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Predicting Fertility Intentions Using Cultural Norms, Economic Security, and Relationship Satisfaction via a Machine Learning Approach

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A B S T R A C T

Objective: The present study aimed to predict fertility intentions based on cultural norms, economic security, and relationship satisfaction using advanced machine learning techniques.

Methods and Materials: This study employed a cross-sectional, predictive-correlational design conducted on 512 adults of reproductive age in South Africa selected through stratified random sampling. Data were collected using standardized instruments including the Cultural Values Scale, Economic Stability Index, Dyadic Adjustment Scale, and a Fertility Intention Scale, all of which demonstrated acceptable validity and reliability in previous studies. Data were analyzed using IBM SPSS-27 for descriptive and correlational analyses, followed by machine learning modeling in Python using Random Forest, Support Vector Machine, Gradient Boosting, and Artificial Neural Network algorithms. Data preprocessing included normalization, missing data imputation, and categorical encoding. Model performance was evaluated using 10-fold cross-validation and metrics including accuracy, precision, recall, F1-score, and area under the ROC curve.

Findings: The results indicated significant positive relationships between cultural norms, economic security, relationship satisfaction, and fertility intentions ($p < .01$). Among predictors, economic security demonstrated the strongest predictive power, followed by relationship satisfaction and cultural norms. Machine learning results showed that the Artificial Neural Network achieved the highest performance (accuracy = 0.868, AUC = 0.926), followed by Gradient Boosting (accuracy = 0.856, AUC = 0.914) and Random Forest (accuracy = 0.842, AUC = 0.901), while Support Vector Machine showed comparatively lower performance (accuracy = 0.801, AUC = 0.862). Feature importance analysis confirmed the dominant role of economic security across all models.

Conclusion: The superior performance of machine learning models demonstrates their effectiveness in capturing complex, nonlinear relationships among predictors, offering a powerful approach for understanding and predicting reproductive decision-making.

Keywords: *Fertility intentions, cultural norms, economic security, relationship satisfaction, machine learning, predictive modeling*

1 Introduction

Fertility intentions represent a central construct in demographic, sociological, and psychological research, reflecting individuals' subjective plans and desires regarding childbearing within a given socio-cultural and economic context. In recent decades, global fertility patterns have undergone substantial transformations, characterized by declining birth rates, delayed parenthood, and increased variability across regions and social groups. These shifts have drawn attention to the multifaceted determinants of fertility decision-making, which extend beyond biological capacity to encompass a complex interplay of cultural norms, economic conditions, and relational dynamics (Ranjbar et al., 2024; Zhang & Cheng, 2024). Understanding fertility intentions is therefore critical not only for population policy and planning but also for advancing theoretical frameworks that explain how individuals negotiate reproductive choices within contemporary societies.

Cultural norms constitute a foundational dimension shaping fertility intentions by embedding reproductive behaviors within shared values, traditions, and expectations. Societies differ considerably in their pronatalist or antinatalist orientations, with cultural narratives influencing the perceived desirability of parenthood, ideal family size, and the timing of childbearing (Han & Oh, 2024; K. & S., 2024). In many contexts, adherence to traditional norms is associated with stronger intentions to have children, as individuals align their personal decisions with collective expectations and moral frameworks. Conversely, the diffusion of individualistic values and shifting gender roles has contributed to the diversification of reproductive preferences and the weakening of normative pressures to conform to traditional family models (Chang et al., 2023; Park, 2021). These transformations underscore the need to examine cultural norms not as static determinants but as dynamic forces interacting with other contextual variables in shaping fertility intentions.

Economic security represents another critical determinant of fertility intentions, as decisions regarding childbearing are inherently linked to perceptions of financial stability and future prospects. The costs associated with raising children, including housing, education, and healthcare, necessitate a level of economic preparedness that varies across individuals and households. Empirical evidence suggests that higher levels of perceived economic security are generally associated with increased fertility intentions, as individuals feel more capable of meeting the material demands of parenthood (Kapelle et al., 2022; Zhang & Cheng, 2024). Conversely, economic uncertainty, unemployment, and income instability often lead to postponement or reduction of childbearing plans (Pathak et al., 2025; Umoh, 2022). Additionally, the structure of household financial management and intra-couple resource allocation plays a significant role in shaping reproductive decisions, highlighting the importance of examining economic factors at both individual and relational levels (Kaur & Singh, 2025).

