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# Brand diversity and cost variation among registered anti-diabetic medicines in Pakistan and Saudi Arabia: a comparative analysis for cost-saving opportunities

**Muhammad Subhan Arshad**
Bahauddin Zakariya University
**Muhammad Fawad Rasool**
Bahauddin Zakariya University
**Anees Ur Rehman**
Bahauddin Zakariya University
**Hussain Alqhtani**
hmhalqhtani@nu.edu.sa
Najran University

**Research Article**

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# Brand diversity and cost variation among registered anti-diabetic medicines in Pakistan and Saudi Arabia: a comparative analysis for cost-saving opportunities


## Abstract

**Background:** Diabetes mellitus is a highly prevalent disease that requires lifelong pharmacological treatment, significantly contributing to its high economic burden. This study aimed to explore the price variation among registered anti-diabetic medicines in two contrasting pharmaceutical markets.

**Methods:** A data-based cross-sectional study was conducted from May to August 2025 using official databases of Pakistan (DRAP) and Saudi Arabia (SFDA) to collect data regarding registered anti-diabetic medicines. The registered brand data were presented in terms of percentage contributions, cost ratios, and percentage price variations between the highest and lowest cost brands. Price data were converted to international dollars using purchasing power parity conversion rates for comparison.

**Results:** A total of 1,069 and 272 anti-diabetic medicine brands were registered in Pakistan and Saudi Arabia, respectively. Sulfonylureas represented the highest proportion of single-drug formulations, with Glimepiride showing the highest price variation among its brands. Fixed drug combinations of DPP-4 Inhibitors and Biguanides have the highest brand contribution and price variation in both countries. In Pakistan, the top 10 price variations were above 300% with a maximum of 769%, while in Saudi Arabia, the top 10 price variations were above 150% with a maximum of 467%. The median prices of anti-diabetic medicines were higher in Saudi Arabia in comparison to Pakistan.

**Conclusion:** This comparative analysis revealed that brand load has a substantial impact on price variation. Highlighting the need to address brand proliferation as a strategy to enhance the affordability of diabetes care, particularly in resource-constrained settings where out-of-pocket expenditures predominate.



**Keywords:** Hypoglycemic drugs, Drug prices, Price Variation, Generics, Price comparison


## 1. Introduction

The escalating prevalence of diabetes mellitus (DM) poses a significant impact on public health worldwide in terms of morbidity, mortality, and economic burden (Ong et al., 2023). According to the regional classification of the World Health Organization, the Eastern Mediterranean region (EMR) has the highest DM prevalence (17.6%), with total DM-related healthcare expenditure of 35 billion USD. Whereas Pakistan has the highest prevalence (31.4%), followed by Saudi Arabia (23.1%) in the region, with total DM related healthcare expenditure of 2.7 billion USD and 7.3 billion USD, respectively (Genitsaridi et al., ). The chronic nature of DM and the need for long-term pharmacological interventions for its management intensify the economic burden (Alzaid et al., 2021). While the cost of medications represents the major component of the overall cost of DM, which also makes it a crucial factor influencing treatment adherence, disease control, and patient outcomes (Arshad et al., 2024). Sustained access to affordable medicines is required to manage DM effectively (Mohan et al., 2020).

The prices of medicines are influenced by various factors, including regulatory policies, procurement systems, and the availability of generic substitutes (Lee et al., 2020). The concept

of brand load could be defined as the number of brands available for an active pharmaceutical ingredient (API) within a given market (Ayub et al., 2022, Abdullah et al., 2025). A high brand load usually leads to wide price variation among the different brands of the same API, which could result in risk of financial burden for the healthcare system or a cost-saving opportunity if brands with lower prices are utilized. While lower brand load reduces the intra-country price variation among various registered brands of the same API (Shyam and Mahanthegowda 2020, Ayub et al., 2022).

The high-income countries (HICs) usually maintain strict regulatory policies that lead to low brand load. In contrast to the low- and middle-income countries (LMICs) where little flexible polices lead to high brand load (Abdel Rida et al., 2017, Babar 2022). In theory, the markets with high brand load foster price competition and lead to a wider range of options for patients. Conversely, in low brand load markets, a less competitive environment may result in higher prices due to reduced alternatives.

The national regulatory policies and health economic landscape of a country affect the extent of brand load and its impact on the pricing of medicines. The fragmented, mixed healthcare system (private and public) of Pakistan presents an example where high brand load may be a basic reason for medicine cost variation, which is mainly characterized by out-of-pocket expenditures and a competitive pharmaceutical market (Shaikh and Ali 2023). In contrast, Saudi Arabia is an example where the government has very strict controls via compulsory health insurance, centralized procurement systems, and greater price transparency that might lead to lower brand load and narrower price variation (Al-Anezi et al., 2020).

This study aimed to explore the price variation among registered anti-diabetic medicines (ADM) in two contrasting pharmaceutical markets from EMR with the highest DM prevalence. This unique comparative approach will allow for an in-depth analysis of market competition (as reflected by brand load) that collectively influences the pricing of ADMs. By analyzing these distinct environments, we seek to identify potential cost-saving opportunities for patients and inform policy recommendations aimed at enhancing the affordability and accessibility of ADMs.

## 2. Methods

### 2.1. Study design

This study was conducted using a data-based, cross-sectional study design to compare the brand load and prices of ADMs registered in Pakistan and Saudi Arabia, an LMIC and HIC, respectively. The current study was conducted from May 2025 to August 2025, including data collection and data analysis.

### 2.2. Data sources and data collection

The required data were acquired from official national drug regulatory authorities and their associated publications to ensure accuracy and reliability. For Pakistan, the official database of the Drug Regulatory Authority of Pakistan (DRAP) was used to collect data regarding registered brands of ADM in Pakistan. The DRAP website provides both a list of registered medicines and the maximum retail price on different webpages (DRAP , DRAP). After collecting data from the DRAP website, the data were cross-matched with Pharmaguide (edition 2024) (PharmaGuide). For Saudi Arabia, data were extracted from the online official national database of the Saudi Food and Drug Authority (SFDA) (SFDA). The data from SFDA were regularly updated, so it did not require validation like the data from DRAP. During the data extraction process, all registered ADMs were identified using their ATC codes, and

information regarding generic name, brand name, strength, dosage form, manufacturer name, pack size, and retail/public price was extracted for analysis.

### 2.3. Data management and analysis

All collected data were imported into Microsoft Excel for cleaning, sorting, and further analysis. First of all, data were sorted according to their pharmacological classes and then according to generic name and available strengths in those classes. The schematic presentation of the required data extraction and sorting can be seen in Figure 1.

