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Identification of Import Tariff Factors Affecting the Gross Domestic Product Index Using Factor Analysis

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ABSTRACT

This study was conducted with the aim of identifying the factors influencing the structure of import tariffs and their impact on the gross domestic product (GDP) index. The research method was quantitative and based on exploratory factor analysis. The statistical population included economic actors, producers, traders, and experts related to the field of foreign trade, and sampling was carried out using a stratified random method. Considering the requirements of factor analysis and the need for at least 5 to 15 observations per variable, the sample size was determined to be approximately 150 individuals. The validity of the questionnaire was evaluated using expert opinions, face validity, and content validity, as well as the Content Validity Ratio (CVR) and Content Validity Index (CVI). The reliability of the instrument was assessed using Cronbach's alpha, with a value above 0.8 indicating the reliability of the measurement instrument. Quantitative data analysis was conducted using SPSS software, and the results identified a set of key factors constituting import tariff barriers, which were subsequently used in further models to examine their effects on GDP. Based on the exploratory factor analysis, six main factors were extracted, each encompassing a set of variables related to import processes. These factors include: senior management and import regulations, financial management and exchange rate policies, digital payment services and e-commerce, marketing and macroeconomic activities, technology and innovation, and economic and social infrastructure. The findings indicate that import tariffs have a multidimensional nature and influence import patterns and ultimately GDP through institutional, monetary, digital, economic, and infrastructural channels. It can be concluded that the structure of import tariffs is influenced by six institutional, financial, digital, economic, technological, and infrastructural factors, which simultaneously affect import patterns and ultimately GDP.

Keywords: Gross Domestic Product, Import Tariffs, Exploratory Factor Analysis, Exchange Rate Policies, Technology and Innovation, Economic Infrastructure, E-commerce

Introduction

International trade has long been recognized as a central driver of economic growth, structural transformation, and integration into the global economy. In contemporary economic systems, trade flows are shaped not only by comparative advantage but also by a complex interplay of policy instruments, institutional arrangements, and technological capabilities. Among these instruments, import tariffs occupy a pivotal position as they directly influence the cost structure of imported goods, the competitiveness of domestic industries, and the overall allocation of resources within an economy. The relationship between trade policy and economic performance, particularly

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gross domestic product (GDP), has been extensively examined in both theoretical and empirical literature, highlighting the multifaceted and often nonlinear effects of tariff structures on macroeconomic outcomes (1, 2). In this context, understanding the determinants and consequences of tariff policies becomes essential for policymakers seeking to balance protectionist objectives with growth-oriented strategies.

The evolution of global trade regimes over the past decades, particularly through regional trade agreements and multilateral frameworks, has intensified the need to reassess the role of tariffs in shaping economic performance. Agreements such as the Regional Comprehensive Economic Partnership (RCEP) and various free trade agreements (FTAs) have demonstrated that reductions in trade barriers can significantly enhance trade flows, value-added production, and economic welfare (3-5). At the same time, regional integration initiatives, including the African Continental Free Trade Area (AfCFTA), have underscored the importance of coordinated tariff policies in promoting intra-regional trade and economic resilience (6, 7). These developments suggest that tariffs are not merely fiscal tools but strategic instruments embedded within broader economic and political frameworks that influence growth trajectories and development outcomes.

Despite the global trend toward trade liberalization, tariffs remain a critical component of national economic policy, particularly in developing and emerging economies. Empirical evidence indicates that the impact of tariff structures on GDP is mediated by various factors, including institutional quality, exchange rate stability, and market efficiency (8, 9). In many cases, tariff policies are intertwined with domestic regulatory environments and administrative procedures, which can either facilitate or hinder trade flows. For instance, product market regulations and trade-related administrative barriers have been shown to significantly affect participation in global value chains and the distribution of economic gains from trade (10, 11). Consequently, a comprehensive analysis of tariff impacts must account for these institutional and structural dimensions.