Relationship satisfaction and quality further contribute to fertility intentions by influencing the emotional and interpersonal context within which reproductive decisions are made. Stable and satisfying relationships provide a supportive environment for childbearing, fostering mutual commitment and shared life goals between partners. Research indicates that higher levels of relationship satisfaction are positively associated with the desire to have children, as individuals perceive parenthood as an extension of a fulfilling partnership (Karney, 2021; Lo-oh, 2023). Conversely, relationship instability, conflict, or dissatisfaction may deter individuals from pursuing childbearing due to concerns about the long-term viability of the partnership. Moreover, gender dynamics and power relations within couples can shape reproductive decision-making processes, as partners negotiate their preferences and expectations regarding family formation (Yu, 2024). These findings highlight the importance of incorporating relational variables into models of fertility intentions to capture the interpersonal dimension of reproductive behavior.

Recent research has increasingly emphasized the role of social and contextual determinants in shaping fertility intentions, including access to social support, healthcare, and information. Social determinants of health, such as education, community resources, and social networks, have been shown to influence individuals' readiness and willingness to have children by affecting both perceived and actual capacities for parenting (Fakari et al., 2025). Similarly, fertility knowledge and awareness of reproductive health issues play a crucial role in shaping intentions, as individuals with greater knowledge are better equipped to make informed decisions regarding childbearing (Mashayekh-Amiri et al., 2025). Qualitative studies further reveal that fertility intentions are embedded within broader life narratives, encompassing personal aspirations, career goals, and cultural expectations (Mesbah et al., 2025). These insights underscore the multidimensional nature of fertility

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intentions and the need for integrative approaches that consider multiple levels of influence.

In addition to these factors, macro-level processes such as urbanization, migration, and digitalization have introduced new dynamics into fertility decision-making. Urbanization, for instance, is often associated with reduced fertility intentions due to increased living costs, changing lifestyles, and greater access to education and employment opportunities (Zhang & Cheng, 2024). Migration experiences can also influence reproductive behavior, as individuals adapt to new cultural and economic environments that may differ from their countries of origin (Mussino, 2025). Furthermore, the proliferation of digital technologies has transformed family life and social interactions, potentially affecting fertility intentions by reshaping communication patterns, access to information, and work-life balance (liao, 2025). These developments highlight the evolving context within which fertility decisions are made and the importance of incorporating contemporary factors into empirical analyses.

Gender roles and inequalities remain central to understanding fertility intentions, as reproductive decisions are often embedded within broader patterns of gendered expectations and responsibilities. Traditional gender norms that assign primary caregiving roles to women can influence their fertility intentions by increasing the perceived costs of childbearing, particularly in contexts where institutional support for work-family balance is limited (Han & Oh, 2024; Kim & Kim, 2023). Conversely, more egalitarian gender arrangements may facilitate higher fertility intentions by enabling a more equitable distribution of parenting responsibilities. The interaction between gender dynamics and economic conditions further complicates this relationship, as women's participation in the labor market and access to resources influence their reproductive choices (Karney, 2021; Yu, 2024). These considerations underscore the need to account for gendered dimensions in models of fertility intentions.

Another important consideration is the role of life satisfaction and subjective well-being in shaping reproductive decisions. Individuals who report higher levels of life satisfaction are generally more likely to express intentions to have children, as they perceive their current circumstances as conducive to parenting (Kapelle et al., 2022). Conversely, stress, mental health challenges, and dissatisfaction with life conditions may lead to postponement or avoidance of childbearing (Umoh, 2022). The interplay between psychological well-being and external conditions further illustrates the complexity of fertility intentions, which are influenced by both internal and external factors.

Despite the extensive body of research on fertility intentions, traditional analytical approaches often rely on linear models that may not fully capture the complex, nonlinear relationships among variables. In recent years, machine learning techniques have emerged as powerful tools for analyzing large and complex datasets, enabling the identification of patterns and interactions that may be overlooked by conventional methods. Machine learning approaches, such as Random Forest, Gradient Boosting, and Artificial Neural Networks, are particularly well-suited for modeling fertility intentions, as they can accommodate high-dimensional data and nonlinear relationships among predictors (Wang & Sun, 2025; Wang & Fan, 2025). These methods also allow for the assessment of variable importance and the exploration of complex interactions, providing deeper insights into the determinants of fertility behavior.

