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ORIGINAL RESEARCH ARTICLE

Demand- Versus Supply-Side Policies in Market Penetration of Biosimilars: Which is More Effective?

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Abstract

Objective To evaluate the impact of demand- and supply-side policies on the biosimilar market penetration and identify effective strategies for promoting biosimilar uptake in eight high-income countries.

Methods We analyzed biosimilar market penetration for infliximab, rituximab, and trastuzumab in six European countries—France, Germany, Italy, Spain, Sweden, and the UK—and two Asian countries—Japan and South Korea. Biosimilar market penetration was measured using two indicators: biosimilar market share and the time required for biosimilars to reach the majority point (> 50% market share). Policies were categorized into demand- and supply-side measures, and weights were applied to reflect the extent and timing of policy implementation. Spearman correlation examined the relationship between policy implementation and biosimilar market penetration.

Results Sweden, Italy, and the UK showed the highest biosimilar market shares, adopting various demand-side policies, while Japan and South Korea exhibited slower biosimilar adoption with fewer or no demand-side policies. Biosimilars in most European countries reached the majority point within 5–6 quarters, while projections for Japan and South Korea exceeded 30 quarters. Correlation analysis revealed that adoption of demand-side policies was significantly associated with higher market share ($r_s = 0.69$, $p < 0.001$) and shorter time to reach the majority point ($r_s = -0.62$, $p < 0.01$). In contrast, supply-side policies showed a weaker and less consistent association.

Conclusions Demand-side policies, such as financial incentives and prescribing guidelines, are significantly associated with rapid and widespread biosimilar adoption, while supply-side policies had limited impact. Policymakers should prioritize demand-side measures to improve biosimilar uptake and reduce healthcare expenditures effectively.

1 Introduction

Biologic therapies have provided significant clinical benefits for patients across a range of severe and chronic conditions, including rheumatoid arthritis, diabetes, certain gastrointestinal disorders, and various forms of cancer [1–3]. Despite their therapeutic advantages, biologics have placed substantial financial pressure on healthcare systems worldwide. In the USA, for example, biologic drugs comprise only about 2% of all prescribed medications but account for nearly 40% of total prescription drug expenditure [4]. Moreover, spending on biologics is anticipated to grow further in the coming years [5].

Key Points

Various policy measures were introduced to enhance biosimilar uptake, yet few studies have explored the relative importance of demand-side and supply-side policies.

Demand-side policies play a stronger and more consistent role in improving biosimilar market penetration than supply-side policies.

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When patents for biologic medicines expire, biosimilars—highly similar and therapeutically similar versions of the original biologic drugs—can enter the market. These products typically offer comparable efficacy and safety profiles at lower prices, with price reductions of around 40% in some European countries [6]. The launch of biosimilars decreases the financial burdens on healthcare budgets by increasing market competition and reducing treatment costs [7].

In several countries, adopting biosimilars has led to measurable cost savings. In the USA, projected savings from biosimilars between 2021 and 2025 are estimated to reach US $38.4 billion [5]. Similarly, in countries where adalimumab biosimilars were made available, consumption increased by 1.0 standard units per 1000 people ($p = 0.02$) while spending significantly decreased (− $371.0 USD per gross domestic product per capita; $p = 0.03$) over four quarters [8]. These savings could support aging populations' increased access to medications and finance new, high-priced orphan drugs [9, 10].

Despite these demonstrated benefits, the uptake of biosimilars faces several barriers, including prescriber hesitancy, lack of patient familiarity, patent litigation, and variations in pricing and reimbursement policies across different countries [4, 11]. To overcome these challenges, policymakers have implemented diverse demand-side policies (targeting healthcare providers or patients, such as financial incentives and prescribing guidelines) or supply-side policies (targeting pharmaceutical companies, such as price linkage) to encourage biosimilar adoption [12]. However, the success of these efforts has varied, indicating the need for more comprehensive analyses of policy effectiveness.

