

Presenting a Model of Managers' Behavior in the Digital Age with a Structural Equation Modeling Approach in Petrochemical Companies

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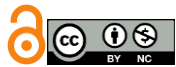
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ABSTRACT

Objective: The purpose of this research was to present a model of managers' behavior in the digital age using a structural equation modeling approach in petrochemical companies. It was a behavioral model for managers in the digital age utilizing structural equation modeling. The research methodology was applied in purpose and exploratory in nature.

Methodology: The research method was quantitative-descriptive and applied in objective. The study population consisted of managers of petrochemical companies affiliated with the National Petrochemical Company of Iran, where 105 managers were selected as the research sample. The dimensions of the model were examined and analyzed using the interpretive structural equation method with Smart PLS software.

Findings: The results demonstrated that in the paradigmatic model, the causal conditions of the studied phenomenon included human, environmental, and organizational factors; digital understanding and education; digital culture; management of talent experience and digital skills; future-oriented and strategic digital thinking; change management; and leadership capabilities. Contextual conditions included digital attitudes and mindsets, managerial intelligence, managerial values, innovation, and the nature of business and industry. Intervening conditions comprised communications and interactions, trust-building, decision-making under uncertainty, and digital personality and demeanor. The main phenomenon presented was innovation and learning, digital preservation, integration and focus, digital collaboration, and digital leadership and governance as the main strategies and individual and organizational dimensions of outcomes. The findings also showed significant relationships between causal conditions and the main phenomenon; the main phenomenon and strategies; contextual and intervening conditions with strategies; and strategies with outcomes.

Conclusion: Managers' behavior in the digital age involves various conditions that companies must enhance in managers' behavior to increase efficiency and achieve their goals.

Keywords: *Managers' behavior model, Digital age, Structural equation modeling approach.*

1 Introduction

The growth and progress of any organization hinge on the development of its human capital. Attention to human capital is considered a fundamental axis for the development of organizations. Human resources are regarded as the most valuable assets of an organization that can shape the competitive advantage of contemporary organizations in the face of extensive environmental changes. Empowered human resources are seen as a trump card for today's organizations (Pourreza et al., 2022). Employees (managers) are also mentioned as a type of human capital that steps towards the growth and flourishing of the organization and are influential. Employees (managers) are the most important fundamental assets of companies on the path to success (Guinan et al., 2019).

The growth and development of the organization are deemed dependent on creating the capacity of employees (managers) to meet the current and future needs of organizations. Consequently, every organization relies on its employees to expand competitiveness and profitability. Organizations that can rely on their human resources and empower them are able to maintain their competitive edge and continuously create new knowledge and acquire new skills (Pourreza et al., 2022). Attention to employees (managers) through the enhancement of their skills and capabilities, often manifested through strategic organizational choices, helps them perform better in leadership and interpersonal roles and human skills. A manager who undergoes growth and development through management actions, leadership, personal development, and advanced career moves, attains learning and behavioral change (Volkov et al., 2020). These changes are relatively permanent and manifest in the knowledge, work skills, and abilities of the individual, which is so significant that it is said major global companies like IBM, Xerox, McDonald's, and Ford allocate substantial annual budgets for the training and development of their managers. A portion of these investments is spent on updating their technical and scientific skills, another part on preparing managers for future business environment challenges (Kiel et al., 2016). Equipping the organization with capable and deserving managers has always been a necessity for growth and

development and a concern for any organization (Rachinger et al., 2019). Attention to capable and deserving managers who can meet the future needs of the organization in the face of business changes has long been a concern for organizations, including Iranian companies such as petrochemical firms, which have not been left out of this matter.

In the digital age, the processes and rules of managing employees have completely changed, and information technology has not only changed the way tasks are performed but also involved the people and organizations of the digital age in a significant and different revolution (Firouzbakht & Rezaeean, 2022; Sirghani et al., 2023; Tabibnia & Noorafrooz, 2023; Weber et al., 2022). The digital age or the so-called Fourth Industrial Revolution helps develop various organizational aspects including the development of products and services. Therefore, Matzler et al. (2016) remind us that production management and business innovation models will essentially change the way work is done and the management of employee affairs, resulting in superior organizational performance (Matzler et al., 2016). Thus, what is increasingly necessary in the digital age and in a knowledge-based economy is attention to human capital as a factor in progress, development, and competitive advantage of organizations, as well as the development of knowledge, skills, and abilities that increasingly create economic value for organizational employees (Dachner et al., 2021).

