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Reproductive Inequality and the Stalled Fertility Transition in Egypt: Multilevel Evidence from the Demographic and Health Survey

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1 Abstract

Despite ongoing investments in family planning initiatives and significant improvements in female education, fertility decline in Egypt has shown clear signs of stagnation. This study examines reproductive inequality from a biostatistical perspective by modelling high fertility rates and modern contraceptive use within a hierarchical population framework. Using nationally representative data from 9,722 ever-married women aged 15-49 from the 2014 Egypt Demographic and Health Survey, multilevel logistic regression models were applied to measure both individual-level associations and variability across different contexts in reproductive outcomes. Higher educational attainment was linked to notably lower odds of high fertility and a greater likelihood of using modern contraception. Nonetheless, these effects were influenced by socioeconomic and life-course factors. Cross-level interaction analyses revealed a significant amplification of the educational impact among women in higher wealth quintiles ($OR \approx 12.4$) and older age groups ($OR \approx 3.0$). Random-effects estimates showed that a considerable proportion of variation in reproductive outcomes remained attributable to community-level factors, even after adjusting for individual characteristics. Results suggest that the stagnation of fertility decline in Egypt reflects reproductive inequality within hierarchical social structures. This study highlights the importance of multilevel inference to capture conditional effects and contextual heterogeneity in population health research.

Keywords: multilevel inference; reproductive health heterogeneity; fertility dynamics; socioeconomic moderation; hierarchical data; contraceptive behaviour.

2 Introduction

Recent demographic debates increasingly question the assumption that fertility decline follows a linear and self-sustaining trajectory once modern contraception becomes widely available. In Egypt, this assumption has proven problematic. Although national indicators once suggested steady progress toward lower fertility, more recent evidence reveals a reversal that challenges standard demographic expectations. The Total Fertility Rate (TFR), which had declined markedly during the 1990s and early 2000s, rose again to 3.5 children per woman according to the 2014 Demographic and Health Survey, raising concerns about the resilience of earlier demographic gains (Khalifa et al., 2017).

This reversal occurred in a context characterised by relatively high contraceptive prevalence and dominance of modern methods. Survey evidence indicates that nearly three-fifths of married women reported using contraception, with intrauterine devices constituting the most common method, followed by oral pills and injectables (DHS, 2025). Such patterns would ordinarily be interpreted as evidence of effective fertility regulation. However, the coexistence of high contraceptive use and stalled fertility decline suggests that method adoption alone does not guarantee sustained fertility reduction. Instead, reproductive outcomes appear to be shaped by broader structural and contextual constraints that limit the translation of contraceptive use into effective fertility control.

Earlier demographic analyses mainly depended on the proximate determinant framework, which linked fertility decline closely to the expansion of contraceptive methods. While this framework effectively described earlier stages of Egypt's demographic transition, its explanatory power has diminished over time. Recent research indicates that increases in contraceptive use have primarily occurred among wealthier and better-educated women, with limited impact on fertility in economically disadvantaged and marginalised regions (Guengant, 2009). These spatial and socioeconomic disparities highlight the uneven

distribution of reproductive agency across different population groups.

Compounding these inequalities, contraceptive use in Egypt is often marked by discontinuation and method switching, patterns that increase the risk of unintended pregnancy even in contexts with high overall prevalence. Such variability is frequently linked to insufficient counselling, side effects, or supply chain disruptions, all of which compromise the effectiveness of contraceptive strategies (Mohamed et al., 2022). Therefore, assessments of fertility decline need to go beyond general prevalence figures to examine whether contraceptive use is consistent, suitable, and supported by accessible service environments.

Evidence indicates that modern contraceptive use remains disproportionately higher among women with greater educational and economic capital, even after considering regional differences (Awadalla, 2012). These patterns highlight ongoing informational and structural inequalities that limit reproductive choices among less advantaged groups. However, much of the existing literature treats fertility and contraceptive behaviour as separate analytical processes.

Several studies have examined community-level influences on contraceptive use without explicitly linking them to fertility outcomes (Anwar, 2019), while others have focused on socioeconomic and educational gradients in fertility without incorporating contraceptive dynamics (Samari, 2019). More recent research has begun to bridge this divide. For example, (Woldeamanuel et al., 2023) demonstrated that women's education and contraceptive use jointly shape high-fertility risk, though their findings were limited to the Ethiopian context. Similarly, (Negash et al., 2023) identified associations between contraceptive use and high fertility among women of reproductive age in Sub-Saharan Africa, yet their analyses did not account for hierarchical population structures or cross-level interactions.

Taken together, this body of evidence highlights a critical gap in the literature: the absence of integrated, multilevel analyses that simultaneously examine fertility and contraceptive behaviour within stratified socioeconomic and geographic contexts. Addressing this gap, the present study employs multilevel modelling to investigate reproductive inequality in Egypt, focusing on how education, household wealth, and regional context collectively influence fertility and contraceptive outcomes. By explicitly modelling hierarchical data structures and interaction effects, the study aims to provide a more nuanced and statistically robust understanding of the factors shaping the pace and sustainability of fertility decline in Egypt.

2.1 Literature Gap

Despite the breadth of existing scholarship, prevailing analytical frameworks do not fully resolve the contradictions characterising Egypt's fertility transition. Prior studies have documented the role of education in expanding contraceptive awareness and use, yet few have explicitly linked educational gradients to fertility outcomes within an integrated analytical model. Fertility levels remain disproportionately high among asset-poor and rural women, challenging assumptions that economic resources universally translate into smaller family sizes.

Moreover, evidence indicates that wealth does not consistently predict lower fertility, even in Egypt's more developed regions, and may in some cases contradict expectations derived from classical demographic theory (Giusti & Vignoli, 2006) (Anwar, 2019). The paradoxical finding that rural

areas may exhibit relatively strong access to contraceptive methods while experiencing stalled fertility decline further underscores the limitations of focusing on method availability alone. These patterns point to a need to reassess the assumed simplicity of the relationships among education, wealth, and fertility.

Importantly, existing studies rarely investigate whether the effects of education on fertility vary across different socioeconomic and geographic contexts, nor do they combine modelling of fertility and contraceptive behaviour within a multilevel framework. To date, no study has systematically examined how education influences both contraceptive use and fertility outcomes simultaneously in the context of Egypt's uneven demographic transition.

The demographic trend in Egypt is a fascinating case study of analysing the changing nature of fertility transition in the 21st century. As opposed to most of the nations where fertility has steadily declined, the recent stall and reversal in Egypt have been experienced in the middle ground of development, and this has left a puzzle to both policymakers and researchers. It is an excellent place to explore agency-policy relations between macro-level policy and micro-level agency within hierarchical social networks. Though the proximate determinants approach provides a very effective way of explaining the mechanism by which fertility change takes place, it is less suited to the explanation of why the mechanisms are not uniformly undertaken by all social strata.