The application of machine learning in social science research has been steadily increasing, offering new opportunities to enhance predictive accuracy and theoretical understanding. Studies have demonstrated the utility of machine learning in predicting various behavioral outcomes, including health behaviors, economic decisions, and social attitudes (Bi, 2024; Li & He, 2024). In the context of fertility intentions, machine learning can facilitate the integration of diverse data sources and the identification of complex patterns that reflect the multifactorial nature of reproductive decision-making. However, the use of these methods in fertility research remains relatively limited, highlighting a gap in the literature that this study seeks to address.

Furthermore, cross-cultural variability in fertility intentions underscores the importance of contextualizing findings within specific sociocultural environments. Evidence from different regions indicates that the relative importance of cultural norms, economic security, and relationship satisfaction varies across contexts, reflecting differences in institutional frameworks, cultural values, and economic conditions (Lo-oh, 2024; Ranjbar et al., 2025). This variability suggests that models of fertility intentions must be sensitive to contextual factors and capable of capturing the unique dynamics of different populations. By focusing on a diverse sample and employing advanced analytical techniques, the present study aims to contribute to a more nuanced understanding of fertility intentions.

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In summary, fertility intentions are shaped by a complex interplay of cultural, economic, relational, and contextual factors, which interact in dynamic and often nonlinear ways. While existing research has provided valuable insights into these determinants, there remains a need for integrative approaches that leverage advanced analytical techniques to capture the complexity of reproductive decision-making. Machine learning offers a promising avenue for addressing this need by enabling the analysis of high-dimensional data and the identification of complex patterns among variables.

Therefore, the aim of the present study is to predict fertility intentions using cultural norms, economic security, and relationship satisfaction through a machine learning approach.

2 Methods and Materials

2.1 Study Design and Participants

The present study employed a cross-sectional, predictive-correlational design aimed at modeling fertility intentions based on sociocultural and psychological determinants using advanced machine learning techniques. The study population consisted of adults of reproductive age residing in urban and semi-urban regions of South Africa. A total of 512 participants were selected through a stratified random sampling method to ensure adequate representation across gender, socioeconomic status, and cultural backgrounds. Inclusion criteria required participants to be between 18 and 45 years old, currently in a romantic relationship or married, and without diagnosed infertility issues. Data collection was conducted through both online and in-person survey administration to minimize sampling bias and enhance accessibility.

2.2 Measures

Data collection was carried out using a structured questionnaire composed of standardized and validated instruments measuring the primary study variables. Cultural norms were assessed using an adapted version of the Cultural Values Scale, which captures dimensions such as collectivism, traditionalism, and perceived societal expectations regarding childbearing. Economic security was measured using the Economic Stability Index, which evaluates subjective financial well-being, employment stability, and perceived future economic prospects. Relationship satisfaction was assessed using the Dyadic Adjustment Scale, a widely used instrument that measures relationship quality across dimensions such as consensus, cohesion, and emotional expression. Fertility intentions, the outcome variable, were measured using a multi-item Fertility Intention Scale designed to assess both short-term and long-term reproductive plans. All instruments employed Likert-type response formats, and previous studies have reported satisfactory psychometric properties, including internal consistency coefficients above 0.80 and confirmed construct validity. A pilot study was conducted with 30 participants to ensure clarity and reliability of the instruments in the South African context.

2.3 Data Analysis

Data analysis was performed using a combination of traditional statistical techniques and machine learning algorithms to enhance predictive accuracy and model interpretability. Initially, descriptive statistics and correlation analyses were conducted using IBM SPSS version 27 to examine the distribution and relationships among variables. Subsequently, the dataset was preprocessed, including handling missing values through multiple imputation, normalization of continuous variables, and encoding of categorical variables. Machine learning models, including Random Forest, Support Vector Machine, Gradient Boosting, and Artificial Neural Networks, were implemented using Python-based libraries such as Scikit-learn and TensorFlow. Model performance was evaluated using k-fold cross-validation (k=10) to ensure generalizability, and metrics such as accuracy, precision, recall, F1-score, and area under the receiver operating characteristic curve were computed. Feature importance analysis was conducted to determine the relative contribution of cultural norms, economic security, and relationship satisfaction in predicting fertility intentions. Additionally, hyperparameter tuning was performed using grid search optimization to improve model performance. The final model selection was based on a balance between predictive performance and interpretability, allowing for both theoretical insight and practical application.

