the compliance.[14] The treatment's outcome and compliance will be enhanced by choosing an affordable medication.

The prevalence of type 2 diabetes mellitus is greater in males (58%) compared to females (42%), which reflects the differences in risk factors such as lifestyle, diet, and healthcare access to the patients. The study is comparable to prior research by Dhakal et al.,[7] Upadhyay et al.,[15] and Manapurthu et al.[16] Diabetes mellitus is more common in patients aged 51-70 years (51.2%) than in other age groups. The predominance of patients aged 51-70 years aligns with global trends, representing that T2DM is most common in middle-aged and elderly individuals compared to other age groups. This incidence is similar to the research done by Upadhaya et al.[15] The increased prevalence of type 2 diabetes in the 51-70 years age group may be due to insulin resistance and metabolic changes associated with aging.

The present study revealed that hypertension was the most prevalent co-morbidity among patients with type 2 diabetes mellitus (28%), followed by hypothyroidism (11.6%) and dyslipidaemia (9.6%). Hypertension and dyslipidemia were higher in the study done by Dhakal et al.,[7] which is 45% and 11.3%, respectively. Similarly, the survey conducted by Karthikeyan et al.[17] showed a lesser incidence of HTN (19.59%). Likewise, the research by Ijtaba et al.[18] revealed a greater prevalence of hyperlipidaemia (20.4%). This suggests the correlation between diabetes and hypertension and highlights the importance of management strategies addressing both glycaemic control and associated comorbidities.

In the present study, Metformin accounted for 36.5% of all antidiabetic prescriptions, followed by Linagliptin (21.2%) and Glimepiride (17.5%). Studies indicate the established position of Biguanide as the first-line therapy for type 2 diabetes mellitus, owing to its efficacy and safety profile. Additionally, our study highlights the relatively high use of DPP4 inhibitors (Linagliptin 21.2%) and SGLT2 inhibitors like Empagliflozin (6.8%), suggesting a shift towards the newer agents for patients who cannot tolerate Metformin or require alternative treatment. Among Sulfonylurea, Glimepiride was preferred as these have a lesser risk of hypoglycemia. The findings of this study are consistent with those of other earlier research done by Dhakal et al., Abidi et al., and Acharya et al.[7, 19, 20] Among the newer groups, the physicians preferred Linagliptin (21.2%) and Voglibose (10.4%).

The present study used 161 prescriptions in the combined therapy. Metformin and glimepiride (46.6%) were the most often given medications, which is comparable to the findings by Das et al.[21] and Abidi. et al.[19] Among oral hypoglycaemic medications, this combination is the most rational, as both medications have a synergistic effect on managing blood glucose levels effectively.

This study analyzed Biguanides, Sulfonylureas, DPP4 inhibitors, and Alpha-glucosidase inhibitors. There are fluctuations in the maximum and minimum prices of oral hypoglycemic agents. Among monotherapy, Voglibose 0.3mg shows the highest percentage of price variation (454.4%), followed by Metformin 500 mg (260%), Metformin 850 mg (94.2%), Glimepiride 2 mg (62.3%). The DPP4 inhibitors Sitagliptin and Linagliptin show the lowest percentage price variation, 4.2%, and 3.89%, respectively. Unlike our study, Dupaguntla et al.[14] and Abidi et al.[19] showed Glimepiride has the highest price variation (892%, 633.3%), respectively. Similarly, the percentage price variation of Metformin 500 mg was highest in studies conducted by Amaravati et al.[5] A study conducted in Nepal by Shrestha B showed the percentage price variation of Metformin 500 mg was 171.42%, which is lower than the present study. Sitagliptin 50 mg showed a percentage price variation of 33.3%, more than the present study.[6] This variation may be due to the rise in the number of pharmaceutical companies and fresh brands entering the market.