The latest academic output has started to shift its focus to studying this heterogeneity with the concepts of reproductive agency, intersectionality, and the life-course approach becoming the primary focus. Much of this research is, however, closed-ended and focuses on either contraceptive behaviour or fertility effects individually. It is thus urgently needed that resources such as education and wealth be unpacked out of complex pathways through which they are or are not converted into reproductive control. This paper seeks to bridge this integrative gap on the premise that the stagnation of the fertility transition in Egypt is not an outcome of failures of the family planning program per se, but is a symptom of the systemic reproductive inequalities that are reproduced in the interaction between the individual capital and the community environment.

Addressing this gap is crucial not only for understanding the persistence of stagnating fertility rates despite widespread contraceptive use but also for guiding policies aimed at reducing structural and regional inequalities in reproductive outcomes.

To fill these gaps in the literature, we have two research questions. First, we ask whether there is significant individual and community-level variation in high fertility rates and modern contraceptive use across hierarchical social and geographic structures in Egypt. Second, we ask whether and how the impact of women's educational attainment on reproductive outcomes is moderated by socioeconomic status (household wealth) and life-course factors (age groups).

This study offers two main contributions to the literature. First, it moves beyond traditional single-level analyses by employing a multilevel framework to quantify the extent to which reproductive outcomes are attributable to shared community contexts versus individual characteristics. Second, it utilizes cross-level interaction modeling to demonstrate how the relationship between education and fertility is not uniform but is conditioned by material and demographic circumstances. This will allow us to understand how the intersection of these factors contributes to the stagnation of fertility decline in

Egypt despite widespread contraceptive availability and improvements in female schooling.

3 Background

3.1 Theoretical Context

Contemporary interpretations of demographic transition increasingly emphasise that fertility change is not driven solely by economic development or contraceptive diffusion, but by the interaction of social structures, gender relations, and individual agency. Classical demographic transition theory predicts declining fertility as socioeconomic conditions improve, while the proximate determinants framework highlights contraception as a direct mechanism through which fertility change is realized (Zaidi & Morgan, 2017) (Laelago et al., 2019). However, empirical applications of these frameworks suggest that their explanatory power is contingent on social context and institutional arrangements.

In Egypt, demographic change has occurred within a patriarchal and religiously conservative context, where gendered power relations continue to influence reproductive decision-making. Under such conditions, improvements in education or access to contraception do not automatically lead to autonomous fertility control. Instead, women's social agency, mediated by household dynamics, cultural norms, and economic dependence, plays a central role in shaping reproductive outcomes. This perspective closely aligns with the Gender and Development (GAD) framework, which views fertility behaviour as embedded within structural gender relations rather than as a result of individual choice alone (Jaquette, 2017).

Within this theoretical framing, fertility and contraceptive behaviour emerge from multilayered social systems encompassing education, wealth, gender norms, and power relations at both household and community levels. Such complexity challenges single-level analytical approaches and calls for multilevel frameworks that integrate individual-level determinants with broader contextual influences. These frameworks allow for examination of how structural constraints condition the extent to which individual resources are converted into effective reproductive control.

3.2 Empirical Evidence

1. *Determinants of Fertility Decline*

Empirical research on fertility decline in Egypt consistently identifies education, economic resources, and access to health services as key correlates, although the mechanisms through which these factors operate remain contested. Using data from the Egyptian Labour Market Panel Survey (ELMPS 2006–2012), (Samari, 2019) employed mediation regression models to examine whether women's empowerment mediated the relationship between education and fertility among 4,336 married women. The analysis revealed a negative association between education and fertility, partially mediated by women's decision-making power and egalitarian attitudes. Notably, the mediation process was asymmetric: shifts toward joint decision-making were associated with higher fertility, whereas greater individual autonomy was linked to lower fertility, underscoring the conditional nature of empowerment effects.

Further evidence of contextual conditioning was provided by (Samari, 2017), who applied multilevel modelling techniques to a sample of 3,795 women. Contrary to expectations that community effects would dominate fertility outcomes, the study found that community-level factors accounted for a relatively modest share of total fertility variation. Nevertheless, the analysis demonstrated that social norms and community embeddedness significantly shaped reproductive

behaviour beyond individual characteristics. Importantly, women's agency within patriarchal systems was shown to function paradoxically: fulfilling culturally prescribed reproductive roles could reinforce higher fertility, complicating assumptions that empowerment uniformly reduces fertility.

At the couple level, (Ambrosetti et al., 2021) analysed fertility intentions using cross-sectional survey data and documented substantial regional variation in ideal family size. While urban and more educated women expressed preferences for smaller families, discrepancies between desired and achieved fertility persisted, indicating the presence of barriers that operate beyond intention formation. These findings highlight the structural and normative constraints that limit the translation of fertility preferences into outcomes. However, this body of work largely examined fertility in isolation and did not explicitly integrate contraceptive behaviour into the analytical framework, despite its centrality to recent fertility reversals.

3.2.1 2. Determinants of Contraceptive Use

Parallel research on contraceptive behavior in Egypt reveals comparable structural and contextual influences. Drawing on the 2000 and 2014 Demographic and Health Surveys, (Anwar, 2019) conducted a multilevel analysis demonstrating that approximately 7.5% of the variation in modern contraceptive use was attributable to regional clustering. Educational attainment, spousal communication, and household wealth emerged as significant predictors of use, yet the husband's approval exerted a particularly strong influence, highlighting the persistence of male dominance in reproductive decision-making. Although regional variance declined slightly by 2014, this reduction did not eliminate contextual disparities, suggesting that prolonged service availability alone has limited capacity to dismantle socio-normative constraints.

Using EDHS 2000 data, (Giusti & Vignoli, 2006) applied random-intercept logistic models and found that both individual education and regional development indicators influenced modern contraceptive use. Women living in wealthier and more urbanised regions were more likely to adopt modern methods, supporting the argument that community-level development enhances individual empowerment. However, the study did not examine whether empowerment or decision-making autonomy moderation accounted for these relationships, leaving unresolved questions about the interaction between agency and socioeconomic context.

The dynamics of contraceptive adoption and discontinuation were further explored by (Khalifa et al., 2017) through analysis of DHS calendar data from 2008 and 2014. Their findings indicated stagnation in contraceptive prevalence at approximately 60 per cent, alongside elevated rates of discontinuation, particularly for hormonal methods. Side effects, misinformation, and inadequate service quality were identified as primary drivers of discontinuity, suggesting that service consistency and counselling quality are critical determinants of effective contraceptive use. These dynamics underscore the distinction between nominal coverage and functional effectiveness in fertility regulation.

Additional cross-sectional evidence supports these conclusions. (Awadalla, 2012) reported that approximately 57.5% of married women used contraception, with intrauterine devices comprising one-third of all methods. Education, parity, and spousal communication emerged as consistent predictors. However, reliance on single-

level regression limited the study's capacity to capture contextual influences, leaving community and service-level factors unexamined. Collectively, these studies demonstrate that while education and economic status enhance contraceptive uptake, structural and normative barriers persist, particularly in rural and economically disadvantaged settings.