It is generally accepted that policy measures significantly influence the adoption of biosimilars [13, 14], and health authorities and payers frequently use biosimilar market penetration (biosimilar uptake) as a key indicator to measure their impact. For example, the National Health Service (NHS) England explicitly established uptake targets, aiming for 90% of new patients and 80% of existing patients within 1 year of biosimilar market entry [15]; similarly, the 2018−2022 French National Health Strategy aimed at increasing biosimilar use through a target of 80% biosimilar penetration by 2022 [16]. While the impact of biosimilars can also be assessed using various other parameters, such as improved patient access to treatments and cost reductions [17], this study focuses on uptake as an indicator because it directly reflects the extent to which biosimilars are utilized in clinical practice. Ultimately, this research seeks to inform evidence-based policymaking, supporting the design and refining of interventions that promote biosimilar use and bolster healthcare sustainability.

2 Methods

2.1 Data

We compiled the quarterly sales volumes of originators and biosimilars for infliximab, rituximab, and trastuzumab for the period from July 2012 to June 2020 (32 quarters) from the Multinational Integrated Data Analysis System (IQVIA-MIDAS®). The IQVIA-MIDAS® database provides comprehensive global sales data on pharmaceutical manufacturers' sales to retail and hospital pharmacies [18]. This database is widely recognized for its reliability and has been utilized in numerous cross-national studies and market penetration analyses of biosimilars [14, 19–22]. Sales volume data were measured in standard units (SU). The SU represents the number of standard "dose" units sold—a measure commonly adopted to observe biosimilar usage patterns [8, 14, 23].

2.2 Selection of Biologics and Countries

To conduct a cross-country comparison of biosimilar market dynamics, three biologics—infliximab, rituximab, and trastuzumab—were selected because biosimilars for these biologics were launched at different times across the included countries during the study period. The introduction of infliximab biosimilars began as early as 2012 in South Korea, while trastuzumab biosimilars were introduced in some countries as late as the third quarter of 2018 [24–26]. By the end of 2018, biosimilars for all three biologics had been launched in all included countries, ensuring sufficient data for analysis.

Six European countries—France, Germany, Italy, Spain, Sweden, and the UK—and two Asian countries—Japan and South Korea—were selected for comparison. These countries are high-income nations with similar economic levels and are members of both the Organization for Economic Cooperation and Development [27] and the Group of Twenty [28].

2.3 Assessment and Comparison of Biosimilar Market Penetration

Biosimilar market penetration was assessed using two indicators. The first indicator was the market share of biosimilars in the final quarter of the study period. Countries with higher market share at the end of the study were considered to have higher levels of biosimilar market penetration. The second indicator was the time from the biosimilar market entry point (0Q) to the point at which biosimilar market share first achieved a majority (> 50%) of the market (majority point). When the majority point was

not observed within the study period, it was extrapolated using linear regression analysis on the basis of observed market share trends to predict the majority point.

For each biologic, we established observation periods that started when the biosimilar market entered each country (0Q). This approach was chosen to ensure a fair comparison by measuring biosimilar market share simultaneously after entry across all countries, regardless of the initial launch dates. For infliximab, the observation period was set from 0Q to 21 quarters, while for rituximab and trastuzumab, it was set at 9 and 7 quarters, respectively.

2.4 Policy Implementation Assessment

This study examined the association of five demand-side and four supply-side policies on the biosimilar market penetration. Owing to the variability in policy classifications across previous studies [7, 12, 29–34], we categorized policies on the basis of the classifications by Rémuzat et al. [31] and Renwick et al. [32], focusing on those deemed effective in promoting biosimilar use or considered key factors in the adoption of biosimilars [7, 35–42].

The demand-side policies considered in our analysis included financial incentives [43], prescribing guidelines [34], prescription budgets, prescription quotas [31], and education and information initiatives [44]. Financial incentives involve offering monetary benefits for prescribing biosimilars or sharing cost savings from biosimilar use [30, 45]. These incentives aim to promote the adoption of more cost-effective therapies, thereby increasing biosimilar utilization [46]. Prescribing guidelines refer to establishing national prescription criteria or directives specifically aimed at promoting the prescription of biosimilars [47]. Prescription budgets establish a cap on total prescribing expenditures, encouraging physicians to prioritize more cost-effective biosimilars over originator drugs [48]. Prescription quotas directly promote biosimilar use by requiring physicians to meet a minimum prescription threshold for biosimilars, often with penalties for noncompliance. Information and education initiatives aim to improve biosimilar accessibility by raising awareness of biosimilars or educating stakeholders about the cost-saving benefits of adopting biosimilars [31].