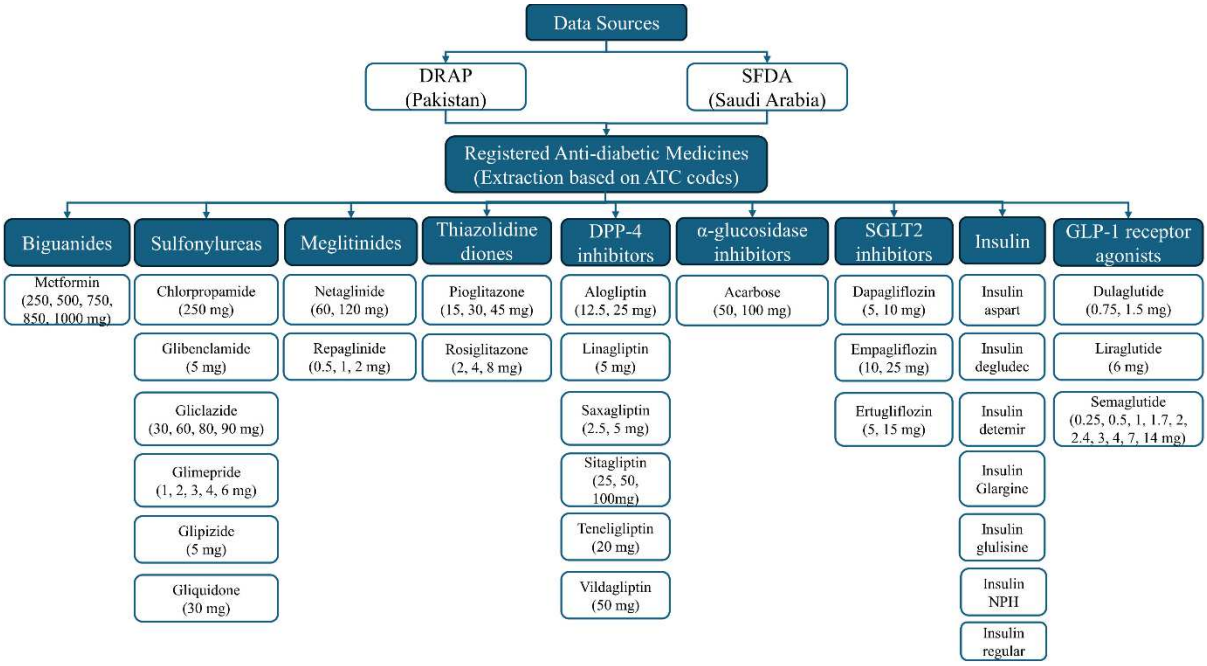



**Figure 1.** Schematic presentation of data extraction and sorting for analysis.

Afterward, brand load was calculated for pharmacological class and generic name (stratified according to different available strengths). The number of available brands in a specific pharmacological class and the number of brands for each generic with different strengths were counted, and their percentage contribution within class and all registered brands were calculated for brand load comparison between both countries. To enhance the understanding, single drug formulations (SDFs) and fixed drug combinations (FDCs) were handled separately. Maximum retail prices per pack obtained from data sources were converted to per-unit price by dividing them by the number of units in one pack. Afterward, maximum, minimum, and median prices for SDFs and FDCs having two or more brands in both countries were calculated. Percentage variation and cost ratios were also calculated for comparison based on brand load. Cost ratios were calculated by dividing the maximum costs by the minimum costs. While the percentage variation is calculated by using the following formula (Shyam and Mahanthegowda 2020, Ayub et al., 2022).

$$\text{Percentage Variation} = \frac{\text{Maximum Price} - \text{Minimum Price}}{\text{Minimum Price}} \times 100$$

All price data were converted to international dollars from their local currencies to facilitate the direct comparison using the conversion rate of purchasing power parity (PPP), which is the number of units of a country's currency required to buy a product in the domestic market that US$ would buy the same product in the USA (Schneider and Vogler 2019, Moye-Holz and

Vogler 2022). The PPP conversion rates for the most recent year, 2024, were utilized, which were 1 international $ = 66.86 PKR and 1 USD = 1.85 SAR as per World Bank data (Bank).

## 3. Results

A total of 1,069 ADM brands were registered in Pakistan, and 272 brands were registered in Saudi Arabia, including both SDFs and FDCs with different strengths. These were classified into 9 pharmacological classes, i.e., Biguanides, Sulfonylureas, Meglitinides, Thiazolidinediones, α-glucosidase inhibitors, Dipeptidyl Peptidase-4 (DPP-4) inhibitors, Sodium-Glucose Cotransporter 2 (SGLT2) inhibitors, Insulin, and Glucagon-like Peptide-1 (GLP-1) receptor agonists. Among those drug agents from 2 classes were registered as injectable dosage forms (Insulin and GLP-1 receptor agonists), while other was registered as oral dosage forms.

Among registered ADM, 506 brands were registered as SDFs in Pakistan, with major contribution from Sulfonylureas (44.1%), followed by DPP-4 inhibitors (19.8%) and SGLT2 inhibitors (17.8%) as presented in Figure 2. Glimepiride 2mg had the highest contribution (10.9%) among all registered SDFs, followed by Glimepiride 4 mg (9.7%), Glimepiride 1 mg (8.3%), Glimepiride 3 mg (7.5%), and Sitagliptin 50 mg (7.5%). Details can be seen in Table 1. In Saudi Arabia, 207 brands of SDF ADM were registered, with major contributions of DPP-4 inhibitors (23.7%), followed by Sulfonylureas (22.2%) and Biguanides (14.5%). Vildagliptin 50 mg had the highest contribution (12.1%) among all registered SDFs, followed by Insulin glargine (5.3%), Glimepiride 3 mg (4.3%), Glimepiride 1 mg (4.3%), and Metformin 1000 mg (4.3%).

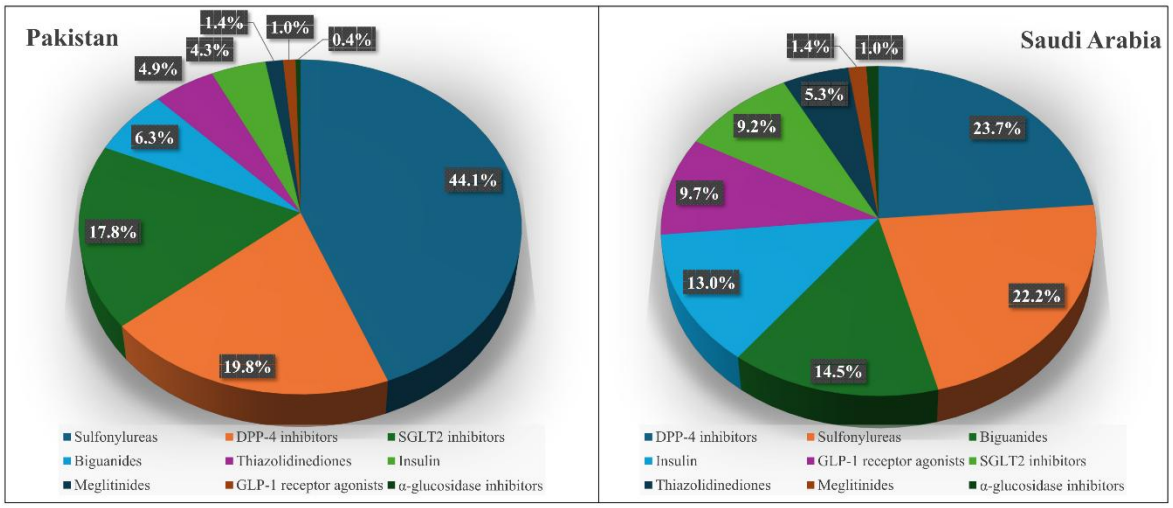



**Figure 2.** Market share of registered anti-diabetic medicines (single-drug formulations) by pharmacological class in Pakistan and Saudi Arabia.