3.2.2 3. Moderation by Women's Education, Wealth, and Regional Context

Education remains one of the strongest predictors of both contraceptive use and fertility decline in Egypt, yet its effects vary considerably across socioeconomic and geographic contexts. Using data from the 2008 Egypt Demographic and Health Survey ($n = 13{,}734$), (Sumri, 2015) demonstrated that women with higher education and greater economic resources were significantly more likely to use modern contraceptive methods, even after accounting for employment status and place of residence. The interaction between education and wealth was especially notable: women in the richest quintile with secondary education or higher showed the highest likelihood of using modern methods (AOR = 1.32, 95% CI 1.18–1.49), highlighting the synergistic effect of knowledge and material resources.

Socioeconomic disparities were also evident in the 2015 EDHS, which revealed that women in the highest wealth quintile were significantly more likely to participate in household and reproductive health decision-making and to utilise modern contraception than women in the lowest quintile. These disparities emphasise how access to information and integrated health services is stratified by economic status. Persistent inequalities in service delivery further exacerbate these issues: urban areas benefit from a diverse range of methods and multiple providers, whereas rural governorates continue to face gaps in counselling and method options (Orabi et al., 2024).

Micro-level analyses from Upper Egypt reinforce the importance of structural context. (Orabi et al., 2024) found that women earning cash income and residing in smaller, nuclear households were significantly more likely to use long-acting or permanent methods, with patterns closely linked to parity and the husband's occupation. Complementary evidence from the Egypt Labour Market Panel Survey indicates that later age at marriage and higher educational attainment predict delayed fertility and sustained contraceptive use (Crandall et al., 2016). Together, these findings suggest that fertility reduction in Egypt is less a reflection of attitudinal change than of the interaction between education, wealth, and regionally structured access to reproductive health services.

4 Data and Methods

4.1 Data Collection

The empirical analysis uses data from the 2014 Egypt Demographic and Health Survey (EDHS), which is the most extensive nationally representative source of information on fertility, family planning, and women's health outcomes in Egypt. The survey was carried out by the Ministry of Health in partnership with El-Zanaty and Associates (Demographic, 2015) and ICF International, following internationally standardised protocols for data collection and quality assurance.

The EDHS used a stratified two-stage cluster sampling method to ensure comprehensive geographic coverage across Egypt's 27 governorates. In the first stage, 1,301 primary sampling units (PSUs) were systematically selected from the national population census frame, stratified by region and urban–rural residence. In the second stage, a fixed number of households were randomly

selected within each selected PSU, yielding a nationally representative household sample.

Eligible respondents included women who were ever-married, aged 15-49, and living in the sampled households. After applying sampling weights to account for differences in selection and non-response probabilities, the final analytical sample consisted of 9,722 women. This weighting approach ensures that estimates accurately represent population-level reproductive patterns and permit valid statistical inference at both individual and contextual levels.

Data on fertility history, contraceptive behaviour, household socioeconomic status, and women's decision-making indicators were gathered using standardised household and individual questionnaires. These tools are designed to collect comparable measures across regions and population groups, enabling multilevel analyses that differentiate between personal traits and shared contextual factors. The rigour and consistency of the EDHS design provide a solid basis for examining reproductive outcomes within a hierarchical analytical framework and for analysing the interactions between individual- and community-level determinants (Terefe et al., 2025).

4.2 Variables and Measurement

Table 1: Definition, Coding, and Measurement of Study Variables

Variable	Definition and Coding Scheme	Analytical Role
Fertility Status	Binary indicator coded as 1 for high fertility (three or more children ever born) and 0 for lower fertility (fewer than three children).	Outcome
Modern Contraceptive Use	Dichotomous variable coded as 1 if the respondent was currently using any modern contraceptive method (including pills, intrauterine devices, injectables, implants, or condoms), and 0 if using traditional methods or no method.	Outcome
Educational Attainment	Ordinal variable reflecting highest level of schooling completed: no education (0), primary (1), secondary (2), and higher education (3).	Individual-level covariate
Employment Status	Binary indicator coded as 1 for women currently engaged in paid employment and 0 otherwise.	Individual-level covariate
Household Wealth Quintile	Composite index derived from DHS asset-based measures, categorised into quintiles ranging from poorest (1) to richest (5).	Individual-level covariate
Place of Residence / Region	Binary indicator distinguishing urban (1) and rural (0) residence, supplemented by governorate-level indicators to capture regional disparities.	Contextual covariate
Cluster-level Educational Context	Mean years of schooling among women residing within each primary sampling unit (PSU), representing aggregated educational exposure at the community level.	Level-2 predictor

4.3 Data Analysis

All statistical analyses were conducted in Stata version 17.0, using multilevel logistic regression to account for the hierarchical structure of the data. Individual women constituted the first level of analysis (Level 1) and were nested within 1,301 primary sampling units (PSUs), which formed the second level (Level 2). This structure reflects the embedded nature of reproductive behaviour within shared community contexts, where access to services, prevailing gender norms, and local socioeconomic conditions exert collective influence.

Conventional single-level regression models assume that observations are independent, an assumption that is violated when individuals are grouped within communities. Failing to account for this clustering can result in biased standard errors and inefficient parameter estimates. Multilevel modelling addresses this issue by explicitly partitioning variance across hierarchical levels and adjusting for dependence within clusters, leading to more reliable inference (Huang, 2018). As (McNeish, 2019) explains, this method enables the simultaneous estimation of individual-level relationships and contextual differences, enhancing both interpretability and statistical validity.

Model estimation proceeded sequentially. First, an unconditional (null) model was fitted for each outcome to quantify baseline community-level variation and to compute the intra-class correlation coefficient (ICC), providing an initial assessment of the extent to which reproductive outcomes clustered within communities. Second, a main-effects model was estimated, incorporating individual-level covariates and contextual predictors to evaluate their direct associations with fertility status and modern contraceptive use at both levels of analysis.

Finally, an interaction model was specified to examine whether the effects of women's

educational attainment varied across socioeconomic and life-course contexts. Cross-level interaction terms were introduced to test whether household wealth and age group moderated the association between education and reproductive outcomes. This specification was theoretically motivated by the premise that educational resources do not operate uniformly, but are conditioned by material circumstances and reproductive stage, potentially amplifying or attenuating their influence on fertility and contraceptive behaviour.

5 Results

5.1 Sample Characteristics and Descriptive Overview

Table 1 summarises the socio-demographic profile of the 9,722 ever-married women aged 15-49 years included in the analytical sample. The distribution of fertility outcomes indicates that a substantial majority of women (76.6%) fell within the high-fertility category, defined as having three or more children ever born, while 23.4% were classified as having lower fertility. This pattern underscores the predominance of higher parity within the study population.

Regarding contraceptive behaviour, 61.7% of respondents reported current use of a modern contraceptive method. However, a significant proportion (38.3%) relied on traditional methods or reported no contraceptive use at the time of the survey, emphasising a notable gap between method availability and effective coverage. The age profile of the sample was skewed towards later reproductive stages, with more than half of the women (56.6%) aged 35-49 years. Younger women aged 15-24 years accounted for a comparatively smaller share (14.1%), reflecting both cohort composition and the concentration of completed fertility in older age groups.