Moreover, the effects of tariffs extend beyond traditional trade metrics and encompass broader socioeconomic outcomes, including employment, income distribution, and welfare. Trade liberalization, while generally associated with increased efficiency and growth, may also generate distributional effects that require careful policy consideration. Studies have shown that tariff reductions can influence labor markets, agricultural productivity, and gender dynamics, particularly in developing regions (12, 13). At the same time, the interaction between trade policies and macroeconomic variables such as inflation, fiscal balance, and investment further complicates the assessment of tariff impacts on GDP. These complexities highlight the need for multidimensional analytical frameworks capable of capturing the diverse channels through which tariffs affect economic performance.

In addition to institutional and macroeconomic factors, technological change has emerged as a key determinant of the relationship between trade and economic growth. Advances in digital technologies, e-commerce platforms, and payment systems have transformed the nature of international trade, reducing transaction costs and expanding market access. However, these developments also introduce new challenges related to regulatory harmonization, cybersecurity, and digital infrastructure. The interplay between trade policies and technological innovation is particularly evident in the context of trade conflicts and protectionist measures, which can either stimulate or hinder technological progress depending on the policy environment (14, 15). As such, any analysis of tariff structures must consider the role of technology as both a driver and an outcome of trade dynamics.

Another important dimension of tariff analysis relates to market behavior and macroeconomic cycles. Trade flows are closely linked to business cycle fluctuations, with changes in global demand and supply conditions influencing the effectiveness of tariff policies. Empirical research suggests that trade and business cycle co-movements can

amplify or dampen the impact of policy interventions, depending on the degree of economic integration and synchronization among trading partners (16). Furthermore, the efficiency of trade systems, including logistics, infrastructure, and administrative processes, plays a crucial role in determining how tariffs translate into economic outcomes. Studies on trade efficiency and export performance emphasize the importance of complementary policies, such as trade facilitation and infrastructure investment, in maximizing the benefits of tariff reforms (17, 18).

The literature also highlights the role of uncertainty and policy volatility in shaping trade outcomes. Policy uncertainty, particularly in the context of geopolitical tensions and economic crises, can significantly affect trade flows, investment decisions, and welfare outcomes. Research indicates that uncertainty in trade policies can lead to reduced economic activity and increased volatility in key macroeconomic indicators (19, 20). In this regard, stable and transparent tariff structures are essential for fostering a predictable business environment and encouraging long-term investment. At the same time, the design of tariff policies must be aligned with broader economic objectives, including sustainable development and climate mitigation, as highlighted in recent studies on green investments and policy frameworks (21).

Furthermore, the impact of tariffs on trade performance and economic growth is not uniform across sectors and regions. Sector-specific analyses reveal that the effects of tariff changes can vary significantly depending on the characteristics of the industry, the level of technological development, and the degree of integration into global value chains. For example, manufacturing and agricultural sectors often respond differently to tariff adjustments, reflecting variations in production structures and market conditions (3, 15). Similarly, regional differences in institutional capacity and economic development influence the effectiveness of tariff policies, as evidenced by comparative studies across Asia, Africa, and Latin America (22, 23). These findings underscore the importance of context-specific analyses in understanding the role of tariffs in economic development.

In light of the above considerations, it becomes evident that import tariffs are embedded within a complex system of interrelated factors that collectively determine their impact on GDP. Traditional approaches that treat tariffs as isolated policy instruments are insufficient to capture the multidimensional nature of their effects. Instead, there is a growing need for integrative analytical methods that can identify the underlying structures and interactions among various determinants of tariff policies. Exploratory factor analysis, as a multivariate statistical technique, provides a suitable framework for uncovering latent dimensions and reducing the complexity of multiple interrelated variables into a manageable set of factors. By identifying these underlying factors, researchers can gain deeper insights into the mechanisms through which tariffs influence economic performance.

Accordingly, the present study seeks to contribute to the existing literature by adopting a factor-analytic approach to identify the key dimensions of import tariff structures and examine their implications for GDP. This approach not only facilitates a more comprehensive understanding of tariff determinants but also provides a basis for developing more effective and coherent trade policies. Given the increasing complexity of global trade systems and the growing importance of integrated policy frameworks, such analyses are essential for informing evidence-based decision-making and enhancing economic resilience. Therefore, the aim of this study is to identify the underlying factors shaping import tariff structures and to analyze their impact on the gross domestic product index.