3 Findings and Results

The demographic profile of the participants indicated that the final sample of 512 individuals reflected a balanced and heterogeneous representation of the target population. The mean age of participants was 29.84 years (SD = 6.12), with ages ranging from 18 to 45 years. Of the total sample, 54.3% were female and 45.7% were male. In terms of relationship

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status, 62.5% were in long-term committed relationships, while 37.5% were legally married. Regarding educational attainment, 28.7% held a high school diploma, 46.1% had completed undergraduate studies, and 25.2% possessed postgraduate qualifications. Employment status showed that 58.6% were employed full-time, 21.4% part-time, and 20.0% were unemployed or economically inactive. Cultural background distribution reflected the diversity of South Africa, with participants identifying across multiple ethnic and linguistic groups. Overall, the demographic characteristics suggest that the sample was sufficiently diverse to support generalizable inferences regarding fertility intentions within the studied population.

Table 1

Descriptive Statistics and Correlations Among Study Variables

Variable	Mean	SD	1	2	3	4
1. Cultural Norms	3.68	0.74	1			
2. Economic Security	3.42	0.81	0.36**	1		
3. Relationship Satisfaction	3.85	0.69	0.41**	0.47**	1	
4. Fertility Intentions	3.27	0.88	0.44**	0.52**	0.49**	1

Table 1 presents the descriptive statistics and Pearson correlation coefficients among the main study variables. The mean scores indicate that participants reported moderately high levels of cultural norm adherence and relationship satisfaction, while economic security and fertility intentions were slightly lower but still above the midpoint of the scale. Correlation analysis revealed statistically significant positive relationships among all variables. Fertility intentions showed the strongest association with economic security ($r = 0.52$, $p < .01$), followed by relationship satisfaction ($r = 0.49$, $p < .01$) and cultural norms ($r = 0.44$, $p < .01$). Additionally, the intercorrelations among predictors suggest that individuals who reported stronger adherence to cultural norms also tended to experience higher relationship satisfaction and greater perceived economic security. These findings provide preliminary evidence supporting the hypothesized relationships and justify the use of multivariate predictive modeling.

Table 2

Machine Learning Model Performance Metrics

Model	Accuracy	Precision	Recall	F1-Score	AUC
Random Forest	0.842	0.835	0.821	0.828	0.901
Support Vector Machine	0.801	0.793	0.784	0.788	0.862
Gradient Boosting	0.856	0.849	0.837	0.843	0.914
Artificial Neural Network	0.868	0.861	0.852	0.856	0.926

Table 2 summarizes the predictive performance of the implemented machine learning models in classifying fertility intentions. Among the tested algorithms, the Artificial Neural Network demonstrated the highest overall performance, achieving an accuracy of 0.868, with strong precision (0.861), recall (0.852), and F1-score (0.856), as well as the highest AUC value (0.926), indicating excellent discriminative ability. Gradient Boosting also performed robustly, with slightly lower but comparable metrics, suggesting its suitability for this type of predictive task. Random Forest showed strong performance as well, particularly in terms of stability and generalization, while the Support Vector Machine yielded comparatively lower, yet still acceptable, predictive accuracy. These results indicate that nonlinear ensemble and deep learning models outperform traditional classification approaches in capturing the complex interplay among sociocultural and psychological predictors of fertility intentions.