Educational attainment was unevenly distributed. Nearly half of the respondents (47.1%) had completed secondary education, while 26.3% had completed primary education. A further 15.6% had received no formal education, and only 11.0% had attained higher education. These distributions highlight significant educational stratification within the sample. Geographic residence further reflected structural imbalance, with 58.6% of participants living in rural areas, consistent with Egypt's broader urban-rural demographic profile. Economic participation among women was limited: only 18.7% reported engagement in paid employment, indicating restricted access to independent income-generating opportunities.

Household wealth was broadly distributed, with 20.5% of women in the highest wealth quintile and 19.8% in the poorest quintile, suggesting marked economic heterogeneity. Exposure to family planning information was also variable; approximately 38.4% of respondents reported receiving messages on family planning through media outlets or community-based health programs.

Table 2 Socio-Demographic Profile of the Study Sample (N = 9,722)

Characteristic	**Category**	**n**	**%**
Fertility status	Lower fertility (< 3 children)	2,273	23.4
	High fertility (≥ 3 children)	7,449	76.6
Modern contraceptive use	Currently using modern methods	5,998	61.7

	Traditional methods or none	3,724	38.3
Age group (years)	15-24	1,369	14.1
	25-34	2,848	29.3
	35-49	5,505	56.6
Educational attainment	No formal education	1,517	15.6
	Primary education	2,558	26.3
	Secondary education	4,578	47.1
	Higher education	1,069	11.0
Place of residence	Urban	4,023	41.4
	Rural	5,699	58.6
Employment status	Currently working	1,818	18.7
	Not working	7,904	81.3
Exposure to family planning Awareness	Exposed	3,730	38.4
	Not exposed	5,992	61.6

5.2 Descriptive Patterns

The distribution shown in Table 2 indicates a concentration of high fertility among women in later reproductive ages, as well as among those living in rural areas and with lower educational levels. Although modern contraceptive use is fairly widespread, the continued high fertility suggests that merely using contraception may not be enough to change reproductive outcomes. Limited participation in paid work and restricted exposure to family planning messaging further highlight potential structural barriers that hinder the effectiveness of fertility regulation strategies.

5.3 Multilevel Determinants of Modern Contraceptive Use: (Main Effects Model)

Table 3 shows the results of the multilevel logistic regression model estimating the determinants of modern contraceptive use among ever-married women aged 15-49 years, without interaction terms. Several individual-level characteristics emerged as significant predictors, highlighting the varied nature of contraceptive behaviour across different demographic and social groups.

Age demonstrated a strong inverse relationship with contraceptive use. Older women showed significantly lower odds of using modern contraception ($OR = 0.76, p < 0.001$), indicating reduced demand once the desired family size has been reached or as women near the end of their reproductive years. This pattern aligns with life-course perspectives on contraceptive behaviour rather than access-related explanations.

Educational attainment showed a clear, graded positive effect. Women who had completed secondary education ($OR = 1.58, p = 0.001$) and those with higher education ($OR = 1.62, p = 0.001$) were significantly more likely to use modern contraceptive methods compared to women with no formal education. This gradient highlights the role of education in enhancing reproductive health literacy, strengthening decision-making capacity, and supporting reproductive autonomy.

Contrary to traditional beliefs, living in rural areas was linked to higher chances of using

modern contraception ($OR = 1.76, p = 0.004$). This might reflect the cumulative impact of decentralised family planning programmes and increased outreach services in rural governorates over the past decade, indicating that institutional access can counteract structural disadvantages in certain conditions.

Exposure to family planning messages was positively associated with contraceptive use; however, the relationship did not reach statistical significance ($OR = 1.07, p = 0.359$). This pattern may indicate message saturation or limited behavioural impact of media exposure in the absence of sustained counselling and service integration. Notably, neither household wealth nor employment status had a statistically significant effect, suggesting that economic capacity alone does not drive contraceptive adoption in the Egyptian context.

Taken together, these results suggest that educational attainment and place-based service accessibility exert a stronger influence on contraceptive use than material resources. The findings emphasise the importance of informational and institutional factors over purely economic explanations in shaping reproductive behaviour.

Table 3 Multilevel Logistic Regression Results for Modern Contraceptive Use (Main Effects Model)

Predictor	Odds Ratio (OR)	Std. Error	95% Confidence Interval
Older reproductive age	0.76	0.05	0.65 – 0.87
Exposure to family planning messages	1.07	0.08	0.92 – 1.22
Education (Primary)	1.12	0.16	0.84 – 1.49
Education (Secondary)	1.58	0.17	1.27 – 1.94
Education (Higher)	1.62	0.20	1.26 – 2.06
Residence (Rural)	1.76	0.35	1.19 – 2.59
Wealth (Poorer)	0.94	0.12	0.73 – 1.21
Wealth (Middle)	0.81	0.11	0.62 – 1.06
Wealth (Richer)	1.20	0.19	0.87 – 1.64
Wealth (Richest)	1.45	0.28	0.99 – 2.10
Employment (Seasonal)	1.10	0.13	0.86 – 1.39
Employment (Occasional)	1.43	0.33	0.91 – 2.24
Constant	1.49	0.32	0.98 – 2.25

5.4 Multilevel Determinants of High Fertility: (Main Effects Model)

The results of the multilevel logistic regression examining the main effects of fertility determinants are presented in Table 4. Several individual-level characteristics exhibited strong and statistically independent associations with the likelihood of high fertility, underscoring the cumulative and socially structured nature of reproductive outcomes in Egypt.

Age was the most significant predictor. Women in later reproductive stages had markedly higher odds of high fertility ($OR = 13.22, p < 0.001$), reflecting extended exposure to childbearing across their lifespans. This finding aligns with demographic expectations and emphasises the cumulative nature of fertility behaviour rather than an immediate effect.

Marital status demonstrated a pronounced association with fertility outcomes. Compared with married and cohabiting women, those who were divorced or not living with a partner exhibited substantially lower odds of high fertility, with odds ratios of 0.045 and 0.36 ($p < 0.01$), respectively. These estimates indicate that union stability and co-residence remain central to reproductive accumulation in the Egyptian context.

Educational attainment showed a strong inverse relationship with high fertility. Women with higher education were approximately 90 per cent less likely to experience high fertility ($OR = 0.15, p < 0.001$) compared with women with no formal education. This association underscores the role of education in shaping reproductive trajectories through delayed marriage, enhanced access to family planning, and increased capacity for fertility regulation.

Household wealth was similarly associated with reduced fertility. Women in the wealthiest wealth category had the lowest likelihood of high fertility ($OR = 0.27, p < 0.001$), lending empirical support to demographic–economic hypotheses linking improved socioeconomic conditions to diminished incentives for larger family sizes. This pattern suggests that economic security continues to function as a fertility-limiting factor, even within a context of stalled aggregate fertility decline.

Place of residence also influenced fertility differences. Living in rural areas was associated with a modest yet statistically significant increase in the odds of high fertility ($OR = 1.37$), reflecting ongoing contextual effects of residence. However, the size of this effect suggests a narrowing rural–urban fertility gap compared to earlier demographic stages.