The brand load of ADM with FDCs registered in Pakistan and Saudi Arabia is presented in Table 2. A total of 563 FDC brands were registered in Pakistan, and 65 FDC brands were registered in Saudi Arabia. DPP-4 inhibitors and Biguanides were the most common pharmacological classes with FDCs registered in both Pakistan and Saudi Arabia, having a contribution in total FDCs of 48.1% and 32.3% respectively (Figure 3). While the SGLT2 inhibitors and Biguanides were the pharmacological classes with the 2nd-highest contribution to total FDCs brand in Pakistan (27.2%) and Saudi Arabia (13.8%). Sitagliptin 50 mg and Metformin 1000 mg were the FDC with the highest contribution to total brand load in both countries in Pakistan and Saudi Arabia, 13.5% and 9.2%, respectively.

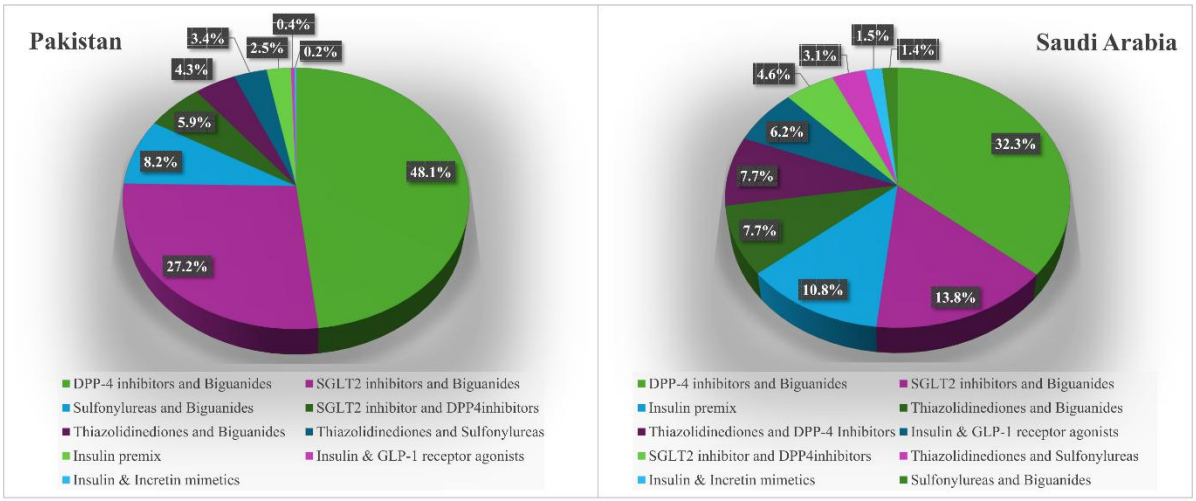



**Figure 3.** Market share of anti-diabetic medicines (fixed-dose combinations) by pharmacological class in Pakistan and Saudi Arabia.

The price variation analysis revealed that Insulin regular had the highest price variation (769%) among SDF registered brands in Pakistan, followed by Insulin NPH (709%), Metformin 500 mg (700%), Glibenclamide 5 mg (580%), and Glimepiride 4 mg (438%). The percentage variations in the price of SDF brands are presented in Figure 4. While Glimepiride 1 mg and Glimepiride 4 mg had the highest price variation (467%) among SDF registered brands in Saudi Arabia, followed by Metformin 1000 mg (450%), Glimepiride 1 mg (433%), Metformin 500 mg (400%), and Metformin 850 mg (400%). The details of the price comparison of SDFs can be seen in Table 3. Among FDCs brands, Vildagliptin 50 mg and Metformin 850 mg had the highest price variation (392%) in Pakistan, while Sitagliptin 50 mg and Metformin 850 mg had the highest price variation (275%) in Saudi Arabia (Figure 5). The 2$^{nd}$ highest price variations among registered FDCs in Pakistan and Saudi Arabia were Glimepiride 2 mg & Metformin 500 mg (378%), and Pioglitazone 15 mg & Metformin 850 mg (36%), respectively. The price comparison analysis of FDC brands in both countries is presented in Table 4. The median costs of each brand, including both SDFs and FDCs, were comparatively lower in Pakistan than in Saudi Arabia.

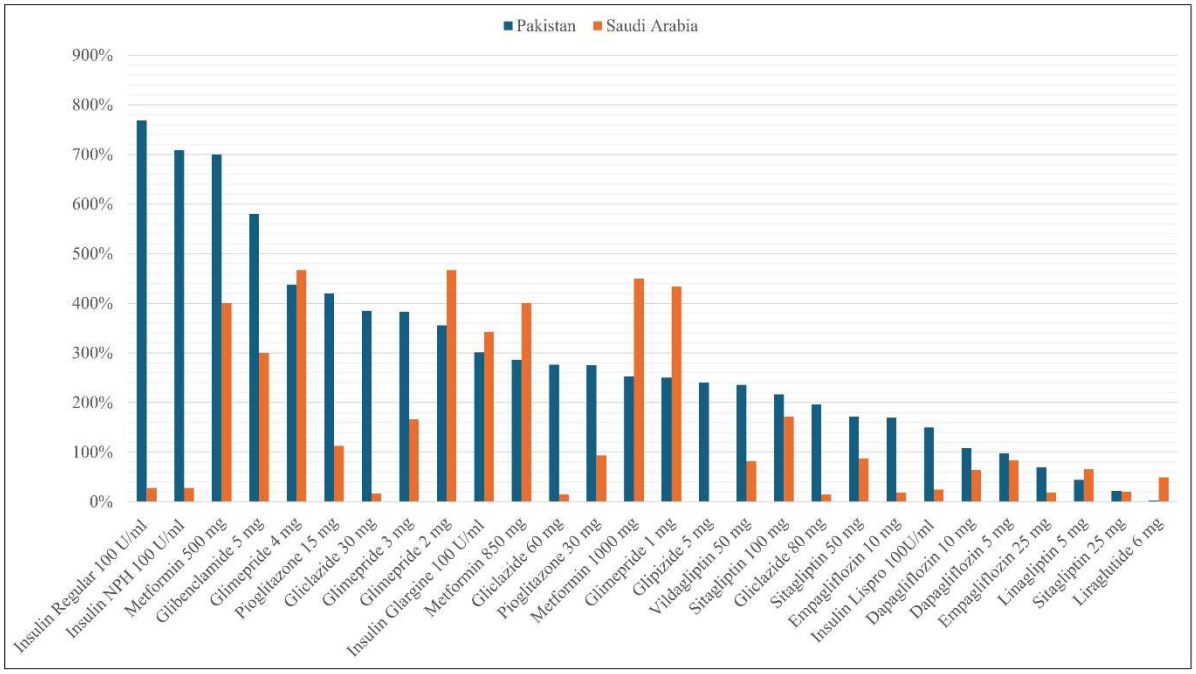



**Figure 4.** Percentage variations in prices of registered anti-diabetic medicines (single-drug formulations) in Pakistan and Saudi Arabia.