Supply-side policies such as price linkage [12], tendering [31], internal reference price systems, and external reference price systems [49] have been widely discussed in previous studies [12, 31, 33, 34] and were considered in our study, where policies were classified into broader categories on the basis of existing literature. Price linkage sets the price of a biosimilar on the basis of the price of a reference drug—originator biologic—when the biosimilar enters the market or achieves reimbursement status [34]. Typically, this involves reducing the reference drug's price by a certain percentage to establish the biosimilar's price. Tendering employs competitive bidding to allocate contracts for specific drugs, particularly in cases where alternatives or equivalent products exist [50]. Tendering mechanisms for biosimilars vary across countries, with some adopting a winner-takes-all approach, in which a single supplier is awarded the contract, while others use multiple-winner tenders to distribute market share among several suppliers. Although both models are in practice, this study did not distinguish between them, as its primary focus was on overall policy measures rather than specific mechanisms. Internal reference price systems compare the costs of drugs with the same active ingredient or therapeutically similar drugs within a country, encouraging overall price reductions if biosimilars are priced lower than reference drugs [12]. An external reference price system sets a drug's price on the basis of the prices of the same product in one or more other countries [51].

The extent of policy implementation was evaluated using weights on the basis of the timing and scope of their execution. Given that different countries adopted policies at varying times, the duration of policy exposure differed across biologics. The extent of policy implementation was evaluated using the following formula:

$$\sum\left(\text{Policy implementation weight} \times \frac{\text{Duration of implementation}}{\text{Observation period}}\right).$$

The policy implementation weight reflects the level of enforcement, with a value of 1 assigned to policies that were fully enacted throughout the observation period. Policies introduced partway through the observation period were assigned a weight adjusted proportionally to their duration of enforcement. Partially or indirectly implemented policies, owing to their limited scope, were assigned a weight of 0.5. The duration of implementation represents the specific period during which the policy was enforced, whereas the observation period refers to the total time frame under analysis. Normalizing the duration of policy enforcement against the observation period facilitates a consistent comparison of policy effects across different biologics, irrespective of variations in their observation periods (Supplementary Table S1).

2.5 Analysis of the Relationship Between Policy Implementation and Biosimilar Market Penetration

This study aimed to assess which type of policy—demand-side or supply-side—is associated with the biosimilar market penetration. Scatter plots were generated to visually compare the level of biosimilar market penetration with the extent of demand- and supply-side policy implementation. Each data point represents biologic-specific data for each country, illustrating the association between policy implementation