Employment status further differentiated fertility outcomes. Women engaged in seasonal work had lower odds of high fertility ($OR = 0.47, p < 0.001$), a pattern that may reflect opportunity costs associated with labour participation, time constraints, or a higher valuation of economic activity relative to additional childbearing.

Taken together, these results indicate that fertility reduction in Egypt is strongly associated with educational attainment, economic position, marital dynamics, and labour participation. Nevertheless, the persistence of residential differentials suggests that fertility behaviour remains partially conditioned by contextual and normative factors, tempering the fertility-reducing effects of socioeconomic development.

Table 4 Multilevel Logistic Regression Results for High Fertility (Main Effects Model)

Predictor	**Odds Ratio (OR)**	**Std. Error**	**95% Confidence Interval**
Older reproductive age	13.22	1.21	11.04 – 15.80
Marital status (Widowed)	0.69	0.15	0.45 – 1.05
Marital status (Divorced)	0.05	0.01	0.02 – 0.07
Marital status (Separated / not cohabiting)	0.37	0.14	0.17 – 0.76

Education (Primary)	0.41	0.08	0.28 – 0.59
Education (Secondary)	0.31	0.05	0.23 – 0.41
Education (Higher)	0.15	0.02	0.10 – 0.20
Residence (Rural)	1.37	0.27	0.92 – 2.02
Wealth (Poorer)	0.51	0.09	0.36 – 0.71
Wealth (Middle)	0.64	0.11	0.45 – 0.90
Wealth (Richer)	0.35	0.07	0.23 – 0.51
Wealth (Richest)	0.27	0.06	0.16 – 0.42
Religion (Christian)	0.33	0.07	0.22 – 0.50
Religion (Other)	7.02	17.60	0.05 – 0.75
Employment (Seasonal)	0.48	0.08	0.35 – 0.65
Employment (Occasional)	1.64	0.50	0.90 – 2.99
Constant	8.10	1.98	5.02 – 13.06

5.5 Contextual and Socioeconomic Interaction Effects on High Fertility

The introduction of interaction terms substantially refined the explanatory power of the fertility model, revealing how structural and social factors jointly shape reproductive behaviour. As shown in Table 5, model fit improved significantly following the inclusion of cross-level interactions ($LR\ \chi^2 = 397.46, p < 0.001$), confirming that fertility outcomes in Egypt cannot be adequately explained through additive main effects alone.

A particularly salient interaction emerged between age and educational attainment. Among women in later reproductive stages, higher education was associated with a markedly lower likelihood of high fertility ($OR = 0.04, p = 0.001$), indicating that education plays a critical role in regulating cumulative fertility, especially toward the end of the reproductive life course. This finding underscores the capacity of education to translate into effective fertility control when biological exposure to childbearing is prolonged.

However, the interaction analysis also revealed countervailing patterns under specific marital circumstances. Widowed women with primary education exhibited substantially elevated odds of high fertility ($OR = 13.18, p = 0.010$), suggesting that fertility behaviour in this group may be shaped by post-marital replacement dynamics or by incomplete fertility limitation prior to widowhood. This pattern highlights the importance of marital trajectories in conditioning the fertility-reducing effects of education.

Socioeconomic stratification further complicated the relationship between education and fertility. The interaction between wealth and education indicated that high fertility persisted among women who combined economic advantage with educational attainment. Specifically, women with secondary education who belonged to wealthier households were more likely to experience high fertility ($OR = 3.37, p = 0.004$), as were women with higher education in the wealthiest strata ($OR = 1.88, p = 0.018$). These findings suggest that, beyond economic necessity, fertility decisions among affluent and educated women may be influenced by cultural norms, lineage considerations, or social expectations rather than material constraints.

Taken together, the interaction effects demonstrate that education and wealth do not operate uniformly or synergistically to reduce

fertility. While each factor independently exhibits a fertility-limiting association, their combined effects are highly context-dependent and, in certain social configurations, may even counteract one another. These results reinforce the interpretation that Egypt's fertility transition is heterogeneous and uneven, with segments of the population, particularly those embedded in specific marital and socioeconomic contexts, exhibiting resistance to conventional pathways of demographic change.

Table 5 Multilevel Logistic Regression Results for High Fertility with Interaction Effects

Predictor	**Odds Ratio (OR)**	**Std. Error**	**95% Confidence Interval**
Main Effects			
Older reproductive age	7.55	1.91	4.60 – 12.39
Marital status (Widowed)	0.35	0.16	0.14 – 0.84
Marital status (Divorced)	0.01	0.01	0.00 – 0.04
Marital status (Separated / not cohabiting)	0.35	0.33	0.06 – 2.19
Exposure to family planning messages	1.07	0.09	0.90 – 1.26
Education (Primary)	0.36	0.15	0.16 – 0.81
Education (Secondary)	0.16	0.05	0.08 – 0.31
Education (Higher)	0.02	0.01	0.01 – 0.05
Residence (Rural)	1.35	0.28	0.90 – 2.04
Wealth (Poorer)	0.31	0.09	0.18 – 0.54
Wealth (Middle)	0.72	0.28	0.33 – 1.54
Wealth (Richer)	0.23	0.09	0.11 – 0.51
Wealth (Richest)	0.44	0.29	0.12 – 1.58
Religion (Christian)	0.35	0.08	0.23 – 0.54
Religion (Other)	7.56	22.53	0.02 – 2598.60
Employment (Seasonal)	0.49	0.08	0.36 – 0.67
Employment (Occasional)	1.58	0.49	0.86 – 2.90
Interaction Effects: Age × Education			
Older age × Primary education	0.88	0.35	0.41 – 1.91
Older age × Secondary education	1.62	0.46	0.92 – 2.83
Older age × Higher education	3.04	0.88	1.72 – 5.37
Interaction Effects: Marital Status × Education			
Widowed × Primary education	13.16	13.13	1.86 – 93.02
Widowed × Secondary education	2.24	1.23	0.76 – 6.55
Widowed × Higher education	2.16	1.37	0.63 – 7.46
Divorced × Primary education	22.64	20.24	3.93 – 130.51
Divorced × Secondary education	5.60	4.29	1.25 – 25.14
Divorced × Higher education	1.34	1.18	0.24 – 7.59
Separated × Primary education	6.40	8.37	0.49 – 83.05
Separated × Secondary education	0.25	0.29	0.03 – 2.41
Separated × Higher education	2.58	3.12	0.24 – 27.64
Interaction Effects: Wealth × Education			
Poorer × Primary education	0.73	0.37	0.27 – 1.98
Poorer × Secondary education	3.28	1.31	1.49 – 7.19
Poorer × Higher education	2.93	1.76	0.90 – 9.52
Middle × Primary education	0.83	0.50	0.25 – 2.72
Middle × Secondary education	0.66	0.30	0.27 – 1.62
Middle × Higher education	4.85	2.97	1.46 – 16.10
Richer × Primary education	0.76	0.44	0.25 – 2.34
Richer × Secondary education	1.62	0.70	0.69 – 3.79

Richer × Higher education	5.38	3.16	1.70 – 17.00
Richest × Primary education	0.61	0.53	0.11 – 3.36
Richest × Secondary education	0.66	0.44	0.18 – 2.46
Richest × Higher education	1.88	1.46	0.41 – 8.60
Constant	15.54	5.05	8.22 – 29.40

5.6 Interaction Effects of Education, Wealth, and Age on Modern Contraceptive Use

The inclusion of interaction terms in the multilevel model substantially enhanced its explanatory capacity, indicating that contraceptive behaviour in Egypt is shaped by conditional and intersecting influences rather than additive effects alone. As reported in Table 6, overall model fit improved markedly following the introduction of interaction effects ($LR\ \chi^2 = 2053.32, p < 0.001$), confirming the importance of accounting for socioeconomic and life-course heterogeneity when analysing contraceptive use.