Methods and Materials

The present study employs a quantitative research design based on exploratory factor analysis. To develop the initial indicators related to tariff barriers, a comprehensive literature review and expert opinions were utilized to

extract a set of preliminary items, which formed the basis for designing a researcher-made questionnaire. The statistical population included economic actors, producers, traders, and experts associated with the field of foreign trade, and sampling was conducted using a stratified random method. Considering the requirements of factor analysis and the need for at least 5 to 15 observations per variable, the sample size was determined to be approximately 150 individuals. The validity of the questionnaire was assessed using expert judgment, face validity, and content validity, as well as the Content Validity Ratio (CVR) and Content Validity Index (CVI). The reliability of the instrument was examined using Cronbach's alpha, with values above 0.8 indicating acceptable reliability of the measurement instrument.

For data analysis, exploratory factor analysis was applied. This method is used to identify the underlying structure of variables, reduce dimensionality, and detect latent factors. Prior to conducting factor analysis, sampling adequacy was evaluated using the Kaiser–Meyer–Olkin (KMO) index, which was found to be at an acceptable level. Additionally, Bartlett's test of sphericity was significant, indicating that the correlation matrix among variables was suitable for factor analysis. Factor extraction was performed using the principal component analysis method based on the criterion of eigenvalues greater than one and inspection of the scree plot. To enhance factor differentiation and facilitate interpretation, orthogonal Varimax rotation was applied. Items with factor loadings below 0.4 or with significant cross-loadings were removed. After stabilizing the factor structure, the items of each factor were grouped based on their conceptual similarity and the factors were labeled accordingly. Quantitative data analysis was conducted using SPSS software, and the results identified a set of key factors constituting import tariff barriers, which were subsequently used to examine their effects on gross domestic product in further modeling.

Findings and Results

Descriptive results indicated that 147 respondents (65.2%) were male and 78 respondents (34.8%) were female. In terms of educational level, 36% held a bachelor's degree, 58.2% held a master's degree, and 5.8% had a doctoral degree, with the highest frequency corresponding to the master's level. Regarding age distribution, 27.6% were under 30 years old, 39.8% were between 31 and 45 years old, and 32.6% were over 45 years old. Additionally, 30.1% had less than 10 years of work experience, 36.3% had between 10 and 20 years, and 33.5% had more than 20 years of experience. These results indicate an appropriate distribution of the sample across different demographic groups.

In the factor analysis, the principal component method was used for factor extraction. As shown in Table 1, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.929, indicating that the research data are suitable for reduction into a set of underlying factors and that the sample size is adequate. Furthermore, the result of Bartlett's test (7595.774), which is significant at the 0.01 level, indicates a strong correlation among the variables within the factors.

Table 1. KMO Measure of Sampling Adequacy and Bartlett's Test

Index	Value
Kaiser–Meyer–Olkin (KMO) Measure	0.929
Bartlett's Test (Chi-Square)	7595.774
Degrees of Freedom	435
Significance Level	0.000

Using exploratory factor analysis, factors are first identified statistically and then labeled according to the nature of the variables loading on them. Table 2 presents the communalities results for each variable.

Table 2. Communalities of Variables

Variable	Initial	Extracted	Variable	Initial	Extracted
Q1	1.000	0.688	Q16	1.000	0.649
Q2	1.000	0.721	Q17	1.000	0.689
Q3	1.000	0.765	Q18	1.000	0.617
Q4	1.000	0.767	Q19	1.000	0.685
Q5	1.000	0.732	Q20	1.000	0.725
Q6	1.000	0.801	Q21	1.000	0.508
Q7	1.000	0.755	Q22	1.000	0.653
Q8	1.000	0.683	Q23	1.000	0.643
Q9	1.000	0.639	Q24	1.000	0.586
Q10	1.000	0.764	Q25	1.000	0.676
Q11	1.000	0.660	Q26	1.000	0.697
Q12	1.000	0.604	Q27	1.000	0.687
Q13	1.000	0.738	Q28	1.000	0.714
Q14	1.000	0.746	Q29	1.000	0.601
Q15	1.000	0.682	Q30	1.000	0.619

It can be inferred that the extracted factors explain a substantial proportion of the variance of each indicator. For this purpose, factor analysis was employed. Factor analysis is a multivariate statistical technique that establishes a specific structure among a large set of variables that may initially appear unrelated, based on a hypothetical model. Factor analysis is not a statistical test and does not involve a p-value or a null hypothesis. Instead, it computes the correlation relationships among questionnaire items, including item-total correlations and inter-item correlations.