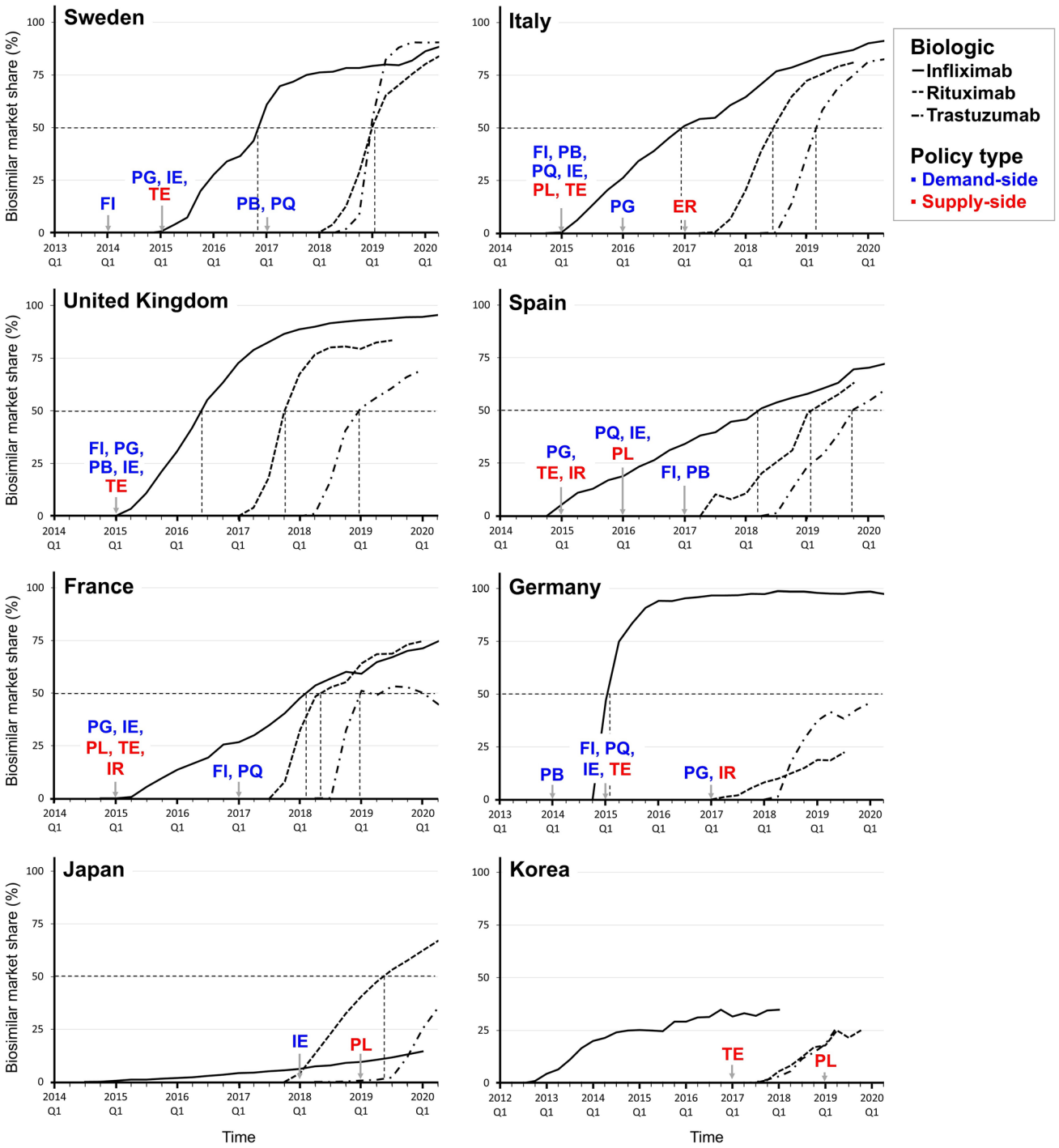


Fig. 1 Biosimilar market share trends and policy implementation timeline across countries. The biosimilar market share represents the proportion of biosimilars occupied at a fixed observation period after their market entry in each country (21 quarters for infliximab, 9 quarters for rituximab, and 7 quarters for trastuzumab). Demand-side policy: *FI* financial incentives, *IE* information and education, *PG* prescribing guidelines, *PB* prescription budget, *PQ* prescription quota. Supply-side policy: *ER* external reference price system, *IR* internal reference price system, *PL* price linkage, *TE* tendering

market penetration, measured by market share and time to reach the majority point. Furthermore, Spearman correlation analysis was separately conducted for demand-side and supply-side policies to quantify the strength of these associations. Spearman's rank correlation coefficient (r_s) was used to measure the strength and direction of monotonic relationships between policy implementation and

Table 1 Biosimilar market share across countries

Countries	Biosimilar market share (%)[a]			
	Infliximab	Rituximab	Trastuzumab	Average
Sweden	88.24	83.70	90.48	87.47
Italy	91.23	81.00	82.51	84.91
UK	95.45	83.45	69.38	82.76
Spain	72.02	63.01	59.57	64.87
France	74.68	74.74	44.71	64.71
Germany	97.61	22.20	45.91	55.24
Japan	14.44	66.85	35.02	38.77
Korea	34.77	24.80	26.79	28.79

[a]The biosimilar market share represents the proportion of the market occupied by biosimilars at a fixed observation period after their market entry in each country (21 quarters for infliximab, 9 quarters for rituximab, and 7 quarters for trastuzumab)