Educational attainment remained positively associated with modern contraceptive use; however, its influence varied considerably across age groups. Among women in later reproductive stages, higher education was linked to a significantly increased likelihood of contraceptive use ($OR = 1.79, p = 0.007$). This pattern indicates that education enhances the ability for sustained reproductive planning at stages in the life course when fertility intentions are largely established and the focus shifts towards fertility limitation rather than postponement.

Household wealth emerged as a critical moderator of educational effects. The strongest associations were observed among women who combined higher education with placement in the richest wealth category ($OR = 12.42, p < 0.001$), followed by those with secondary education in the richer wealth stratum ($OR = 3.54, p = 0.003$). These findings indicate that material resources amplify the practical benefits of education by facilitating access to reliable contraceptive services and enabling consistent methods to use.

At the same time, the interaction patterns revealed important limits to economic advantage in the absence of educational empowerment. Wealthier women with lower levels of education did not exhibit comparable increases in contraceptive uptake, underscoring that financial capacity alone does not substitute for knowledge, health literacy, or informed decision-making. This divergence highlights the distinction between economic privilege and effective reproductive agency.

Collectively, the interaction effects demonstrate that modern contraceptive use in Egypt reflects the convergence of education, wealth, and reproductive stage. Interventions that focus narrowly on service provision or economic access, without parallel investment in women's education, are therefore likely to produce uneven outcomes. These results support an integrated family-planning strategy that simultaneously strengthens educational attainment and economic empowerment to achieve more equitable and sustained contraceptive use.

Table 6 . Multilevel Logistic Regression Results for Modern Contraceptive Use with Interaction Effects

Predictor	Odds Ratio (OR)	Std. Error	95% Confidence Interval
Main Effects			
Older reproductive age	0.51	0.09	0.36 – 0.72
Exposure to family planning messages	1.06	0.08	0.92 – 1.22
Education (Primary)	1.71	0.56	0.90 – 3.25
Education (Secondary)	0.81	0.21	0.50 – 1.34
Education (Higher)	0.19	0.09	0.08 – 0.48
Residence (Rural)	1.83	0.37	1.23 – 2.72
Wealth (Poorer)	0.76	0.14	0.53 – 1.10
Wealth (Middle)	0.60	0.16	0.36 – 1.00
Wealth (Richer)	1.81	0.54	1.01 – 3.26
Wealth (Richest)	0.68	0.26	0.32 – 1.44
Employment (Seasonal)	1.04	0.13	0.82 – 1.33
Employment (Occasional)	1.32	0.31	0.83 – 2.09
Interaction Effects: Education × Age			
Primary × Older reproductive age	1.14	0.36	0.61 – 2.13
Secondary × Older reproductive age	1.59	0.34	1.05 – 2.42
Higher × Older reproductive age	1.79	0.39	1.17 – 2.75
Interaction Effects: Education × Wealth			
Primary × Poorer	0.51	0.20	0.24 – 1.08
Primary × Middle	1.08	0.47	0.46 – 2.55
Primary × Richer	0.29	0.13	0.12 – 0.72
Primary × Richest	0.12	0.08	0.03 – 0.45
Secondary × Poorer	1.78	0.50	1.02 – 3.10
Secondary × Middle	1.57	0.50	0.84 – 2.92
Secondary × Richer	0.84	0.28	0.44 – 1.61
Secondary × Richest	2.54	1.01	1.17 – 5.52
Higher × Poorer	5.90	3.00	2.18 – 15.97
Higher × Middle	6.27	3.23	2.28 – 17.20
Higher × Richer	2.67	1.36	0.98 – 7.27
Higher × Richest	12.42	6.90	4.18 – 36.90
Constant	2.29	0.60	1.37 – 3.81

In short, the models of interaction indicate that the relations between education, wealth, and reproductive results are highly conditional. The synergistic effect is evident in terms of modern contraceptive use where the highest odds are found when high education is coupled with the highest wealth ($OR = 12.42$), which indicates that economic resources enhance the benefit of education. On the other hand, to be high fertile, the interaction is more complicated. Although education and wealth have a negative effect on fertility, their interaction in some subgroups (e.g. secondary-educated women in wealthier households) positively affects the fertility odds, which makes linear socioeconomic models hard to estimate. Such findings highlight the importance of emphasizing that it is not just a matter of individual factors adding up to produce reproductive behavior but rather that it is a matter of configuration of the individual factors in overlapping social positions.

6 Discussion

The findings of this study demonstrate that reproductive behaviour among Egyptian women is shaped by a layered and conditional interplay between education, socioeconomic position, demographic characteristics, and contextual influences. Consistent with demographic transition theory, higher educational attainment was associated with lower fertility and increased use of modern contraception. However, the multilevel evidence presented here indicates that these relationships are neither linear nor uniform across social strata or life-course stages. Instead, education operates as both a direct and indirect determinant of reproductive outcomes, interacting with age, wealth, marital trajectories, and community context.

The inverse association between higher education and fertility, alongside the positive association between education and contraceptive use, aligns with prior evidence suggesting that education enhances reproductive awareness, delays marriage, and strengthens informed decision-making (Ali & Gurmu, 2018). The present analysis extends this literature by demonstrating that secondary and higher education substantially increase the likelihood of modern contraceptive use while sharply reducing the odds of high fertility. At the same time, interaction effects reveal that educational benefits are realised differently across the reproductive life course. The significant education–age interactions suggest that fertility control among educated women is most pronounced at later reproductive stages, supporting interpretations of education as a mechanism for cumulative fertility regulation rather than immediate fertility reduction.

These findings also resonate with arguments that education does not necessarily lead to uniformly delayed or reduced childbearing. As noted by (Zalak & Goujon, 2017), highly educated women may experience compressed fertility schedules, particularly in contexts where career opportunities are limited and social expectations around childbearing remain strong. In the Egyptian context, this pattern may reflect a strategic reconciliation of educational attainment with prevailing gender norms, whereby fertility is concentrated earlier to accommodate constrained labour-market participation. The interaction between education, age, and fertility outcomes underscores the importance of viewing education not as an isolated factor, but as one whose reproductive effects are contingent on broader institutional and normative environments.