Among combination therapies, Metformin (500 mg) and glimepiride (1 mg) showed the highest price variation of 285.7% in the present study, which is similar to the study conducted by Dupaguntla et al.[14] (346%). A survey by Amaravati et al.[5] showed the highest percentage of price variation with the combination drug Glibenclamide (5 mg) and Metformin (500 mg) (300.8%), Jadhav et al.[11] showed the highest percentage of price variation with the combination drug Glipizide and Metformin (399.0%). In the present study, the combination of Metformin (850 mg) and Linagliptin (5 mg) showed the lowest percentage price variation of 3.84%. Likewise, the survey conducted by Acharya et al.[20] revealed the combination of Metformin+Pioglitazone and Glipizide (5 mg)+Metformin (500 mg) had price variations of 1.5% and 44.7%, respectively.

Thus, this study revealed high price variations among oral hypoglycaemic agents manufactured by different pharmaceutical companies. This approach helps the physician identify and prescribe a more cost-effective drug. Choosing cost-effective medication reduces the likelihood of a patient's financial burden. As a result, enhance the patient adherence to the prescribed course of treatment, thereby improving health outcomes. Moreover, some measures should be taken at the government level to bring uniformity to the price of oral hypoglycaemic agents and improve patients' economic burden. Further, government policymakers and healthcare professionals should address these significant percentage price variations and ensure the access of drugs to essential medications.

Limitations and recommendations:

The study had a limited sample size, a brief study duration, and was carried out in a single center. Hospitalized diabetic individuals were excluded from the study, and only oral hypoglycaemic medications were included. According to the present study, patient adherence and appropriate treatment outcomes depend on the prescription of cost-effective medication. The implementation of price control policies at the government level is necessary to regulate price variation, lower treatment costs, and improve patient adherence to treatment. More studies should be carried out in multicenter settings with large numbers of patient populations to investigate comorbidities and how they affect the treatment decisions of individuals with type 2 diabetes.

Conclusion

This study showed Voglibose (0.3 mg) and Metformin (500 mg) had a high price difference among monotherapy, and a combination of Metformin and glimepiride (500 mg+1 mg) had a high price variation among combination therapy of oral hypoglycaemic agents. The least price variation was observed among DPP4 inhibitors in monotherapy and a combination of Metformin and Linagliptin in combination therapy. The price variations may be due to the availability of various brands of anti-diabetic medications in the market. It is crucial to educate prescribers about the significant price variation of oral hypoglycaemic medications. The cost-effective drugs should be prescribed by the prescriber as they increase the patient adherence and lessen their financial burden.