Table 2 Time (in quarters) to reach the majority point (50% market share) for biosimilars across countries

Countries	Time to reach the majority point after biosimilar adoption (quarters and year)			
	Infliximab	Rituximab	Trastuzumab	Average
Sweden	8Q (Q1 2017)	4Q (Q1 2019)	2Q (Q1 2019)	4.7Q
Italy	8Q (Q1 2017)	4Q (Q3 2018)	3Q (Q2 2019)	5.0Q
UK	6Q (Q3 2016)	3Q (Q1 2018)	3Q (Q1 2019)	4.0Q
Spain	13Q (Q2 2018)	7Q (Q2 2019)	5Q (Q4 2019)	8.3Q
France	13Q (Q2 2018)	3Q (Q3 2018)	2Q (Q1 2019)	6.0Q
Germany	1Q (Q2 2015)	13Q[a]	8Q[a]	7.3Q
Japan	77Q[a]	6Q (Q3 2019)	13Q[a]	32.0Q
Korea	92Q[a]	24Q[a]	20Q[a]	45.3Q

[a]If the majority point was not reached during the study period, the time was projected using linear regression on the basis of the observed market share trend

biosimilar market penetration, with significance assessed using *p*-values.

3 Results

3.1 Level of Biosimilar Market Penetration by Country

Figure 1 shows the biosimilar market share by country, the majority point when biosimilars surpassed 50% market share, and the timeline of biosimilar policy implementation in each country. This overview highlights the varying patterns of biosimilar adoption across different countries and biologics.

On average, European countries showed higher biosimilar market share, with country averages ranging from 55.24 to 87.47%. In contrast, South Korea and Japan showed notably lower biosimilar market shares, with 28.79% and 38.77%, respectively. Particularly in Japan, infliximab biosimilars accounted for only 14.44% of the market, while in South Korea, trastuzumab biosimilars had a market share of just 26.79% (Fig. 1; Table 1).

Table 2 presents the time (in quarters) required to reach the majority point for infliximab, rituximab, and trastuzumab across the eight countries. In most European countries, biosimilars reached the majority point relatively quickly. For instance, in the UK, infliximab and rituximab biosimilars reached the majority point within six and three quarters, respectively, with an average of four quarters. Similarly, Sweden and Italy recorded an average time of around five quarters. In contrast, Japan and South Korea showed significant delays, with the majority of points not being reached during the study period. Projections suggest that infliximab biosimilars will surpass originator sales after 77 quarters in Japan and 92 quarters in South Korea.

3.2 Patterns of Policy Implementation by Country

In Sweden and Italy, all five demand-side policies were fully implemented, whereas in Spain, although all five demand-side policies were introduced, some were only partially applied. Regarding supply-side policies, Italy, France, and Spain demonstrated the highest levels of implementation among the eight countries. In contrast, Japan and South Korea showed minimal policy implementation, with South Korea notably lacking any demand-side policies (Table 3).

While some biosimilar policies were implemented simultaneously, others were introduced several years later, resulting in the mid-observation introduction of some policies during the study period (Fig. 1). For instance, Sweden introduced the prescription budget policy in 2017. Consequently, infliximab biosimilars, launched in 2015, were only partially influenced by this policy from the middle of the observation period onward. In contrast, rituximab and trastuzumab biosimilars launched in 2018 were fully subjected to the policy from the time of their market entry.

3.3 Association of Policy Implementation on the Level of Biosimilar Market Penetration

Figure 2 shows the correlation between demand-side and supply-side policy implementation (based on Supplementary Table 2) and biosimilar market penetration. A significant, positive correlation ($r_s = 0.69$, $p < 0.001$) was observed between the extent of demand-side policy implementation and biosimilar market share (Fig. 2A). Conversely, a