Socioeconomic stratification further complicates the relationship between education and reproductive behaviour. The interaction results indicate that women with both high educational attainment and substantial economic resources were most likely to use modern contraceptive methods, suggesting that wealth amplifies the practical capacity to translate knowledge into sustained contraceptive use. This finding is consistent with evidence of service-quality disparities and provider bias that disproportionately constrain access for younger and less educated women (Aziz & El-Gazzar, 2023). However, the observed persistence and in some cases increase of fertility among well-educated and wealthy women challenge assumptions of homogeneous fertility restraint among socioeconomically advantaged groups. This pattern may reflect forms of “prestige fertility,” in which larger family sizes serve symbolic, cultural, or lineage-related functions rather than responding to economic necessity.

The conclusion that increased socioeconomic status does not always or in some forms correlate with reduced fertility, and may

instead be linked in some form or other with enduring or increased fertility, destabilizes the basic assumptions of demographic transition theory and demand economics. This trend indicates that in such a situation as Egypt, where the shift has been frozen, the symbolic and social status of children might develop in nonlinearity. Children can be not a material possession but a sort of social capital, and the perpetuation of the lineage, the satisfaction of religious requirements, or the strengthening of marriage ties in a stable patriarchal system in the eyes of educated and wealthy women. This bears out the recent criticisms of the so-called hypothesis of wealth-flow where it is argued that, in transitional contexts, the decoupling and even reversal of the relationship between resources and fertility takes place as new forms of status competition are introduced. As a result, there can be less constraint in material calculation involved in fertility decisions and more aspect of identity, cultural preservation, and negotiation in the kinship networks of this group. This subtly makes a reassessment of policy models which suppose a negative, simple elasticity between income and fertility. It also shows that to a group of the population, fertility decay might need a change of more profound cultural schemas of family, success, and gender, which cannot be caused by socioeconomic progress on its own.

The heterogeneity observed across socioeconomic and geographic contexts highlights the uneven nature of Egypt's fertility transition. Rising fertility in the post-2010 period has been linked to weaknesses in population-policy governance and unequal service delivery (Ahmed et al., 2022). Despite improvements in contraceptive availability, access to quality education, employment opportunities, and reproductive health services remains spatially stratified.

Regional patterns provide further insight into this complexity. Rural residence was associated with a modestly higher likelihood of high fertility, yet simultaneously with increased contraceptive use. This apparent paradox suggests that while family-planning programmes have achieved considerable penetration in rural areas, cultural norms favouring larger families continue to shape reproductive preferences. As argued by (Kundu et al., 2022), empowerment translates into contraceptive adoption only when supported by social endorsement and stable economic conditions. The significant random intercepts observed in the multilevel models reinforce the conclusion that individual-level determinants alone are insufficient to explain reproductive behaviour, and that service accessibility, provider attitudes, and regionally differentiated policy implementation remain influential (Ersado & Gignoux, 2017).

Marital trajectories further condition fertility outcomes in ways that reflect adaptive social responses. The elevated fertility observed among widowed women with primary education may signal post-marital replacement behaviour or incomplete fertility limitation prior to widowhood. In contrast, the substantially lower fertility among divorced women suggests that marital instability disrupts reproductive accumulation in patriarchal settings. These patterns support the argument advanced by (Ali & Gurmu, 2018) that fertility decline in Egypt is driven primarily by delayed or interrupted childbearing rather than by universal and consistent contraceptive adoption.

From a policy perspective, the findings underscore the necessity of integrated approaches to reproductive health and population policy. Expanding female education alone is insufficient unless accompanied by meaningful labour-market opportunities that allow educational gains to

translate into independent agency. As noted by the International Labour Organisation (2021), women's labour-force participation in Egypt remains below 20%, limiting the demographic returns to educational progress. Policies that support delayed marriage and sustained labour-market engagement may therefore be critical for converting educational attainment into durable fertility decline.

In parallel, family-planning programmes must move beyond a narrow focus on coverage toward improving quality and inclusivity. Addressing provider bias, ensuring equitable distribution of contraceptive methods, and strengthening monitoring systems are essential for closing the gap between awareness and sustained use, as emphasised by UNFPA Egypt (2021). Finally, strategies that promote male involvement, peer learning, and community dialogue are vital for shifting normative environments that resist fertility control. Evidence from UNICEF (2022) demonstrates that locally grounded reproductive-health interventions can alter norms and increase uptake when aligned with community values.

Taken together, the strong interactions between education, wealth, and contextual factors highlight the limitations of individualistic, supply-side approaches to fertility regulation. Sustainable progress in Egypt's demographic transition requires policies that simultaneously address educational empowerment, economic opportunity, and community-level inequalities. Without confronting these structural dimensions, gains in contraceptive availability are unlikely to translate into equitable and lasting fertility decline.

Moreover, it is clear that the consistent impact of community-level variables, as shown by the large random intercepts, is how limited the policies that focus on individuals without changing the environments, in which they live, are. This observation can be supported by socio-ecological theories of health behavior, which hold that the freedom of agency of individuals is constrained by local customs, institutional activities, and geographical disparities (Krafft, 2020). These contextual forces might be regionally entrenched patriarchal norms, which prefer sons, social networks which hinder the use of modern contraception by spreading misinformation, local healthcare systems where the supply chain is erratic and provider attitudes, variable. This tension is typified by the paradox of high use of contraceptives and the lack of fertility growth in the rural regions; while the means of obtaining methods is easy through the decentralized programs, the means to use them are mediated through the context in which high birth rate is still considered a socially and economically desirable condition.

This implies that combining both approaches is necessary to meet demographic targets, which is, on the one hand, empowering individual women by educating them and providing them with economic prospects, and, on the other hand, having a discussion on the matter of the perfect family size and reproductive time that is conducted on a global scale. This strategy goes beyond the proximate determinants model to discuss the distal, structural factors of fertility behavior. The interventions of the future should thus be spatially and socially subtle and should be aware of the fact that what works in urban Lower Egypt may not work in rural Upper Egypt not necessarily because people there lack the relevant knowledge, but because of a completely different structure of social rewards, economic hazard and normative demands on reproduction.

6.1 Analytical Contributions and Limitations

A central strength of this study lies in its application of a multilevel analytical framework,

which enables explicit differentiation between individual-level determinants and contextual influences on reproductive behaviour. By modelling women as nested within communities, the analysis captures both within- and between-cluster variation, allowing for a more accurate assessment of how education, wealth, and marital status operate alongside shared social norms and service environments. This approach moves beyond conventional single-level models and provides a statistically robust basis for examining reproductive inequality.

The incorporation of interaction terms represents an additional methodological strength. By explicitly testing moderation effects, the analysis reveals conditional relationships that would remain obscured under additive specifications. In particular, the identification of age- and wealth-dependent variations in the effects of education on fertility and contraceptive use underscores the value of modelling heterogeneity within demographic processes rather than assuming uniform responses across population subgroups.

The use of a large, nationally representative dataset further enhances the study's external validity. Drawing on the 2014 Egypt Demographic and Health Survey, with a weighted sample of 9,722 ever-married women aged 15–49 years, allows the findings to be generalised to the national population within this demographic group. The standardised design and rigorous data-collection protocols of the DHS also strengthen confidence in the reliability and comparability of the measures employed.