The digital age is characterized by fundamental changes in processes and organizational behaviors. This means that digital transformation transforms all business beliefs and mental backgrounds, and in order to survive in the digital age, it forces organizations to change and transform in all their dimensions (Bu, 2019). In recent years, the term "digitalization" has been heard in many organizations. The importance and necessity of this matter are observed in discussions such as digital innovation, digital strategy, digital transformation, platforms, and digital infrastructures (Shirvani et al., 2021; Sirghani et al., 2023). Digital transformation encompasses all organizational dimensions from processes to employees and products, and seeks to create fundamental changes with modern approaches in these dimensions (Day et al., 2014).

Petrochemical companies have always been the focus of various organizational stakeholders and leaders in managing these companies. Petrochemical companies have experienced many ups and downs such as the imposed war, sanctions, etc., since the victory of the Islamic Revolution in Iran until 1997, and have faced managerial changes and business transformations in the path from traditional to development and modernization on one hand, and from privatization from 2007 to the present on the other. Based on the reviews from 2007 and the studies conducted, one of the focal points in the privatization process of these companies has been the focus on foresight and strategic approaches in managing the future of these companies and facing technological changes (Firouzbakht & Rezaeean, 2022).

Regarding the current research, some studies have been conducted. Sirghani et al. (2023) concluded that the structural dimensions of talent management include six dimensions: organizational structure, recruitment system, training system, compensation services system, management and performance evaluation system, and organizational strategy. Behavioral dimensions include three dimensions: organizational culture, leadership style, and meeting high-level needs, and contextual dimensions include the atmosphere and external environment of the organization (Sirghani et al., 2023). Shirvani et al. (2021) concluded that digital technology, organizational goals and strategies, and the commitment of senior managers significantly influence the formulation and implementation of human capital strategies and ultimately on cognitive, behavioral, and performance outcomes at the individual, group, and organizational levels (Shirvani et al., 2021). Yela Aranega et al. (2023) concluded that teamwork, motivation, and risk-taking have a direct and significant impact on the digital competence of managers. These factors are identified among the most developed competencies; therefore, these factors have the most impact on the style of compassionate leadership, a style that relies more on kindness, supportiveness, gentleness, and kindness to colleagues (Yela Aránega et al., 2023). Weber et al. (2022) concluded that leaders need extensive behavioral complexity to master facing emerging leadership challenges (Weber et al., 2022).

Currently, 68 active petrochemical complexes affiliated with the National Petrochemical Company of Iran are

operating in the country, with new development plans defined at the national level for them. Based on the studies of the implementation of projects and major national projects for business transformations in petrochemical companies, among the most important current issues of these companies in recent years have been stated. This matter has become so important that it has been repeatedly mentioned in the statements of the Supreme Leader from 1995 to the present. A review of the Supreme Leader's statements about the role and place of the petrochemical industry in May 2020, in addition to proving the importance of the growth of this industry in recent years, significantly highlights the responsibility of decision-makers, legislators, and officials of the country in facilitating the path of development of petrochemicals and in completing the second leap and advancing the third leap. Based on the presented materials, the main objective of this research is to present a model of managers' behavior in the digital age with a structural equation modeling approach in petrochemical companies.

2 Methods and Materials

This research is exploratory in nature and aims, and it employs a grounded theory approach for data collection (qualitative and quantitative). The research population consisted of 105 managers from petrochemical companies affiliated with the National Petrochemical Company of Iran. In the qualitative part, interviews were conducted with 15 managers based on the principle of theoretical saturation. In the quantitative section, all 105 individuals were selected as the sample size. The research tools were semi-structured interviews for the qualitative section and researcher-designed questionnaires based on qualitative findings for the quantitative section. Data analysis methods included grounded theory for the qualitative part and structural equation modeling using SMART PLS software for the quantitative research.

3 Findings and Results

Table 1 presents the research findings in the form of main and sub-themes.