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Table 3

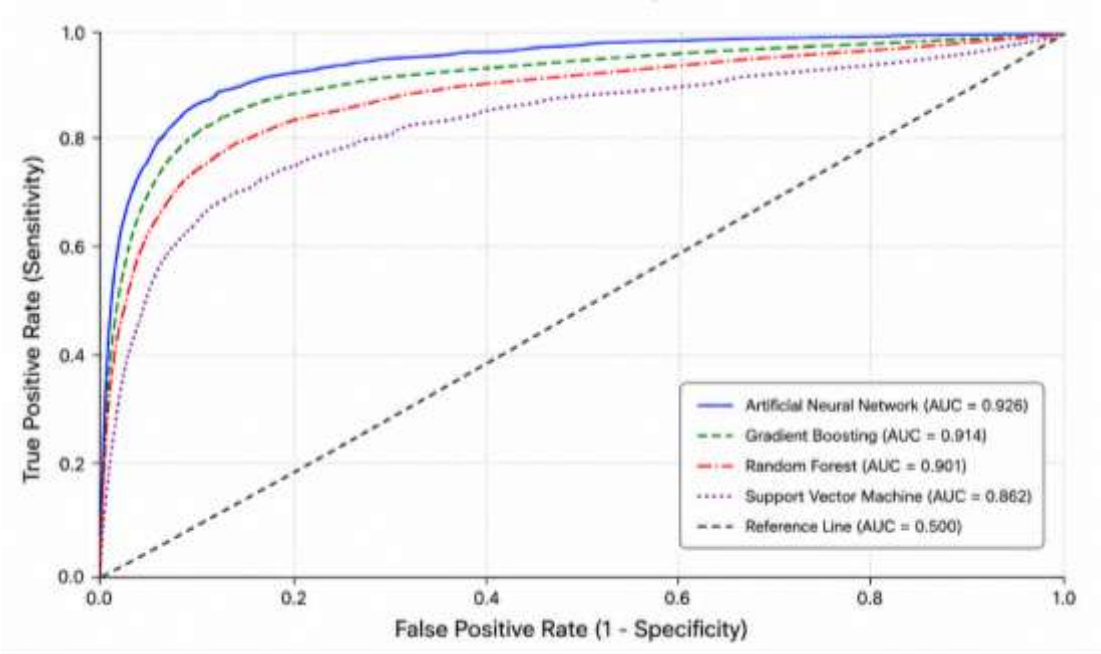
Feature Importance Scores Across Models

Predictor Variable	Random Forest	Gradient Boosting	Neural Network (Normalized)
Cultural Norms	0.312	0.298	0.276
Economic Security	0.357	0.371	0.402
Relationship Satisfaction	0.331	0.331	0.322

Table 3 presents the relative importance of predictor variables across different machine learning models. Economic security consistently emerged as the most influential predictor of fertility intentions across all models, with the highest importance scores, particularly within the Neural Network model (0.402). Relationship satisfaction and cultural norms also demonstrated substantial contributions, with relatively balanced importance values, suggesting that fertility intentions are shaped by a multidimensional set of factors rather than a single dominant determinant. The consistency of these findings across different modeling techniques enhances the robustness and credibility of the results, indicating that economic perceptions, relational dynamics, and cultural expectations jointly influence reproductive decision-making processes.

Figure 1

Receiver Operating Characteristic (ROC) Curves for Machine Learning Models



The ROC analysis further illustrates the comparative performance of the machine learning models in distinguishing between different levels of fertility intentions. The Artificial Neural Network model displayed the most favorable curve, closely approaching the upper-left corner of the ROC space, indicating high sensitivity and specificity. Gradient Boosting and Random Forest models also demonstrated strong classification performance, with curves well above the diagonal reference line, while the Support Vector Machine showed relatively lower, yet still acceptable, discriminative ability. The visual comparison of ROC curves confirms the superiority of ensemble and neural approaches in modeling complex behavioral outcomes and supports the selection of the Artificial Neural Network as the optimal predictive model in this study.

4 Discussion

The present study aimed to predict fertility intentions using cultural norms, economic security, and relationship satisfaction through a machine learning approach, and the findings provide robust empirical support for the multidimensional and interactive nature of reproductive

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decision-making. The results demonstrated that all three predictors were significantly associated with fertility intentions, with economic security emerging as the most influential factor across all analytical models. Additionally, the machine learning analyses indicated that nonlinear and ensemble-based approaches, particularly Artificial Neural Networks and Gradient Boosting, outperformed traditional models in predicting fertility intentions, highlighting the complexity and interdependence of the underlying determinants.

The strong predictive role of economic security aligns with a substantial body of literature emphasizing the centrality of financial stability in shaping reproductive decisions. Individuals who perceive themselves as economically secure are more likely to consider childbearing as feasible and sustainable, given the long-term financial commitments associated with raising children. This finding is consistent with prior research indicating that income stability, employment security, and perceived future financial prospects significantly increase fertility intentions (Kapelle et al., 2022; Zhang & Cheng, 2024). Furthermore, economic uncertainty has been widely documented as a major deterrent to childbearing, leading individuals to delay or forgo parenthood due to concerns about financial strain and instability (Pathak et al., 2025; Umoh, 2022). The present findings extend this literature by demonstrating that economic security not only correlates with fertility intentions but also plays a dominant role in predictive modeling, suggesting that it functions as a primary driver within a broader network of influences.