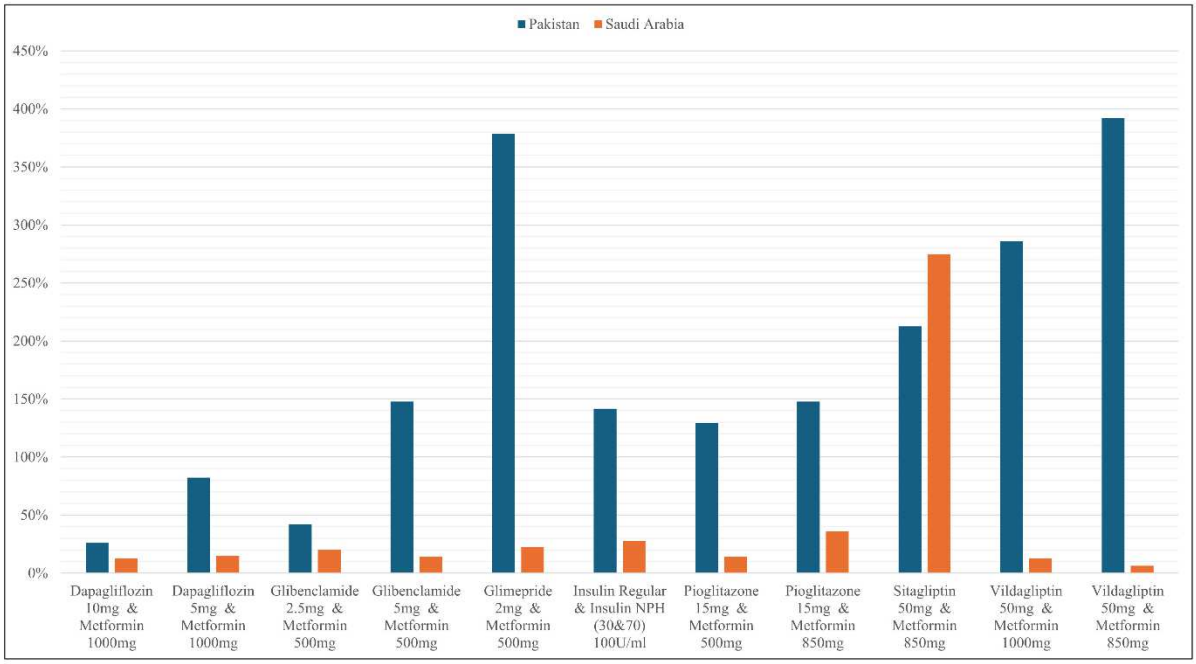



**Figure 5.** Percentage variations in prices of registered anti-diabetic medicines (fixed-dose combinations) in Pakistan and Saudi Arabia

## 4. Discussion

Economic evaluations are a fundamental part of health services research and play a vital role in policy making to utilize resources wisely. Price comparisons between different countries are performed to provide information for policymakers (Vogler and Kilpatrick 2015). Medications

cost contributes a major part to health expenditures, and become more dominant factors in chronic diseases like DM that require lifelong maintenance therapy. The current study explored the price variation among the registered brands of ADM in the region with the highest prevalence of DM. For comparison, two countries were selected from EMR with different economic status and brand load of registered ADM (i.e., Pakistan and Saudi Arabia). The comparative analysis revealed that Pakistan has more price variation with a high brand load in comparison to Saudi Arabia, with a high brand load. Median costs of ADM are higher in Saudi Arabia in comparison to Pakistan.

Brand load of registered ADM is higher in Pakistan, while comparatively lower in Saudi Arabia, as revealed by the current study. Sulfonylureas and DPP-4 inhibitors had the highest number of brands in both countries. These findings are aligned with a similar study conducted in India regarding ADM (Shyam and Mahanthegowda 2020). High brand load in Pakistan was also reported by two different studies exploring branded generics of anti-cancer agents (Ayub et al., 2022) and antibiotics (Abdullah et al., 2025). The low brand load of registered ADM in Saudi Arabia might be due to a strict and well-established pharmaceutical policy (Alrasheedy et al., 2017).

The current study explored that price variation becomes higher with an increase in the number of brands, which is consistent with some already published studies from different countries (Hussain 2015, Hussain and Kumari 2015, Shyam and Mahanthegowda 2020, Ayub et al., 2022). According to findings of this study, Glimepiride and Metformin were the drug agents with the highest number of brands and had the highest price variation in both countries, Pakistan and Saudi Arabia, while the studies with a similar context from India reported similar results (Hussain and Kumari 2015, Shyam and Mahanthegowda 2020). The number of brands and price variation among FDCs Glimepiride and Metformin were higher in Pakistan, which aligns with the findings of studies from neighboring countries (Hussain 2015, Shyam and Mahanthegowda 2020). As Metformin and Glimepiride are first-line and second-line agents in the treatment of DM, there is a higher number of brands. This high brand load creates market competition, leads to the highest price variation, and generates a cost-saving opportunity for patients.

The current study has some limitations that should be acknowledged. First, we may not be able to capture price fluctuations due to the cross-sectional nature of the study, especially in Pakistan, where medicine prices have been fluctuating rapidly for a few years due to economic instability. Second, the study did not assess actual utilization patterns based on availability, which could influence the real-world consequences of cost variation. Despite these limitations, the study provides novel insights into how brand load influences price variability and patient cost burden across two contrasting economic and regulatory settings.

## 5. Conclusion

The current study demonstrated that the brand load of ADM has a substantial impact on price variation in both countries. Pakistan, with its high brand load, showed wide intra-country differences in medicine prices, creating both risks of unnecessary financial burden and opportunities for significant cost savings if lower-priced alternatives are chosen. In contrast, Saudi Arabia, with a low brand load and stronger regulatory controls, exhibits harmonized pricing, reflecting a potentially more regulated and efficient market. Overall, this comparative analysis underscores the potential of addressing brand load as a strategy to enhance the affordability of diabetes care, particularly in resource-constrained settings where out-of-pocket expenditures predominate.