Table 1*Identification of Main and Sub-themes*

Sub-category (Core)	Main Category
Human Factors	Causal Conditions
Environmental Factors	
Organizational Factors	
Digital Mindset and Attitude	Intervening Conditions
Managerial Intelligence	
Managerial Values	
Innovation and Business and Industry Nature	Strategies and Mechanisms
Strategy for Innovation and Learning	
Strategy for Preservation, Integration, and Digital Focus	
Strategy for Digital Collaboration	
Strategy for Digital Leadership and Governance	Outcomes
Individual Dimensions	
Organizational Dimensions	

The findings from [Table 1](#) indicate that causal conditions include human, environmental, and organizational factors; intervening conditions include digital mindset and attitude, managerial intelligence, and values; contextual conditions include digital education and culture, management of experience and digital talent, future-oriented and strategic digital thinking, and change management and leadership capabilities; strategies include innovation and learning,

digital preservation and focus strategy, and digital collaboration strategy; and outcomes include individual and organizational dimensions.

Further, using the outputs of the structural equation modeling software Smart PLS, composite reliability, average variance extracted (AVE), and then the reliability of the questionnaire were examined using Cronbach's alpha coefficient, which results are presented in [Table 2](#).

Table 2*Questionnaire Reliability Using Cronbach's Alpha Coefficient*

Variable	Number of Questions	Composite Reliability	AVE	Cronbach's Alpha
Causal Conditions	3	0.864	0.681	0.922
Main Phenomenon	5	0.887	0.626	0.870
Contextual Conditions	6	0.895	0.591	0.946
Intervening Conditions	4	0.786	0.488	0.840
Strategies	4	0.856	0.611	0.914
Outcomes	2	0.842	0.727	0.790

The findings from [Table 2](#) demonstrate that the Cronbach's alpha coefficient for the variables exceeds the standard value of 0.70, confirming the questionnaire's reliability. Additionally, the composite reliability of all research variables exceeds the standard value of 0.70, and the questionnaire's validity is confirmed. Moreover, the average variance extracted (AVE) for each research variable is above the standard value of 0.40, indicating a very good level; therefore, based on all criteria, the validity and reliability of the questionnaire are confirmed.

Propositions derived from the coding phase components based on the research data include:

- Proposition One: There is a positive and significant relationship between causal conditions and the

main phenomenon of managers' behaviors in the digital age.

- Proposition Two: There is a significant effect between the main phenomenon and the adoption of strategies and mechanisms of managers' behaviors in the digital age.
- Proposition Three: There is a significant effect between contextual conditions and the adoption of strategies and mechanisms of managers' behaviors in the digital age.
- Proposition Four: There is a positive and significant effect between intervening conditions and the adoption of strategies and mechanisms of managers' behaviors in the digital age.

- Proposition Five: There is a positive and significant effect between the strategies of managers' behaviors in the digital age and the outcomes resulting from the implementation of these strategies.

The statistical t-values greater than 1.96 indicate that the relationships between the respective variables are significant at the 95% confidence level. Also, the path coefficients indicate the strength of the relationship between the

variables, with coefficients greater than zero indicating a positive impact (the closer these coefficients are to 1, the stronger the relationship) and coefficients less than zero indicating a negative impact (the closer these coefficients are to -1, the stronger the relationship). Zero path coefficients indicate no relationship between the variables. Before presenting these findings, the factor loadings of the research questions in relation to the corresponding variable based on the paradigm model are presented in [Table 3](#).

Table 3

Factor Loading

Main Variable	Question Number	Factor Loading
Causal Conditions	Q17	0.823
	Q18	0.883
	Q19	0.764
Main Phenomenon	Q1	0.403
	Q2	0.915
	Q20	0.89
	Q21	0.711
	Q22	0.912
Strategies	Q2	0.460
	Q3	0.913
	Q4	0.774
	Q5	0.895
Intervening Conditions	Q15	0.532
	Q16	0.569
	Q23	0.806
	Q24	0.834
Contextual Conditions	Q6	0.733
	Q7	0.602
	Q8	0.666
	Q9	0.788
	Q10	0.888
	Q11	0.889
Outcomes	Q13	0.870
	Q14	0.836

The findings from [Table 3](#) show that since the factor loading coefficients of all questions in the respective variable are greater than 0.4, the questions have adequately explained their corresponding variable. Path coefficients

between the research variables are presented in [Figure 1](#); In [Figure 2](#), the findings regarding significant coefficients related to the relationship between dimensions of the research model are presented.