Relationship satisfaction also emerged as a significant predictor of fertility intentions, underscoring the importance of relational dynamics in reproductive decision-making. Individuals in satisfying and stable relationships are more likely to perceive parenthood as a shared and desirable goal, supported by mutual trust, emotional closeness, and long-term commitment. This finding is consistent with theoretical and empirical work highlighting the role of relationship quality in facilitating reproductive planning and family formation (Karney, 2021; Lo-oh, 2023). Moreover, the interplay between relationship satisfaction and economic factors suggests that these domains are not independent but mutually reinforcing, as financially stable couples may experience lower stress and greater relational harmony, which in turn enhances their readiness for parenthood. This interpretation is supported by research on intra-household financial dynamics, which indicates that equitable resource management and financial transparency contribute to both relationship satisfaction and life planning decisions, including fertility (Kaur & Singh, 2025).

Cultural norms were also found to significantly influence fertility intentions, although their relative importance was slightly lower compared to economic security and relationship satisfaction. This finding reflects the evolving role of cultural norms in contemporary societies, where traditional expectations regarding childbearing coexist with increasing individual autonomy and diverse life trajectories. Previous studies have shown that cultural values such as collectivism, familism, and pronatalism continue to shape fertility preferences by reinforcing the social desirability of parenthood and the moral significance of family formation (Han & Oh, 2024; K. & S., 2024). At the same time, the influence of cultural norms may be moderated by other factors, such as economic conditions and gender roles, leading to variations in their impact across different contexts. The present results support this nuanced perspective by demonstrating that cultural norms remain an important, but not dominant, component of fertility decision-making.

The correlation patterns observed in the study further highlight the interconnected nature of the predictors. The positive associations among cultural norms, economic security, and relationship satisfaction suggest that individuals who adhere more strongly to traditional values may also experience higher levels of relational stability and financial preparedness, thereby creating a conducive environment for childbearing. This integrated perspective is consistent with prior research emphasizing the role of social and contextual determinants in shaping fertility intentions, including social support, education, and access to resources (Fakari et al., 2025; Mashayekh-Amiri et al., 2025). Additionally, qualitative studies have highlighted the importance of personal narratives and life goals in shaping reproductive decisions, suggesting that individuals integrate multiple dimensions of their lives when considering parenthood (Mesbah et al., 2025).

The superior performance of machine learning models, particularly Artificial Neural Networks, provides important methodological insights. These models were able to capture complex, nonlinear relationships among variables, resulting in higher predictive accuracy compared to more traditional approaches. This finding is consistent with emerging research demonstrating the utility of machine learning techniques in social science applications, where behavioral outcomes are influenced by multiple interacting factors (Wang & Sun, 2025; Wang & Fan, 2025). The ability of

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these models to identify subtle patterns and interactions suggests that fertility intentions cannot be fully understood through linear frameworks alone. Instead, they require analytical approaches that can accommodate complexity and heterogeneity, as demonstrated in the present study.

The findings also resonate with broader demographic and sociological trends, including the impact of urbanization, migration, and digitalization on fertility behavior. For example, the role of economic security may be particularly salient in urban contexts, where the costs of living and childrearing are higher, leading individuals to carefully evaluate their financial readiness before having children (Zhang & Cheng, 2024). Similarly, the influence of digital life on family behavior, as highlighted in recent research, may interact with cultural and economic factors to shape fertility intentions in novel ways (liao, 2025). Migration and cross-cultural experiences further add to this complexity by exposing individuals to diverse norms and opportunities, which can influence their reproductive preferences and decisions (Mussino, 2025).

Gender dynamics also play a critical role in interpreting the findings, particularly in relation to relationship satisfaction and economic security. The distribution of resources and responsibilities within couples can significantly affect fertility intentions, as individuals negotiate the costs and benefits of parenthood within the context of their relationships. Research on gender roles and marital bargaining suggests that more egalitarian arrangements may facilitate higher fertility intentions by reducing the burden of childcare and enhancing mutual support (Yu, 2024). Conversely, traditional gender expectations may constrain fertility decisions, particularly for women, by increasing the perceived costs of childbearing in terms of career and personal autonomy (Chang et al., 2023; Kim & Kim, 2023). These dynamics highlight the importance of considering gender as a cross-cutting factor in models of fertility intentions.