## Statements and Declarations

### Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### Funding

This research received no external funding.

### Data availability statement

All the data that was used for the analysis are available with the corresponding author and can be provided on a suitable request.

### Ethical considerations

This study used publicly available data from official national drug regulatory databases (DRAP, SFDA). As no human or animal subjects were involved, ethical approval was not required.

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## Tables

**Table 1.** Brand landscape of registered anti-diabetic single drug formulations in Pakistan and Saudi Arabia.

| **Drug Class** | | **Pakistan** | | | **Saudi Arabia** | | |
|---|---|---|---|---|---|---|---|
| Molecules in each class | Strength | Brands count | Share within class | Share in total brands | Brands count | Share within class | Share in total brands |
| **Biguanides** | | **32** | | | **30** | | |
| Metformin | 250 mg | 3 | 9.4% | 0.6% | 0 | 0.0% | 0.0% |
| | 500 mg | 19 | 59.4% | 3.8% | 8 | 26.7% | 3.9% |
| | 750 mg | 1 | 3.1% | 0.2% | 8 | 26.7% | 3.9% |
| | 850 mg | 5 | 15.6% | 1.0% | 5 | 16.7% | 2.4% |
| | 1000 mg | 4 | 12.5% | 0.8% | 9 | 30.0% | 4.3% |
| **Sulfonylureas** | | **223** | | | **46** | | |
| Chlorpropamide | 250 mg | 1 | 0.4% | 0.2% | 0 | 0.0% | 0.0% |
| Glibenclamide | 5 mg | 12 | 5.4% | 2.4% | 3 | 6.5% | 1.4% |
| Gliclazide | 30 mg | 8 | 3.6% | 1.6% | 2 | 4.3% | 1.0% |
| | 60 mg | 9 | 4.0% | 1.8% | 3 | 6.5% | 1.4% |
| | 80 mg | 5 | 2.2% | 1.0% | 2 | 4.3% | 1.0% |
| | 90 mg | 1 | 0.4% | 0.2% | 0 | 0.0% | 0.0% |
| Glimepiride | 1 mg | 42 | 18.8% | 8.3% | 9 | 19.6% | 4.3% |
| | 2 mg | 55 | 24.7% | 10.9% | 8 | 17.4% | 3.9% |
| | 3 mg | 38 | 17.0% | 7.5% | 9 | 19.6% | 4.3% |
| | 4 mg | 49 | 22.0% | 9.7% | 5 | 10.9% | 2.4% |
| | 6 mg | 0 | 0.0% | 0.0% | 3 | 6.5% | 1.4% |
| Glipizide | 5 mg | 2 | 0.9% | 0.4% | 2 | 4.3% | 1.0% |
| Gliquidone | 30 mg | 1 | 0.4% | 0.2% | 0 | 0.0% | 0.0% |
| **Meglitinides** | | **7** | | | **3** | | |
| Netaglinide | 60 mg | 1 | 14.3% | 0.2% | 0 | 0.0% | 0.0% |
| | 120 mg | 1 | 14.3% | 0.2% | 0 | 0.0% | 0.0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Repaglinide | 0.5 mg | 1 | 14.3% | 0.2% | 1 | 33.3% | 0.5% |
| | 1 mg | 2 | 28.6% | 0.4% | 1 | 33.3% | 0.5% |
| | 2 mg | 2 | 28.6% | 0.4% | 1 | 33.3% | 0.5% |
| **Thiazolidinediones** | | **25** | | | **11** | | |
| Pioglitazone | 15 mg | 7 | 28.0% | 1.4% | 5 | 45.5% | 2.4% |
| | 30 mg | 7 | 28.0% | 1.4% | 5 | 45.5% | 2.4% |
| | 45 mg | 5 | 20.0% | 1.0% | 1 | 9.1% | 0.5% |
| Rosiglitazone | 2 mg | 2 | 8.0% | 0.4% | 0 | 0.0% | 0.0% |
| | 4 mg | 3 | 12.0% | 0.6% | 0 | 0.0% | 0.0% |
| | 8 mg | 1 | 4.0% | 0.2% | 0 | 0.0% | 0.0% |
| **α-glucosidase inhibitors** | | **2** | | | **2** | | |
| Acarbose | 50 mg | 1 | 50.0% | 0.2% | 1 | 50.0% | 0.5% |
| | 100 mg | 1 | 50.0% | 0.2% | 1 | 50.0% | 0.5% |
| **DPP-4 inhibitors** | | **100** | | | **49** | | |
| Alogliptin | 12.5 mg | 0 | 0.0% | 0.0% | 2 | 4.1% | 1.0% |
| | 25 mg | 0 | 0.0% | 0.0% | 2 | 4.1% | 1.0% |
| Linagliptin | 5 mg | 3 | 3.0% | 0.6% | 4 | 8.2% | 1.9% |
| Saxagliptin | 2.5 mg | 1 | 1.0% | 0.2% | 0 | 0.0% | 0.0% |
| | 5 mg | 1 | 1.0% | 0.2% | 0 | 0.0% | 0.0% |
| Sitagliptin | 25 mg | 6 | 6.0% | 1.2% | 2 | 4.1% | 1.0% |
| | 50 mg | 38 | 38.0% | 7.5% | 6 | 12.2% | 2.9% |
| | 100 mg | 33 | 33.0% | 6.5% | 8 | 16.3% | 3.9% |
| Teneligliptin | 20 mg | 1 | 1.0% | 0.2% | 0 | 0.0% | 0.0% |
| Vildagliptin | 50 mg | 17 | 17.0% | 3.4% | 25 | 51.0% | 12.1% |
| **SGLT2 inhibitors** | | **90** | | | **19** | | |
| Dapagliflozin | 5 mg | 14 | 15.6% | 2.8% | 7 | 36.8% | 3.4% |
| | 10 mg | 14 | 15.6% | 2.8% | 8 | 42.1% | 3.9% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Empagliflozin | 10 mg | 28 | 31.1% | 5.5% | 2 | 10.5% | 1.0% |
| | 25 mg | 25 | 27.8% | 4.9% | 2 | 10.5% | 1.0% |
| Ertugliflozin | 5 mg | 5 | 5.6% | 1.0% | 0 | 0.0% | 0.0% |
| | 15 mg | 4 | 4.4% | 0.8% | 0 | 0.0% | 0.0% |
| **Insulin** | | **22** | | | **27** | | |
| Insulin aspart | 100U/ml | 1 | 4.5% | 0.2% | 3 | 11.1% | 1.4% |
| Insulin degludec | 100U/ml | 0 | 0.0% | 0.0% | 2 | 7.4% | 1.0% |
| Insulin detemir | 100U/ml | 1 | 4.5% | 0.2% | 1 | 3.7% | 0.5% |
| Insulin Glargine | 100U/ml | 4 | 18.2% | 0.8% | 11 | 40.7% | 5.3% |
| Insulin Glulisine | 100U/ml | 1 | 4.5% | 0.2% | 1 | 3.7% | 0.5% |
| Insulin Lispro | 100U/ml | 3 | 13.6% | 0.6% | 3 | 11.1% | 1.4% |
| Insulin NPH | 100U/ml | 5 | 22.7% | 1.0% | 2 | 7.4% | 1.0% |
| Insulin Regular | 100U/ml | 7 | 31.8% | 1.4% | 4 | 14.8% | 1.9% |
| **GLP-1 receptor agonists** | | **5** | | | **20** | | |
| Dulaglutide | 0.75 mg | 0 | 0.0% | 0.0% | 1 | 5.0% | 0.5% |
| | 1.5 mg | 1 | 20.0% | 0.2% | 1 | 5.0% | 0.5% |
| Liraglutide | 6 mg | 2 | 40.0% | 0.4% | 4 | 20.0% | 1.9% |
| Semaglutide | 0.25 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| | 0.5 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| | 1 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| | 1.7 mg | 0 | 0.0% | 0.0% | 1 | 5.0% | 0.5% |
| | 2 mg | 1 | 20.0% | 0.2% | 0 | 0.0% | 0.0% |
| | 2.4 mg | 0 | 0.0% | 0.0% | 1 | 5.0% | 0.5% |
| | 3 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| | 4 mg | 1 | 20.0% | 0.2% | 0 | 0.0% | 0.0% |
| | 7 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| | 14 mg | 0 | 0.0% | 0.0% | 2 | 10.0% | 1.0% |
| **Total** | | **506** | | **100.0%** | **207** | | **100.0%** |