Table 3 Overview of policy implementation for biosimilars across countries

Policy		Country								References
		SE	IT	UK	ES	FR	DE	JP	KR	
Demand-side	Financial incentives	2014[a]	2015[a]	2015	2017[a, b]	2017[a]	2015	2021[c]	N/A	[7, 12, 14, 31, 34, 45, 52, 53]
	Prescribing guidelines	2015	2016[a]	2015	2015	2015[a]	2017[a]	N/A	N/A	[12, 14, 31, 34, 53–56]
	Prescription budget	2017[a]	2015[a]	2015	2017[a, b]	N/A	2014[b]	N/A	N/A	[12, 14, 31, 32]
	Prescription quota	2017[a]	2015[a]	N/A	2016[a, b]	2017[b]	2015[b]	N/A	N/A	[12, 14, 31, 39, 57, 58]
	Information and education	2015	2015	2015	2016	2015[a]	2015	2018[b]	N/A	[14, 29, 31, 59, 60]
Supply-side	Price linkage	N/A	2015[a]	N/A	2016[a]	2015	N/A	2019[a]	2019	[7, 12, 14, 31, 34, 53, 59]
	Tendering	2015	2015[a]	2015	2015[a]	2015[a]	2015[a]	N/A	2017[b]	[7, 12, 14, 31, 34, 53, 61]
	Internal reference price system	N/A	N/A	N/A	2015[a]	2015[a]	2017[a, b]	N/A	N/A	[7, 14, 34, 61]
	External reference price system	N/A	2017[a]	N/A	N/A	N/A	N/A	N/A	N/A	[7, 12, 14, 31, 59]

Countries: SE, Sweden; IT, Italy; UK, United Kingdom; ES, Spain; FR, France; DE, Germany; JP, Japan; KR, South Korea

[a]If the exact start date was unclear, it was confirmed that the policy had been in effect by at least the stated year

[b]Partially applied or indirectly implemented policies

[c]In Japan, financial incentives were introduced in 2021. However, since the analysis only included data up to 2020, policies introduced afterward were excluded from the study

weaker and statistically insignificant correlation ($r_s = 0.27$, $p = 0.20$) was found between supply-side policy implementation and biosimilar market share (Fig. 2B). In addition, a significant negative correlation ($r_s = -0.62$, $p < 0.01$) was shown between demand-side policy implementation and the time to reach the majority point, indicating that countries with higher levels of demand-side policy implementation reached the majority market share faster (Fig. 2C). In contrast, a moderate negative correlation ($r_s = -0.43$, $p = 0.03$) was found between supply-side policy implementation and the time to reach the majority point, suggesting a weaker association compared with demand-side policies (Fig. 2D).

These findings indicate that demand-side policies are more strongly and consistently associated with biosimilar market penetration, increasing market share and reducing the time to reach the majority point compared with supply-side policies.

4 Discussion

Our study demonstrated that demand-side policies were significantly associated with the faster and broader adoption of biosimilars, whereas supply-side policies showed a weaker and less consistent association with biosimilar uptake.

The significant role of demand-side policies in facilitating biosimilar penetration has been emphasized in previous research. A few studies have indicated that supply-side policies such as internal reference pricing, external reference pricing, and tendering tend to limit biosimilar market penetration. In contrast, these studies have shown that demand-side policies have a positive association with biosimilar usage [14, 31, 33]. According to Kim et al., in the UK, where demand-side policies such as prescribing guidelines are aggressively implemented, the market share of infliximab biosimilars has shown rapid growth. By contrast, in South Korea, where such demand-side policies were less implemented, the market expansion of infliximab biosimilars was limited [14]. The higher positive impact of demand-side policies on biosimilar uptake, compared with supply-side policies, is due to their direct influence on biosimilar use. Mechanisms such as prescription budgets, prescription quotas, and prescribing guidelines contribute to this effect [34]. In contrast, supply-side policies primarily focus on achieving cost reductions through low-priced alternatives or additional (confidential) discounts rather than expanding the market share of biosimilars [62, 63]. In other words, although supply-side policies may achieve short-term cost savings, their effect on long-term biosimilar market penetration remains vague or limited [31].