Figure 1

Model with Beta Coefficients

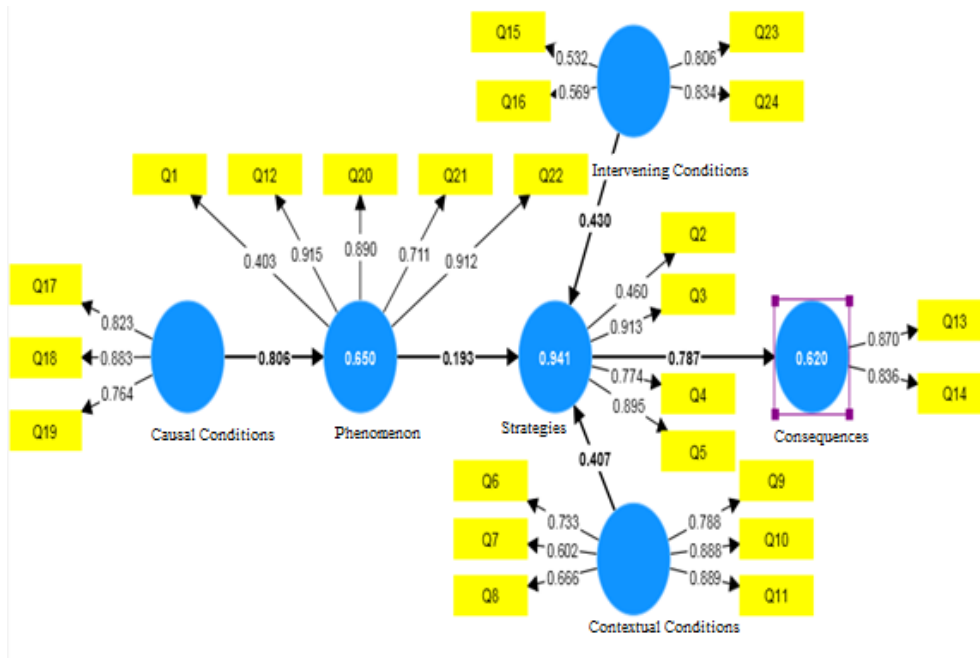
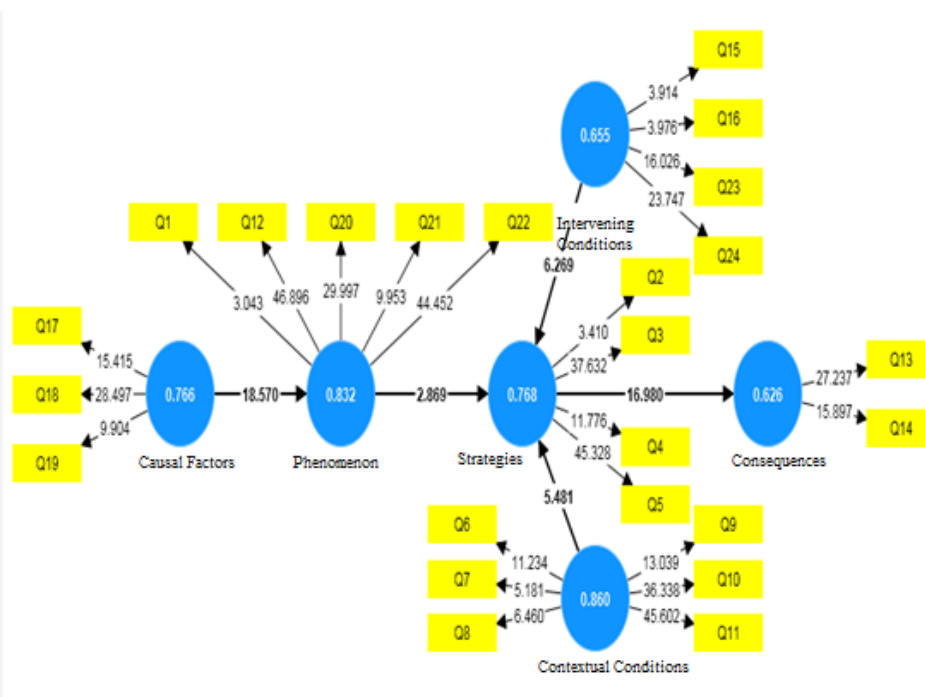