**Abbreviations:** DPP-4 = Dipeptidyl Peptidase-4, GLP-1 = Glucagon-like Peptide-1, SGLT2 = Sodium-Glucose Cotransporter 2, NPH = Neutral Protamine Hagedorn

**Table 2.** Brand landscape of registered anti-diabetic fixed-dose combinations in Pakistan and Saudi Arabia

| **Drug classes of combinations** | | **Pakistan** | | | **Saudi Arabia** | | |
|---|---|---|---|---|---|---|---|
| Fixed dose combinations | Strength | Brands count | Share within class | Share in total brands | Brands count | Share within class | Share in total brands |
| **Sulfonylureas and Biguanides** | | **46** | | | **8** | | |
| Glibenclamide and Metformin | 1.25 mg & 250 mg | 3 | 6.5% | 0.5% | 1 | 12.5% | 1.5% |
| | 2.5 mg & 500 mg | 5 | 10.9% | 0.9% | 2 | 25.0% | 3.1% |
| | 5 mg & 500 mg | 7 | 15.2% | 1.2% | 2 | 25.0% | 3.1% |
| | 5 mg & 1000 mg | 0 | 0.0% | 0.0% | 1 | 12.5% | 1.5% |
| Gliclazide and Metformin | 160 mg & 500 mg | 1 | 2.2% | 0.2% | 0 | 0.0% | 0.0% |
| | 80 mg & 500 mg | 1 | 2.2% | 0.2% | 0 | 0.0% | 0.0% |
| Glimepiride and Metformin | 1 mg & 500 mg | 13 | 28.3% | 2.3% | 0 | 0.0% | 0.0% |
| | 2 mg & 500 mg | 15 | 32.6% | 2.7% | 2 | 25.0% | 3.1% |
| Glipizide and Metformin | 5 mg & 500 mg | 1 | 2.2% | 0.2% | 0 | 0.0% | 0.0% |
| **Thiazolidinediones and Biguanides** | | **24** | | | **5** | | |
| Pioglitazone and Metformin | 15 mg & 500 mg | 9 | 37.5% | 1.6% | 2 | 40.0% | 3.1% |
| | 15 mg & 850 mg | 9 | 37.5% | 1.6% | 3 | 60.0% | 4.6% |
| Rosiglitazone and Metformin | 1 mg & 500 mg | 1 | 4.2% | 0.2% | 0 | 0.0% | 0.0% |
| | 2 mg & 500 mg | 2 | 8.3% | 0.4% | 0 | 0.0% | 0.0% |
| | 2 mg & 1000 mg | 1 | 4.2% | 0.2% | 0 | 0.0% | 0.0% |
| | 4 mg & 500 mg | 1 | 4.2% | 0.2% | 0 | 0.0% | 0.0% |
| | 4 mg & 1000 mg | 1 | 4.2% | 0.2% | 0 | 0.0% | 0.0% |
| **Thiazolidinediones and Sulfonylureas** | | **19** | | | **2** | | |
| Pioglitazone and Glimepiride | 15 mg & 2 mg | 4 | 21.1% | 0.7% | 0 | 0.0% | 0.0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 15 mg & 4 mg | 1 | 5.3% | 0.2% | 0 | 0.0% | 0.0% |
| | 30 mg & 2 mg | 7 | 36.8% | 1.2% | 1 | 50.0% | 1.5% |
| | 30 mg & 4 mg | 7 | 36.8% | 1.2% | 1 | 50.0% | 1.5% |
| **Thiazolidinediones and DPP-4 Inhibitors** | | **0** | | | **5** | | |
| Pioglitazone and Alogliptin | 15 mg & 25 mg | 0 | 0.0% | 0.0% | 2 | 40.0% | 3.1% |
| | 30 mg & 25 mg | 0 | 0.0% | 0.0% | 2 | 40.0% | 3.1% |
| | 45 mg & 25 mg | 0 | 0.0% | 0.0% | 1 | 20.0% | 1.5% |
| **DPP-4 inhibitors and Biguanides** | | **271** | | | **21** | | |
| Alogliptin and Metformin | 12.5 mg & 500 mg | 0 | 0.0% | 0.0% | 2 | 9.5% | 3.1% |
| | 12.5 mg & 850 mg | 0 | 0.0% | 0.0% | 2 | 9.5% | 3.1% |
| Sitagliptin and Metformin | 50 mg & 500 mg | 76 | 28.0% | 13.5% | 1 | 4.8% | 1.5% |
| | 50 mg & 850 mg | 20 | 7.4% | 3.6% | 5 | 23.8% | 7.7% |
| | 50 mg & 1000 mg | 76 | 28.0% | 13.5% | 6 | 28.6% | 9.2% |