Table 3 presents the set of extracted factor values after rotation, which correspond to eigenvalues and determine the factors retained in the analysis. Factors with eigenvalues less than 1 are excluded from the analysis, as their inclusion does not contribute to explaining additional variance.

Table 3. Number of Factors and Total Variance Explained

Factor	Initial Eigenvalues			Rotated Sum of Squared Loadings		
	Eigenvalue	% of Variance	Cumulative %	Eigenvalue	% of Variance	Cumulative %
1	13.527	45.089	45.089	5.432	18.108	18.108
2	2.142	7.138	52.227	4.059	13.528	31.636
3	1.527	5.089	57.316	3.389	11.298	42.934
4	1.220	4.067	61.383	2.635	8.784	51.719
5	1.141	3.803	65.186	2.543	8.478	60.196
6	1.939	3.129	68.314	2.435	8.118	68.314

The results of the above table indicate the proportion of variance in the set of variables explained by each factor. According to the output, six factors with eigenvalues greater than one were extracted. Therefore, the total of 30 indicators can be reduced to six conceptual factors. The eigenvalue of the first factor is 5.432, and the eigenvalue of the last factor is 2.435.

Table 4. Identified Factors and Factor Loadings of Variables (Rotated Component Matrix)

Variable Category	Code / Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Senior Management	Transport permits	0.519			0.351	0.394	
	Ministry permits	0.752					
	Order registration	0.764					
	Import quotas	0.755					

	Import quota allocation	0.737		0.313			
Financial Management	Multiplicity of permits		0.781		0.480		
	Export restrictions		0.749	0.353			
	Technical trade barriers		0.591	0.321			0.402
	Exchange rate policies		0.764	0.522			
	State trading institutions		0.609	0.531			
Digital Payment Services	Minimum import price	0.401		0.520		0.337	
	Import consortia	0.337		0.520			
	Relative import price	0.373		0.657			
	Gross national product			0.540	0.159		
	Demand for imports			0.719			
Marketing	Production and economic activities		0.316		0.519		0.330
	Investment and trade				0.674	0.399	
	Consumption and economic expenditures				0.624		
	Economic policies				0.732		
	Population and labor force				0.783		
Mobile Services	Technology and innovation		0.312		0.317	0.596	
	Environmental and natural factors				0.479	0.420	
	Production and economic activities				0.305	0.535	
	Investment and productive capital					0.646	
	Leading industries					0.611	
Integrated Infrastructure	Domestic and foreign markets						0.719
	Per capita income	0.301					0.759
	Income distribution equity	0.377					0.670
	Education level and skills				0.382		0.613
	Economic structure		0.471				0.638

Based on the results presented in the table, exploratory factor analysis led to the extraction of six main factors, each encompassing a set of variables related to tariff structure and import processes. The rotated component matrix shows the factor on which each variable has the highest loading, thereby determining its conceptual grouping.

The first factor, titled “Senior Management and Import Regulatory Policies,” includes variables related to formal regulations and administrative processes of imports. Variables such as ministry permits, order registration, import quotas, and transport permits exhibit relatively high factor loadings, indicating that the intensity of regulatory oversight and the structure of licensing play a significant role in shaping tariff structures.

The second factor, “Financial Management and Exchange Rate Policies,” reflects the role of financial systems, currency policies, and technical trade barriers. Variables such as multiplicity of permits, export restrictions, exchange rate policies, and state trading institutions demonstrate high factor loadings, suggesting that currency stability and financial trade structures are key determinants influencing import costs and patterns.

The third factor, “Digital Payment Services and E-commerce,” encompasses variables related to pricing mechanisms, import demand, and digital services. High factor loadings for variables such as demand for imports and relative import prices indicate that digital infrastructure and payment mechanisms play a significant role in shaping import patterns.

The fourth factor, “Marketing, Consumption, and Economic Activities,” covers market conditions, investment, and macroeconomic policies. High loadings for population and labor force, economic policies, and investment indicate that macroeconomic conditions and market demand constitute an important mechanism through which tariffs influence GDP.