Figure 2

Model with T-Values



The findings from Figure 1 indicate that the path coefficient between causal conditions and the main phenomenon is positive (0.806), thus causal conditions have a positive impact on the main phenomenon. Additionally, the

path coefficient between the main phenomenon and strategies is positive (0.193), indicating a positive influence of the main phenomenon on strategies. Findings from Figure 4-3 show that the path coefficient between strategies and

outcomes is positive (0.787), hence strategies positively impact the outcomes. Also, the path coefficient between intervening conditions and contextual conditions with strategies is also positive (0.430 and 0.407 respectively), indicating that both intervening and contextual conditions have a positive impact on strategies. In Figure 1, the numbers shown in the circle related to dependent variables represent regression coefficients or R², indicating how much the independent variable has been able to explain the dependent variable. The regression coefficient for the main phenomenon is 0.650, meaning the independent variable, causal conditions, has explained 65% of the variance in the main phenomenon. The regression coefficient for strategies is 0.941, hence the independent variables—main phenomenon, intervening conditions, and contextual conditions—have explained 94.1% of the variance in strategies. The regression coefficient for outcomes is 0.620,

meaning the independent variable, strategies, has explained 62% of the variance in outcomes.

The findings from Figure 2 indicate that the significance coefficient for the relationship between causal conditions and the main phenomenon is greater than 1.96 (18.570), therefore, causal conditions significantly impact the main phenomenon. Additionally, the significance coefficient between the main phenomenon and strategies is greater than 1.96 (2.869), indicating a significant impact of the main phenomenon on strategies. Also, the significance coefficient between strategies and outcomes is greater than 1.96 (16.980), therefore, strategies significantly impact the outcomes. The significance coefficient for the relationship between intervening conditions and contextual conditions with strategies is also greater than 1.96 (6.269 and 5.481 respectively), indicating that both intervening and contextual conditions significantly impact strategies.

Table 4

Test of Research Model Dimensions

No.	Relationship	Path Coefficient	t-Statistic	Result
1	Causal Conditions with Main Phenomenon	0.806	18.570	Confirmed
2	Main Phenomenon with Strategy Adoption	0.193	2.869	Confirmed
3	Contextual Conditions with Strategy Adoption	0.407	5.481	Confirmed
4	Intervening Conditions with Strategy Adoption	0.430	6.269	Confirmed
5	Strategies with Outcomes	0.787	16.980	Confirmed

The findings show that since the path coefficient and the significance coefficient between causal conditions and the main phenomenon are respectively 0.806 and 18.570, both positive and significant, there is a significant positive effect between causal conditions and the main phenomenon of managers' behaviors in the digital age. Since the path coefficient and the significance coefficient between the main phenomenon and strategy adoption are respectively 0.193 and 2.869, both positive and significant, there is a significant positive effect between the main phenomenon and the adoption of strategies and mechanisms of managers' behaviors in the digital age. The findings indicate that since the path coefficient and the significance coefficient between contextual conditions and strategy adoption are respectively 0.407 and 5.481, both positive and significant, there is a

significant positive effect between contextual conditions and the adoption of strategies and mechanisms of managers' behaviors in the digital age. The findings show that since the path coefficient and the significance coefficient between intervening conditions and strategy adoption are respectively 0.430 and 6.269, both positive and significant, there is a significant positive effect between intervening conditions and the adoption of strategies and mechanisms of managers' behaviors in the digital age. Additionally, since the path coefficient and the significance coefficient between strategies and outcomes are respectively 0.787 and 16.980, both positive and significant, there is a significant positive effect between the strategies of managers' behaviors in the digital age and the outcomes resulting from the implementation of these strategies.