| | 100 mg & 1000 mg | 11 | 4.1% | 2.0% | 1 | 4.8% | 1.5% |
| Vildagliptin and Metformin | 50 mg & 500 mg | 24 | 8.9% | 4.3% | 0 | 0.0% | 0.0% |
| | 50 mg & 850 mg | 32 | 11.8% | 5.7% | 2 | 9.5% | 3.1% |
| | 50 mg & 1000 mg | 32 | 11.8% | 5.7% | 2 | 9.5% | 3.1% |
| **SGLT2 inhibitors and Biguanides** | | **153** | | | **9** | | |
| Dapagliflozin and Metformin | 5 mg & 500 mg | 3 | 2.0% | 0.5% | 0 | 0.0% | 0.0% |
| | 5 mg & 850 mg | 9 | 5.9% | 1.6% | 0 | 0.0% | 0.0% |
| | 5 mg & 1000 mg | 12 | 7.8% | 2.1% | 2 | 22.2% | 3.1% |
| | 10 mg & 500 mg | 2 | 1.3% | 0.4% | 1 | 11.1% | 1.5% |
| | 10 mg & 1000 mg | 3 | 2.0% | 0.5% | 2 | 22.2% | 3.1% |
| Empagliflozin and Metformin | 12.5 mg & 500 mg | 23 | 15.0% | 4.1% | 0 | 0.0% | 0.0% |
| | 12.5 mg & 850 mg | 10 | 6.5% | 1.8% | 1 | 11.1% | 1.5% |
| | 12.5 mg & 1000 mg | 30 | 19.6% | 5.3% | 1 | 11.1% | 1.5% |
| | 25 mg & 1000 mg | 8 | 5.2% | 1.4% | 0 | 0.0% | 0.0% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 5 mg & 500 mg | 11 | 7.2% | 2.0% | 0 | 0.0% | 0.0% |
| | 5 mg & 850 mg | 7 | 4.6% | 1.2% | 1 | 11.1% | 1.5% |
| | 5 mg & 1000 mg | 22 | 14.4% | 3.9% | 1 | 11.1% | 1.5% |
| | 10 mg & 1000 mg | 7 | 4.6% | 1.2% | 0 | 0.0% | 0.0% |
| Ertugliflozin and Metformin | 2.5 mg & 500 mg | 1 | 0.7% | 0.2% | 0 | 0.0% | 0.0% |
| | 2.5 mg & 1000 mg | 2 | 1.3% | 0.4% | 0 | 0.0% | 0.0% |
| | 7.5 mg & 500 mg | 1 | 0.7% | 0.2% | 0 | 0.0% | 0.0% |
| | 7.5 mg & 1000 mg | 2 | 1.3% | 0.4% | 0 | 0.0% | 0.0% |
| **SGLT2 inhibitor and DPP4inhibitors** | | **33** | | | **3** | | |
| Empagliflozin and Linagliptin | 10 mg & 5 mg | 10 | 30.3% | 1.8% | 1 | 33.3% | 1.5% |
| | 25 mg & 5 mg | 10 | 30.3% | 1.8% | 1 | 33.3% | 1.5% |
| Ertugliflozin and Sitagliptin | 5 mg & 100 mg | 7 | 21.2% | 1.2% | 0 | 0.0% | 0.0% |
| | 15 mg & 100 mg | 6 | 18.2% | 1.1% | 0 | 0.0% | 0.0% |
| Dapagliflozin and Saxagliptin | 10 mg & 5 mg | 0 | 0.0% | 0.0% | 1 | 33.3% | 1.5% |
| **Insulin premix** | | **14** | | | **7** | | |
| Insulin aspart and Insulin aspart protamine | 100 U/ml | 2 | 14.3% | 0.4% | 2 | 28.6% | 3.1% |
| Insulin aspart and insulin degludec | 100 U/ml | 2 | 14.3% | 0.4% | 2 | 28.6% | 3.1% |
| Insulin Lispro and Insulin Lispro Protamine | 100 U/ml | 4 | 28.6% | 0.7% | 0 | 0.0% | 0.0% |
| Insulin Regular and Insulin NPH | 100 U/ml | 6 | 42.9% | 1.1% | 3 | 42.9% | 4.6% |
| **Insulin & Incretin mimetics** | | **1** | | | **1** | | |
| Insulin degludec and liraglutide | 100 U/ml & 3.6 mg | 1 | 100.0% | 0.2% | 1 | 100.0% | 1.5% |
| **Insulin & GLP-1 receptor agonists** | | **2** | | | **4** | | |
| Insulin glargine and Lixisenatide | 100U/ml & 33 mg | 1 | 50.0% | 0.2% | 2 | 50.0% | 3.1% |
| | 100 U/ml & 50 mg | 1 | 50.0% | 0.2% | 2 | 50.0% | 3.1% |
| **Total** | | **563** | | **100.0%** | **65** | | **100.0%** |