Despite these strengths, several limitations merit careful consideration. First, the cross-sectional nature of the data precludes causal inference and limits the ability to establish temporal ordering between women's empowerment, contraceptive behaviour, and fertility outcomes. As a result, observed associations should be interpreted as correlational rather than causal, particularly with respect to the directionality between education, agency, and reproductive decision-making.

Second, measures of women's empowerment primarily relied on household decision-making indicators, which may not fully capture broader dimensions of autonomy such as economic independence, labour-market involvement, or spatial mobility. These unobserved aspects of empowerment could influence fertility and contraceptive behaviour through pathways not directly measured in the survey. Third, although the multilevel models accounted for unobserved community-level heterogeneity, certain contextual factors, such as physical accessibility of health facilities, contraceptive stock-outs, provider attitudes, and service quality, were not explicitly measured. The omission of these variables may contribute to residual cluster-level variance, a limitation also highlighted in previous work emphasising the need to consider demand- and supply-side dynamics jointly in fertility analysis (Krafft, 2020).

Future research would benefit from methodological extensions that address these constraints. Longitudinal designs are particularly important for disentangling life-course dynamics and assessing how changes in education, employment, and marital status shape reproductive trajectories over time. Integrating DHS microdata with health-facility assessments and geospatial indicators could further illuminate the role of infrastructure, governance, and service distribution in shaping reproductive outcomes.

Qualitative and mixed-method approaches are also essential for deepening understanding of the normative and experiential dimensions of fertility behaviour. In-depth qualitative studies focusing on

younger cohorts and rural populations could provide insight into how gender norms, economic insecurity, and uncertainty influence fertility ideals and contraceptive decision-making. As emphasised by (Abdel-Tawab et al., 2020), the reproductive choices of younger generations in Egypt are evolving within the context of prolonged economic stress, making this group particularly important for future demographic analysis. Finally, extending the analytical framework to incorporate male perspectives and provider-level experiences would offer a more comprehensive account of reproductive decision-making processes during Egypt's ongoing and uneven demographic transition.

7 Conclusions and Policy Implications

This study demonstrates that Egypt's fertility transition is neither uniform nor driven solely by individual-level characteristics. Instead, fertility and contraceptive behaviour are shaped by a dynamic interaction between women's education, economic positioning, decision-making capacity, and structurally embedded social conditions. Although higher educational attainment is consistently associated with lower fertility and greater use of modern contraception, the findings indicate that education alone is insufficient to sustain fertility decline in the absence of enabling economic and institutional environments.

The multilevel analysis highlights persistent variations at the community level, emphasising that reproductive behaviour is shaped not only by household characteristics but also by wider societal and service-related factors. These contextual influences determine how effectively education leads to fertility control. Therefore, education acts as a necessary but partial factor: its demographic benefits are most fully realised when women have economic independence and institutional support, enabling them to act upon reproductive knowledge.

This interpretation aligns with evidence that educational advancement must be accompanied by labour-market participation to generate substantive empowerment. As noted by (Abdeen, 2021), education disconnected from economic opportunity limits women's autonomy and weakens the translation of human capital into reproductive agency. Similarly, disparities in service quality and provider practices further constrain the effectiveness of family-planning programs. Evidence indicates that uneven counselling standards, supply continuity, and method availability disproportionately disadvantage younger and less-educated women, thereby reinforcing reproductive inequality (Elsayed & Zembe-Mkabile, 2024).

Taken together, these findings imply that fertility decline in Egypt cannot be stabilised through educational expansion or contraceptive availability alone. Structural empowerment encompassing equitable employment opportunities, high-quality and unbiased service provision, and effective governance is essential for converting reproductive awareness into sustained behavioural change. Without such integration, fertility-reduction efforts are likely to remain uneven across socio-economic groups and be vulnerable to reversal.

8 Recommendations

Based on the empirical findings, several recommendations can be proposed to support more equitable and sustainable fertility outcomes in Egypt.

First, fertility-related interventions should be embedded within integrated development strategies that link education, employment, and reproductive health. Expanding female education without parallel investment in women's economic

participation is unlikely to translate into sustained fertility control. Policies that promote women's access to stable employment, vocational training, and income-generating opportunities can strengthen autonomy and enhance the capacity to act upon reproductive preferences.

Second, family-planning systems should prioritise equity in access, continuity of care, and informed choice. Service delivery must move beyond coverage targets to address disparities in counselling quality, method availability, and continuity of supply, particularly in rural and socioeconomically disadvantaged settings. Decentralised service provision, mobile outreach, and context-sensitive delivery models can help reduce logistical and informational barriers that limit effective contraceptive use.

Third, interventions should explicitly address the social and normative dimensions of reproductive behaviour. Engaging men, community leaders, and peer networks in dialogue-oriented initiatives can foster social endorsement of fertility regulation and support shared decision-making within households.

Finally, monitoring and evaluation frameworks should incorporate indicators that capture service quality, method continuity, and user experience, rather than relying solely on utilisation rates. Strengthening accountability and feedback mechanisms at local and district levels can ensure that reproductive health programmes contribute to meaningful reproductive autonomy and more balanced demographic outcomes.

In order to transform these general suggestions into action, special, situation-specific initiatives are required. To start with, economic empowerment programs must also be directly connected with the results in the field of reproductive health. As an illustration, microfinance programs or vocational training programs targeting women may include reproductive health education, family budgeting and negotiating with others modules. Second, the quality of the service can be improved by shifting the focus of the trainers to the issue of implicit bias rather than offering training on technical skills. It is important to have standardized protocols of rights based counseling where all women, irrespective of their age, parity, or even education levels, are informed thoroughly of all the method options.

One way to counteract the discontinuation is to invest in supply chain resilience, such as digital inventory management systems in the main health units, to address stock-outs causing discontinuation. Third, social and behavior change communication (SBCC) campaigns need to be co-designed with community members in order to change normative environments. These campaigns might use figures of esteem in the area, such as religious leaders and male elders, to promote the messages on the health and economic importance of spacing births and the importance of girls in schools. Lastly, it is possible to enhance local health service governance through having community accountability committees giving persistent feedback to keep the services tuned and equal.

9 Directions for Future Research

Future research should build on the present findings by adopting longitudinal study designs that allow for tracking fertility intentions, contraceptive behaviour, and reproductive outcomes over time. Longitudinal data would enable clearer identification of causal pathways linking education, employment trajectories, marital transitions, and fertility dynamics across different life-course stages.

Further investigations should integrate population-based survey data with health-facility assessments and geospatial indicators. Such

integration would help explain the residual community-level variation observed in multilevel analyses by capturing differences in service accessibility, quality of care, infrastructural capacity, and local governance.

Qualitative and mixed-method studies focusing on younger cohorts and rural populations are also essential to explore how gender norms, economic uncertainty, and shifting aspirations influence fertility ideals and contraceptive decision-making.

Finally, future analytical frameworks should incorporate male perspectives and provider-level experiences to better capture the relational and institutional dimensions of reproductive decision-making. Expanding the scope of research to include household negotiation dynamics and service-provider practices would offer deeper insight into the mechanisms sustaining fertility inequalities and inform more effective, context-sensitive population policies.

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