The fifth factor, “Mobile Services, Technology, and Innovation,” highlights the role of technological advancement and mobile digital infrastructure. The presence of relatively high factor loadings for technology, innovation, and leading industries indicates the importance of technological progress in facilitating import processes.

The sixth factor, “Integrated Economic and Social Infrastructure,” includes variables related to economic capacity and foundational infrastructure. Per capita income, income distribution, domestic and foreign markets, and economic structure fall within this group, indicating that economic and social infrastructure forms the foundation for the effectiveness of tariff policies.

The rotated component matrix indicates the emergence of six coherent factors that collectively cover various dimensions of tariff policies, ranging from management and regulation to technology and infrastructure. This structure demonstrates that import tariffs are a multidimensional phenomenon and influence the gross domestic product index through institutional, monetary, digital, marketing, and infrastructural channels.

Discussion and Conclusion

The findings of this study revealed that the structure of import tariffs is inherently multidimensional and can be systematically explained through six underlying factors: senior management and import regulatory policies, financial management and exchange rate policies, digital payment services and e-commerce, marketing and macroeconomic activities, mobile services and technological innovation, and integrated economic and social infrastructure. The extraction of these six factors, which together explain a substantial proportion of the total variance, confirms that tariff systems cannot be interpreted as isolated fiscal instruments but rather as complex policy constructs embedded within broader institutional, economic, and technological ecosystems. This result aligns with the broader literature on international trade, which emphasizes the interconnected nature of trade policies and their dependence on regulatory, institutional, and market-based mechanisms (8, 9). The empirical evidence suggests that any attempt to analyze or reform tariff structures must account for these multiple interacting dimensions.

The first factor, related to senior management and import regulatory policies, underscores the critical role of administrative procedures, licensing systems, and regulatory oversight in shaping tariff outcomes. The high factor loadings for variables such as ministry permits, order registration, and import quotas indicate that bureaucratic processes significantly influence the effective implementation of tariff policies. This finding is consistent with studies highlighting the importance of institutional quality and regulatory frameworks in determining trade performance and economic growth (10, 23). In particular, inefficient or overly complex administrative systems can act as non-tariff barriers, increasing transaction costs and reducing the efficiency of trade flows. Therefore, the impact of tariffs on GDP is not only a function of tariff rates but also of the regulatory environment within which these tariffs operate.

The second factor, financial management and exchange rate policies, reflects the strong influence of macro-financial conditions on trade dynamics. Variables such as exchange rate policies, multiplicity of permits, and state trading institutions exhibited high factor loadings, indicating that financial stability and policy coherence are essential for managing import costs and trade competitiveness. This finding supports existing research demonstrating that exchange rate volatility and financial constraints can significantly affect trade flows and economic growth (19, 20). Moreover, the integration of financial and trade policies has been identified as a key determinant of successful trade liberalization strategies, particularly in developing economies where external shocks and policy uncertainty are

more pronounced (12). The results of this study reinforce the notion that tariff policies must be coordinated with broader macroeconomic policies to achieve sustainable economic outcomes.

The third factor, digital payment services and e-commerce, highlights the growing importance of digital infrastructure in shaping modern trade systems. The strong loadings of variables such as import demand and relative import prices suggest that digital platforms and payment mechanisms play a crucial role in facilitating trade transactions and influencing market behavior. This finding is in line with recent studies emphasizing the transformative impact of digitalization on international trade, including reductions in transaction costs and increased market accessibility (3, 4). Furthermore, the integration of digital technologies into trade processes has been shown to enhance efficiency and transparency, thereby improving overall economic performance. The identification of this factor underscores the need for policymakers to invest in digital infrastructure as part of a comprehensive trade strategy.

The fourth factor, marketing, consumption, and economic activities, reflects the role of demand-side dynamics and macroeconomic conditions in determining the effectiveness of tariff policies. High factor loadings for variables such as population, labor force, investment, and economic policies indicate that domestic market conditions and aggregate demand significantly influence import patterns and their subsequent impact on GDP. This finding aligns with the literature on trade and economic development, which highlights the importance of market size, consumption patterns, and investment levels in shaping trade outcomes (1, 2). In addition, the interaction between tariffs and macroeconomic policies can amplify or mitigate the effects of trade interventions, depending on the broader economic context. Therefore, understanding the demand-side mechanisms of trade is essential for designing effective tariff policies.