**Abbreviations:** DPP-4 = Dipeptidyl Peptidase-4, GLP-1 = Glucagon-like Peptide-1, SGLT2 = Sodium-Glucose Cotransporter 2, NPH = Neutral Protamine Hagedorn

**Table 3.** Price comparison of anti-diabetic medicines registered as single drug formulations in Pakistan and Saudi Arabia using purchasing power parities.

| Drug Class | | Pakistan | | | | | Saudi Arabia | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Molecules in each class | Strength | Brands count | Median | Min. Price | Max. Price | Cost Ratio | Brands count | Median | Min. Price | Max. Price | Cost Ratio |
| **Biguanides** | | | | | | | | | | | |
| Metformin | 500 mg | 19 | 0.03 | 0.01 | 0.11 | 8.00 | 8 | 0.16 | 0.05 | 0.27 | 5.00 |
| | 850 mg | 5 | 0.05 | 0.02 | 0.08 | 3.86 | 5 | 0.27 | 0.05 | 0.27 | 5.00 |
| | 1000 mg | 4 | 0.07 | 0.05 | 0.18 | 3.53 | 9 | 0.49 | 0.11 | 0.59 | 5.50 |
| **Sulfonylureas** | | | | | | | | | | | |
| Glibenclamide | 5 mg | 12 | 0.02 | 0.01 | 0.05 | 6.80 | 3 | 0.16 | 0.11 | 0.43 | 4.00 |
| Gliclazide | 30 mg | 8 | 0.17 | 0.07 | 0.34 | 4.85 | 2 | 0.32 | 0.32 | 0.38 | 1.17 |
| | 60 mg | 9 | 0.28 | 0.11 | 0.43 | 3.76 | 3 | 0.43 | 0.38 | 0.43 | 1.14 |
| | 80 mg | 5 | 0.13 | 0.07 | 0.20 | 2.96 | 2 | 0.43 | 0.38 | 0.43 | 1.14 |
| Glimepiride | 1 mg | 42 | 0.10 | 0.04 | 0.16 | 3.50 | 9 | 0.43 | 0.16 | 0.86 | 5.33 |
| | 2 mg | 55 | 0.16 | 0.07 | 0.31 | 4.56 | 8 | 0.43 | 0.16 | 0.92 | 5.67 |
| | 3 mg | 38 | 0.22 | 0.11 | 0.54 | 4.83 | 9 | 0.27 | 0.16 | 0.43 | 2.67 |
| | 4 mg | 49 | 0.32 | 0.12 | 0.64 | 5.38 | 5 | 0.27 | 0.16 | 0.92 | 5.67 |
| Glipizide | 5 mg | 2 | 0.03 | 0.01 | 0.05 | 3.40 | 2 | 0.16 | 0.16 | 0.16 | 1.00 |
| **Thiazolidinediones** | | | | | | | | | | | |
| Pioglitazone | 15 mg | 7 | 0.16 | 0.09 | 0.44 | 5.19 | 5 | 0.70 | 0.43 | 0.92 | 2.13 |
| | 30 mg | 7 | 0.32 | 0.15 | 0.56 | 3.75 | 5 | 1.14 | 0.81 | 1.57 | 1.93 |
| **DPP-4 inhibitors** | | | | | | | | | | | |
| Linagliptin | 5 mg | 3 | 0.37 | 0.31 | 0.45 | 1.44 | 4 | 1.41 | 1.24 | 2.05 | 1.65 |
| Sitagliptin | 25 mg | 6 | 0.27 | 0.25 | 0.30 | 1.22 | 2 | 1.46 | 1.35 | 1.62 | 1.20 |
| | 50 mg | 38 | 0.43 | 0.29 | 0.80 | 2.71 | 6 | 1.46 | 0.86 | 1.62 | 1.88 |
| | 100 mg | 33 | 0.66 | 0.52 | 1.66 | 3.16 | 8 | 1.62 | 0.76 | 2.05 | 2.71 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vildagliptin | 50 mg | 17 | 0.48 | 0.35 | 1.18 | 3.36 | 25 | 0.59 | 0.59 | 1.08 | 1.82 |
| **SGLT2 inhibitors** | | | | | | | | | | | |
| Dapagliflozin | 5 mg | 14 | 0.30 | 0.22 | 0.44 | 1.98 | 7 | 2.70 | 1.68 | 3.08 | 1.84 |
| | 10 mg | 14 | 0.44 | 0.30 | 0.62 | 2.08 | 8 | 2.43 | 1.68 | 2.76 | 1.65 |
| Empagliflozin | 10 mg | 28 | 0.36 | 0.19 | 0.52 | 2.69 | 2 | 2.65 | 2.43 | 2.86 | 1.18 |
| | 25 mg | 25 | 0.53 | 0.44 | 0.75 | 1.69 | 2 | 2.65 | 2.43 | 2.86 | 1.18 |
| **Insulins** | | | | | | | | | | | |
| Insulin Glargine | 100U/ml | 4 | 6.90 | 4.94 | 19.81 | 4.01 | 11 | 6.92 | 5.89 | 26.05 | 4.42 |
| Insulin Lispro | 100U/ml | 3 | 5.60 | 3.04 | 7.58 | 2.50 | 3 | 6.05 | 4.86 | 6.05 | 1.24 |
| Insulin NPH | 100U/ml | 5 | 1.37 | 0.22 | 1.81 | 8.09 | 2 | 6.10 | 2.92 | 3.73 | 1.28 |
| Insulin Regular | 100U/ml | 7 | 1.37 | 0.22 | 1.95 | 8.69 | 4 | 3.51 | 2.92 | 3.73 | 1.28 |
| **GLP-1 receptor agonists** | | | | | | | | | | | |
| Liraglutide | 6 mg | 2 | 55.69 | 55.07 | 56.31 | 1.02 | 4 | 29.41 | 24.00 | 35.78 | 1.49 |

**Abbreviations:** DPP-4 = Dipeptidyl Peptidase-4, GLP-1 = Glucagon-like Peptide-1, SGLT2 = Sodium-Glucose Cotransporter 2, NPH = Neutral Protamine Hagedorn

**Table 4.** Price comparison of anti-diabetic medicines registered as fixed dose combinations in Pakistan and Saudi Arabia using purchasing power parities.

| **Drug Classes** | | **Pakistan** | | | | | **Saudi Arabia** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fixed dose combinations | Strength | Brands count | Median | Min. Price | Max. Price | Cost Ratio | Brands count | Median | Min. Price | Max. Price | Cost Ratio |
| **Sulfonylureas and Biguanides** | | | | | | | | | | | |
| Glibenclamide and Metformin | 2.5 mg & 500 mg | 5 | 0.07 | 0.06 | 0.08 | 1.42 | 2 | 0.27 | 0.27 | 0.32 | 1.20 |
| | 5 mg & 500 mg | 7 | 0.08 | 0.03 | 0.09 | 2.48 | 2 | 0.38 | 0.38 | 0.43 | 1.14 |
| Glimepride and Metformin | 2 mg & 500 mg | 15 | 0.21 | 0.12 | 0.57 | 4.78 | 2 | 0.54 | 0.49 | 0.59 | 1.22 |
| **Thiazolidinediones and Biguanides** | | | | | | | | | | | |
| Pioglitazone and Metformin | 15 mg & 500 mg | 9 | 0.16 | 0.10 | 0.23 | 2.29 | 2 | 0.81 | 0.76 | 0.86 | 1.14 |
| | 15 mg & 850 mg | 9 | 0.19 | 0.11 | 0.26 | 2.48 | 3 | 0.86 | 0.76 | 1.03 | 1.36 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **DPP-4 inhibitors & Biguanides** | | | | | | | | | | | |
| Sitagliptin and Metformin | 50 mg & 850 mg | 20 | 0.48 | 0.34 | 1.08 | 3.13 | 5 | 0.86 | 0.86 | 3.24 | 3.75 |
| Vildagliptin and Metformin | 50 mg & 850 mg | 32 | 0.53 | 0.29 | 1.44 | 4.92 | 2 | 0.86 | 0.86 | 0.92 | 1.06 |
| | 50 mg & 1000 mg | 32 | 0.58 | 0.37 | 1.44 | 3.86 | 2 | 0.92 | 0.86 | 0.97 | 1.13 |
| **SGLT2 inhibitors & Biguanides** | | | | | | | | | | | |
| Dapagliflozin and Metformin | 5 mg & 1000 mg | 12 | 0.38 | 0.27 | 0.49 | 1.82 | 2 | 1.14 | 1.08 | 1.24 | 1.15 |
| | 10 mg & 1000 mg | 3 | 0.52 | 0.42 | 0.53 | 1.26 | 2 | 2.22 | 2.11 | 2.38 | 1.13 |
| **Insulin premix** | | | | | | | | | | | |
| Insulin Regular and Insulin NPH | 100 U/ml | 6 | 1.61 | 1.03 | 2.49 | 2.42 | 3 | 3.51 | 2.92 | 3.73 | 1.28 |

**Abbreviations:** DPP-4 = Dipeptidyl Peptidase-4, GLP-1 = Glucagon-like Peptide-1, SGLT2 = Sodium-Glucose Cotransporter 2, NPH = Neutral Protamine Hagedorn