The study's findings also align with evidence from cross-cultural research, which indicates that the determinants of fertility intentions vary across contexts but share common underlying mechanisms. For instance, studies conducted in different regions have consistently identified economic security, relationship quality, and cultural norms as key factors influencing reproductive decisions, although their relative importance may differ depending on local conditions (Lo-oh, 2024; Ranjbar et al., 2025). This consistency across contexts underscores the generalizability of the present findings while also emphasizing the need for context-sensitive analyses that account for cultural and structural differences.

Furthermore, the results contribute to the growing literature on the psychological and social determinants of fertility intentions by integrating multiple levels of analysis within a single predictive framework. The inclusion of both individual-level variables (such as perceptions of economic security) and relational factors (such as relationship satisfaction) allows for a more comprehensive understanding of reproductive decision-making. This integrative approach is consistent with theoretical models that conceptualize fertility intentions as the outcome of interactions among personal, interpersonal, and contextual factors (Ranjbar et al., 2024). By leveraging machine learning techniques, the study advances this framework by demonstrating how these interactions can be modeled and quantified in a predictive context.

In addition, the findings have important implications for understanding the role of life satisfaction and well-being in fertility decisions. Individuals who experience greater economic stability and relationship satisfaction are likely to report higher overall life satisfaction, which in turn may enhance their readiness for parenthood. This interpretation is supported by research linking subjective well-being to reproductive intentions and outcomes, suggesting that positive life evaluations are associated with a greater likelihood of planning and having children (Kapelle et al., 2022). Conversely, stress and uncertainty may undermine fertility intentions by reducing individuals' confidence in their ability to provide a stable environment for children.

5 Conclusion

Overall, the discussion highlights the complexity of fertility intentions as a behavioral outcome influenced by multiple interacting factors. The study demonstrates that economic security, relationship satisfaction, and cultural norms collectively shape reproductive decisions, with economic considerations playing a particularly prominent role. The use of machine learning techniques further underscores the importance of adopting advanced analytical approaches to capture the nonlinear and multidimensional nature of these relationships. By integrating theoretical insights with empirical findings, the study contributes to a deeper understanding of fertility intentions and their determinants.

Despite its contributions, the study has several limitations that should be acknowledged. First, the cross-sectional

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design limits the ability to infer causal relationships among the variables, as the observed associations may be influenced by unmeasured factors or reverse causality. Second, the reliance on self-reported data may introduce response biases, including social desirability and recall bias, which could affect the accuracy of the measurements. Third, although the sample was diverse, it may not fully capture the heterogeneity of the broader population, particularly in rural or underserved areas. Additionally, while machine learning models provide high predictive accuracy, they may lack interpretability compared to traditional statistical models, which could limit their applicability in certain contexts. Finally, the study focused on a limited set of predictors, and other relevant factors, such as health status, policy environment, and family background, were not included in the analysis.

Future research should address these limitations by employing longitudinal designs that allow for the examination of causal relationships and changes in fertility intentions over time. Expanding the range of predictors to include additional social, psychological, and policy-related variables would provide a more comprehensive understanding of reproductive decision-making. Researchers should also consider incorporating qualitative methods to explore the subjective meanings and experiences associated with fertility intentions, complementing quantitative findings. Furthermore, the integration of explainable artificial intelligence techniques could enhance the interpretability of machine learning models, making them more accessible for policy and practice. Cross-cultural comparative studies would also be valuable in examining how the determinants of fertility intentions vary across different contexts and identifying universal versus context-specific patterns.

The findings of this study have important implications for policymakers, practitioners, and stakeholders involved in population and family-related initiatives. Interventions aimed at increasing fertility rates should prioritize enhancing economic security through policies that promote stable employment, income support, and affordable childcare. Programs that strengthen relationship quality, such as couple counseling and communication skills training, may also contribute to higher fertility intentions by fostering supportive and stable partnerships. Additionally, public awareness campaigns that address cultural attitudes toward parenthood and promote positive narratives around family formation could help shape fertility preferences. Finally, the use of data-driven approaches, including machine learning, can support the development of targeted and evidence-based interventions tailored to specific populations and contexts.

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

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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