Previous studies [20, 22, 39, 47] have focused on individual countries and provided qualitative insights into the relationship between policy interventions and biosimilar market penetration. Rémuzat et al. employed regression analysis to examine the impact of various measures, including demand-side incentives, on biosimilar uptake [64]. Their findings demonstrated that a greater number of incentive policies correlated with higher biosimilar adoption, whereas price discounts alone did not significantly boost market penetration. Although these results reinforce the importance of demand-side policies, the scope of Rémuzat et al.'s research was limited to European Union (EU) countries and included only a single supply-side policy [34, 64]. In contrast, our study provides a broader perspective through a quantitative analysis of three widely used biologics—infliximab, rituximab,

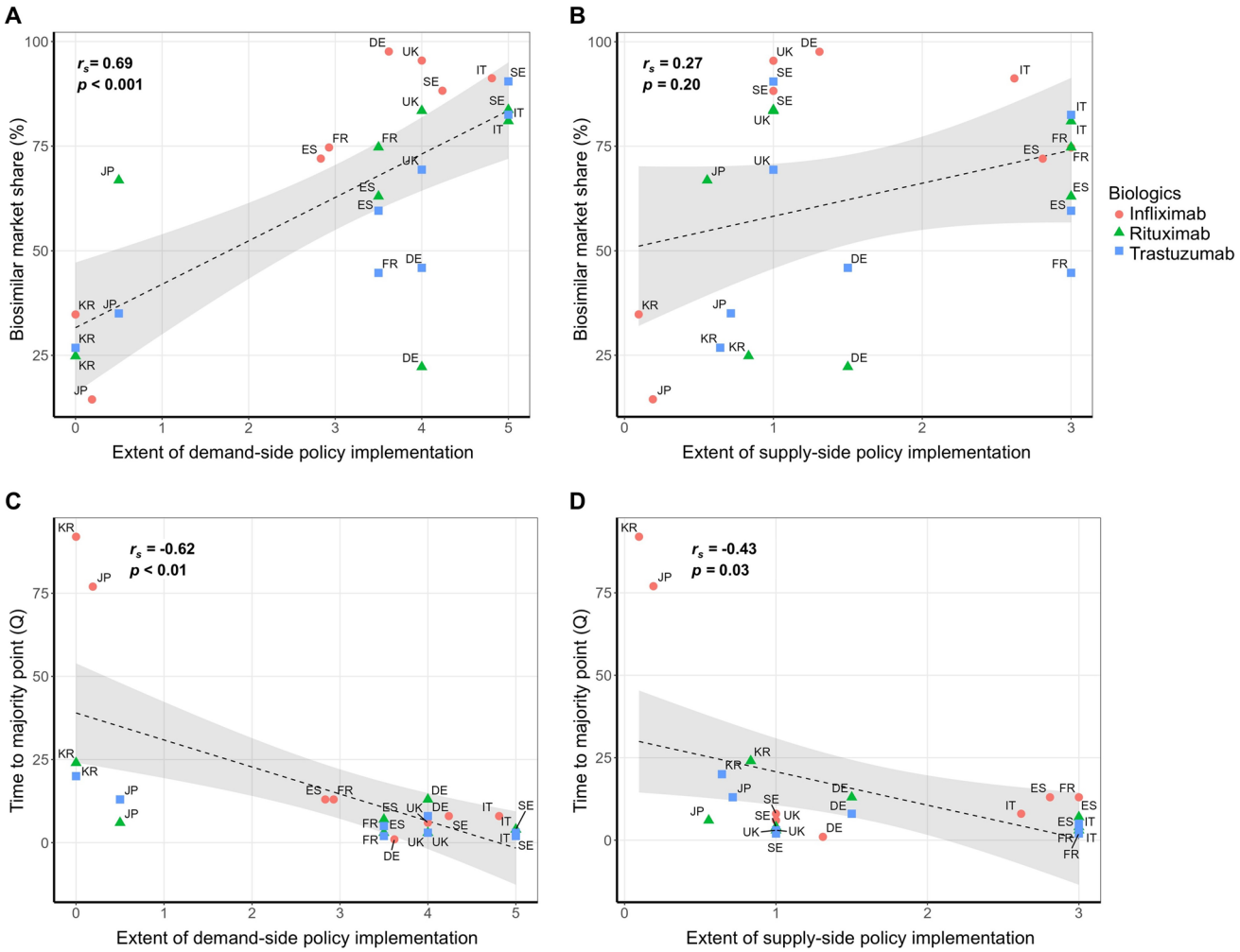


Fig. 2 Correlation between demand-side or supply-side policy implementation and biosimilar market penetration. **A** Correlation between demand-side policy implementation and biosimilar market share. **B** Correlation between supply-side policy implementation and biosimilar market share. **C** Correlation between demand-side policy implementation and the time to majority point. **D** Correlation between supply-side policy implementation and the time to majority point