References

1. World Health Organization WHO. Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia: report of a WHO/IDF consultation. 2006 Available from: https://iris.who.int/bitstream/handle/10665/43588/924159?sequence=1.
2. Gyawali B, Sharma R, Neupane D, Mishra SR, van Teijlingen E, Kallestrup P. Prevalence of type 2 diabetes in Nepal: a systematic review and meta-analysis from 2000 to 2014. Global Health Action. 2015;8(1):29088. DOI: 10.3402/gha.v8.29088 PMID: 26613684 PMCID: PMC4662667
3. Shrestha N, Mishra SR, Ghimire S, Gyawali B, Mehata S. Burden of diabetes and prediabetes in Nepal: a systematic review and meta-analysis. Diabetes Therapy. 2020;11:1935-46. DOI: 10.1007/s13300-020-00884-0 PMID: 32712902 PMCID: PMC7434818
4. Nepal Diabetes Association. 2024. Available: https://www.nepaldiabetesassociation.com/research.php.
5. Amaravati RVC, Kandra NV. Cost analysis of oral hypoglycemic agents available in Indian pharmaceutical market. National Journal of Physiology, Pharmacy and Pharmacology. 2023;13(7):1439-43 DOI: 10.5455/njppp.2023.13.12584202220122022
6. Shrestha B. Cost analysis study of oral hypoglycemic agents available in Nepalese market. Medical Journal of Shree Birendra Hospital. 2014;13(2):6-9 DOI: 10.3126/mjsbh.v13i2.13107
7. Dhakal S, Shakya S, Sharma SK. Cost-effectiveness analysis of oral hypoglycemics for type-2 diabetes mellitus at a tertiary care hospital, Nepal. Journal of Pharmacy and Pharmacology. 2019;7(10):546-56. DOI: 10.17265/2328-2150/2019.10.004
8. Gyawali B, Hansen MRH, Povlsen MB, Neupane D, Andersen PK, McLachlan CS, et al. Awareness, prevalence, treatment, and control of type 2 diabetes in a semi-urban area of Nepal: Findings from a cross-sectional study conducted as a part of COBIN-D trial. PloS One. 2018;13(11):e0206491. DOI: 10.1371/journal.pone.0206491 PMID: 30388140 PMCID: PMC6214524
9. Arya N, Agrawal S, Agrawal M. A study of the cost analysis of various oral antihypertensive drugs available in Indian market. Int J Basic Clin Pharmacol. 2019;8(8):1850-4. DOI: 10.18203/2319-2003.ijbcp20193205
10. Wadagbalkar P, Patel P, Raipurkar S. Cost variation analysis of ACE inhibitors in India. Int J Basic Clin Pharmacol. 2016;5:1636-40. DOI: 10.18203/2319-2003.ijbcp20172253
11. Jadhav N, Bhosale M, Adhav C. Cost analysis study of oral anti diabetic drug available in Indian market. Int J Med Res Health Sci. 2013;2(1): 63-9.
12. Lallan H, Borde M, Ray I, Deshmukh Y. Cost variation study of antidiabetics: Indian scenario. Indian J Appl Res. 2014;4(5):420-1. DOI: 10.15373/2249555X/may2014/130
13. American Diabetes Association. Standards of medical care in diabetes-2014. Diabetes Care. 2014;37(Supplement_1):S14-S80. DOI: 10.2337/dc14-S014 PMID: 24357209
14. Dupaguntla R, Gujjarlamudi H. Pharmacoeconomic evaluation of oral hypoglycemic drugs available in Indian market. The Pharma Innovation. 2017;6(9):436-9
15. Upadhyay DK, Palaian S, Ravi Shankar P, Mishra P, Sah AK. Prescribing pattern in diabetic outpatients in a tertiary care teaching hospital in Nepal. Journal of clinical and diagnostic research. 2007;3:248-55. DOI: 10.7860/JCDR/2007/.94
16. Manapurthu MG, Deepashree C, Pradeep R, Nivedha M. Assessment of prescription pattern and cost effective analysis of oral hypoglycemic agents used in treatment of type 2 diabetes mellitus. Journal of Pharmaceutical and Biological Sciences. 2024;12(1):68-76. DOI: 10.18231/j.jpbs.2024.011
17. Karthikeyan V, Maadhusudhan S, Selvamuthukumran S. Studies on prescribing pattern in the management of diabetes mellitus in rural teaching hospital. Saudi J Med Pharm Sci. 2016;2(5):100-7. DOI: 10.36348/sjmps.2016.v02i05.002
18. Ijtaba Fazili MT, Naqash A, Bader G. Incidence and pattern of diabetes and pharmacoeconomic analysis of antidiabetic drug therapy at a tertiary care hospital. European Journal of Pharmaceutical and Medical Research. 2017;4(6):468-72.
19. Abidi A, Rizvi DA, Ahmad A. Pharmacoeconomic and drug utilization study of antidiabetic therapy in a tertiary care teaching hospital of northern India. Asian Journal of Pharmaceutical and Clinical Research. 2016:371-5.
20. Acharya KG, Shah KN, Solanki ND, Rana DA. Evaluation of antidiabetic prescriptions, cost and adherence to treatment guidelines: a prospective, cross-sectional study at a tertiary care teaching hospital. Journal of Basic and Clinical Pharmacy. 2013;4(4):82. DOI: 10.4103/0976-0105.121653 PMID: 24808678
21. Das P, Das BP, Rauniar GP, Roy RK, Sharma SK. Drug utilization pattern and effectiveness analysis in diabetes mellitus at a tertiary care centre in eastern Nepal. Indian J Physiol Pharmacol. 2011;55(3):272-80.