Table 5*Fit of Research Model*

Index	Values
SRMR	0.135
Chi-Square	2258.912
GOF	0.6759

Based on the findings in [Table 5](#), the SRMR values are closer to zero, which is preferable and indicates a good fit of the research model. Additionally, the Chi-Square value also indicates a good fit. The Goodness of Fit Index (GOF) is 0.6759, which is a very good value and indicates that the research model is well-fitted.

4 Discussion and Conclusion

The objective of the present research was to present a model of managers' behavior in the digital age using a structural equation modeling approach in petrochemical companies. The findings indicated a positive and significant relationship between causal conditions and the main phenomenon, with path coefficients of 0.806 and a t-value of 18.570. Thus, there is a significant positive effect between causal conditions and the main phenomenon of managers' behaviors in the digital age. A positive and significant relationship was also observed between contextual conditions and strategy adoption, with path coefficients of 0.407 and a t-value of 5.481. Furthermore, there was a positive and significant relationship between intervening conditions and strategy adoption, with path coefficients of 0.430 and a t-value of 6.269, and finally, between strategies and outcomes, with path coefficients of 0.787 and a t-value of 16.980. These research results align with prior studies ([Shirvani et al., 2021](#); [Sirghani et al., 2023](#); [Yela Aránega et al., 2023](#)).

Explaining the results, it should be noted that causal conditions in the behavioral model of managers are derived from environmental, human, and organizational conditions. These conditions have been identified as the causes shaping managers' behaviors in the digital age. The findings showed that managers' behaviors, as the main phenomenon in the digital age, are influenced by subcategories such as interpersonal communications and interactions, trust-building by managers on one hand, and on the other hand, managers' personal characteristics and digital demeanor in decision-making processes and in situations of uncertainty are emphasized. Additionally, the results showed that managerial behavior through strategic strategies such as

innovation and learning, which are characteristics of the digital age, manifest through digital collaboration spaces—a focus on the digitalization of the organization and digital governance. It is evident in this path that enablers/contextual conditions that set the stage for the formation of the main phenomenon—managers' behaviors—in the digital age and as the situation for the occurrence of behaviors are guided by subcomponents such as possessing digital understanding and foresight, future-oriented and strategic digital thinking of the manager, digital education and culture, along with management of experience, talent, and digital skills, and change management and leadership capabilities for managers in the digital age.

The results also demonstrated that based on the paradigm model, intervening conditions also play a role. These conditions are also solidified by subcomponents such as the digital mindset and attitude of the manager, managerial intelligence, managerial values, and of course, innovation and the nature of the business industry. Ultimately, according to the paradigm model, outcomes manifest in individual and organizational dimensions.

A distinctive aspect of the model presented in this research compared to existing frameworks is that while existing frameworks mainly focus on examining a specific area, this research not only focuses on strategies and outcomes but also emphasizes factors influencing the formation of the main phenomenon (managers' behaviors) in the digital age, causal conditions, contextual conditions, and intervening conditions, which distinguishes this research and makes it unique nationally. Additionally, the model presented serves as an empowering framework for managers in the digital age, particularly in petrochemical companies, which can pave the way for future research and studies in petrochemical companies and be used as a foundational, native, and empowering model for managers in these companies and their subsidiaries in the future.

This research has been conducted in line with the future roadmap of petrochemical companies under the National Petrochemical Company of Iran and covers areas of human resource development, organizational behavior development, and manager development effectively. The

purpose of discussing research limitations is not merely for the researcher to cover the weaknesses and shortcomings of their research and justify potential issues, but rather it aims to allow the reader to make a fair judgment about the research process and to realistically assess the processes and results with an awareness of the limitations that existed during the project. Among the limitations and obstacles faced by this research were temporal, spatial, and financial constraints of the researcher, the lack of theoretical foundations and literature on the behavior of managers in the digital age both domestically and internationally, which were very limited, and access restrictions to research resources in petrochemical companies due to the confidentiality of these company-industries. It is suggested that since petrochemical companies are among the important economic industries in the country, they should use the results and model obtained from the research as a scientific and practical guide in their path of development and empowerment of their company managers and in achieving the vision of their strategic document for 2032. It is also recommended that petrochemical companies, if they need to redevelop their vision and strategic plans, use the findings of this research in designing and drafting their documents. It is further suggested to leverage the research model results to promote training opportunities and strengthen the digital culture among the companies and their organizational stakeholders.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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