and trastuzumab—across six EU and two Asian countries. Our findings support the critical role of policies that directly affect prescriber and patient choices by confirming a positive correlation between demand-side policy implementation and biosimilar uptake. Notably, establishing steady and organized demand-side policies seems necessary to achieve quick and significant biosimilar market penetration.

Japan stood out in our analysis, exhibiting notably delayed biosimilar adoption and requiring an estimated 32.0 quarters for biosimilars to surpass originators (i.e., to reach the "majority point"). Japan's unique "high-cost medical expense benefit system," which caps patients' out-of-pocket costs, and its limited use of demand-side measures are probably the causes of this slow adoption [65]. As a result, expensive originator biologics quickly reached their limit, which reduced patients' motivation to move to lower-priced options [66]. Similarly, South Korea displayed slower biosimilar uptake, with an average projected majority point of 45.3 quarters. Under South Korea's National Health Insurance framework, the price difference between originator biologics and biosimilars is relatively small, and additional copayment reductions for patients with cancer further reduce perceived savings [11]. Given the unique barriers to adopting biosimilars in each country, selecting and implementing appropriate demand-side biosimilar policies is essential to better align with regional healthcare systems.

There are several limitations in this study. First, the analysis was limited to three biologics—infliximab, rituximab, and trastuzumab— and selected high-income countries in Europe and Asia. Therefore, the findings may not be generalizable to low- and middle-income countries, where biosimilar adoption is often typically lower owing to barriers such as insufficient demand- or supply-side

policies [67–69]. Further studies are needed to integrate these additional indicators to provide a more comprehensive evaluation of biosimilar policy effectiveness. Second, biosimilar uptake was chosen as the measure of biosimilar performance in this study. Although uptake is widely used to assess market penetration, it may not fully capture important outcomes such as improved patient access or reductions in healthcare costs. Future research should integrate these additional indicators to provide a more comprehensive evaluation of biosimilar policy effectiveness. Finally, as this study was based on currently available data, the extrapolated points may vary in reality if additional policies are introduced.

Despite the limitations above, our study is the first to quantitatively analyze the relationship between the extent of demand- and supply-side policy implementation and biosimilar market penetration. This study presents important quantitative evidence on the effectiveness of biosimilar policies, providing policymakers with practical insights to encourage biosimilar adoption and improve healthcare sustainability.

5 Conclusions

Among the eight high-income countries analyzed in this study, faster and greater biosimilar market penetration was observed in those implementing various demand-side policies, which proved more powerful than supply-side measures. These findings offer valuable insights for shaping policies to promote the successful adoption of biosimilars and underscore the importance of expanding demand-side policy measures.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40259-025-00721-5.

Declarations

Author Contributions G.S. Shin, H.J. Han, and S.J. Bae led the study design. Statistical analysis involved contributions from H.J. Han, G.S. Shin, and D.H. Lee. D.H. Lee and G.Y. Choi reviewed study concepts. S.J. Bae acquired the IQVIA-MIDAS® database. All authors contributed to the interpretation of the results. All authors read and approved the final manuscript.

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Availability of Data and Material The dataset utilized in this study is not publicly available. IMS-MIDAS data can be accessed through IQVIA with the purchase of a license.

Code availabiliy Not applicable.

Conflict of Interest S.J.B. has received grants from the Korean Ministry of Food and Drug Safety, National Health Insurance Service, and Health Insurance Review and Assessment Service. H.J.H., G.Y.C., D.H.L., and G.S.S. claim no conflicts of interest.

Ethics Approval Not applicable.

Consent to Participate Not applicable.

Consent for Publication Not applicable.

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