The fifth factor, mobile services, technology, and innovation, emphasizes the role of technological advancement in facilitating trade and enhancing economic performance. The presence of significant factor loadings for variables related to innovation and leading industries suggests that technological capabilities are critical for improving the efficiency of import processes and increasing competitiveness. This finding is supported by studies demonstrating that technological innovation can both drive and respond to trade dynamics, particularly in the context of global value chains and trade conflicts (14, 15). Moreover, the integration of mobile technologies and digital platforms has been shown to expand access to international markets, thereby contributing to economic growth. The results of this study highlight the importance of fostering innovation and technological development as part of a comprehensive trade policy framework.

The sixth factor, integrated economic and social infrastructure, captures the foundational role of structural conditions in shaping the effectiveness of tariff policies. Variables such as per capita income, income distribution, and economic structure exhibited strong loadings, indicating that the broader socioeconomic environment significantly influences trade outcomes. This finding is consistent with research demonstrating that infrastructure quality, institutional capacity, and social development are key determinants of trade performance and economic growth (6, 22). In particular, well-developed infrastructure can enhance the efficiency of trade systems, reduce costs, and improve the distribution of economic benefits. The identification of this factor underscores the importance of adopting a holistic approach to trade policy that integrates economic, social, and infrastructural considerations.

Overall, the results of this study confirm that import tariffs influence GDP through multiple interconnected channels, including institutional, financial, digital, economic, technological, and infrastructural pathways. This multidimensional perspective is consistent with contemporary theories of international trade, which emphasize the

complexity of trade systems and the need for integrated policy approaches (11, 24). Furthermore, the findings suggest that the effectiveness of tariff policies depends not only on their design but also on the broader context in which they are implemented, including regulatory frameworks, market conditions, and technological capabilities. By identifying the key factors underlying tariff structures, this study provides valuable insights into the mechanisms through which trade policies affect economic performance.

In addition, the results contribute to the ongoing debate on the role of trade liberalization and protectionism in economic development. While reductions in trade barriers have been associated with increased efficiency and growth, the findings of this study indicate that the benefits of such policies are contingent upon the presence of supportive institutional and infrastructural conditions. This perspective is supported by empirical evidence showing that the impact of trade liberalization varies across countries and regions, depending on factors such as institutional quality, technological readiness, and market integration (5, 17). Therefore, policymakers must consider these contextual factors when designing and implementing tariff policies to ensure that they contribute to sustainable economic growth.

The limitations of this study should be acknowledged. First, the research is based on cross-sectional data, which limits the ability to capture dynamic changes in tariff structures and their long-term effects on GDP. Second, the use of self-reported data from respondents may introduce potential biases related to perception and subjectivity. Third, the study focuses on a specific sample of economic actors and experts, which may limit the generalizability of the findings to other contexts or regions. Finally, while exploratory factor analysis provides valuable insights into the underlying structure of variables, it does not establish causal relationships among the identified factors.

Future research can build on the findings of this study by adopting longitudinal designs to examine the dynamic interactions between tariff structures and economic performance over time. Additionally, the use of advanced econometric models, such as structural equation modeling or panel data analysis, can help to establish causal relationships among the identified factors. Comparative studies across different countries and regions would also provide valuable insights into the contextual determinants of tariff effectiveness. Furthermore, future research could explore the role of emerging technologies, such as artificial intelligence and blockchain, in shaping the future of trade policies and their impact on economic growth.

From a practical perspective, the findings of this study have important implications for policymakers and practitioners. First, there is a need to streamline administrative procedures and reduce regulatory complexity to enhance the efficiency of import processes. Second, the integration of financial and exchange rate policies with trade strategies is essential for maintaining stability and competitiveness. Third, investments in digital infrastructure and technological innovation should be prioritized to support modern trade systems. Finally, policymakers should adopt a holistic approach that considers the interplay between economic, social, and infrastructural factors in designing effective tariff policies.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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