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**National Innovative Research Center, Kathmandu-32, Nepal**

## **Reproductive Timing, Education, and Fertility Outcomes: Evidence from the Danuwar Community in Nepal**

<sup>1</sup>**Bijaya Mani Devkota**

<sup>2</sup>**Pradeep Kumar Bohara**

<sup>1</sup>Central Department of Population Studies (CDPS),  
Tribhuvan University, Kathmandu, Nepal.

<sup>2</sup>Sanothimi Campus Bhaktapur, TU, Nepal.

<sup>1</sup>**Email:** [devkotabm2006@gmail.com](mailto:devkotabm2006@gmail.com). <sup>2</sup>**Email:** [pradeep.bohara@sac.tu.edu.np](mailto:pradeep.bohara@sac.tu.edu.np)

<sup>1</sup>**ORCID:** <https://orcid.org/0009-0005-1533-2678>

<sup>2</sup>**ORCID:** <https://orcid.org/0009-0009-9700-270X>

### **Abstract**

*Nepal has practiced a high fertility rate drop and marginalized and indigenous groups are more fertile and reproduce earlier interaction of reproductive timing and socio-economic elements. The Fertility was measured by cross-sectional survey in terms of a quantitative survey of the 289 Women of Danuwar in Lalitpur District (Mean fertility) in terms of Fertility Knowledge (FK), and Children Ever Born (CEB) as a measure of the Total fertility rate (TFR), descriptive statistics, ANOVA, multiple linear regression to determine the effects of education, employment, child mortality experience, singulate mean age at marriage (SMAM) and timing of childbearing. TFR was estimated and the socio-demographic variation was large and was 2.41. The factors associated with increased fertility included low education, not part of the working population, lost children, married young and the birth spacing was low. The regression equation was also significant ( $R^2 = 0.153$ ;  $p < 0.01$ ). The reproduction behavior, education, child survival, and economic participation determine fertility of Danuwar women as a transitory period. The absence of equitable improvement of fertility and better reproduction health among the marginalized groups in Nepal requires late marriage, increased female involvement in the labor force, better education and better child-survival programs.*

**Keywords:** *Fertility transition; Reproductive timing; Education; Child mortality; Indigenous communities; Nepal*

### Introduction

Nepal's demographic transition is characterized by fertility decline, but geographical location, socio-economic, and social group patterns have shown uneven development. The national statistics indicate that the overall fertility declined over the past several decades, although aggregate numbers may ignore chronic areas of greater fertility and earlier reproduction within the marginalized populations. Both international and domestic statistics sources have been reporting the decreasing fertility trend in Nepal recently and note the relevance of inequality sensitive readings to policy and programme design (World Bank, 2023; United Nations, Department of Economic and Social Affairs [UN DESA], 2024). The data on demographic reporting in Nepal also show that fertility, marriage age and reproductive behaviour are again patterned by education, wealth, and social disadvantage, which supports the importance of community-based study that can capture heterogeneity that is not reflected by national statistics (Ministry of Health, Nepal et al., 2017; NSO, 2023). One reason fertility remains elevated in disadvantaged environments is the timing of reproduction, in particular, early marriage and early childbearing. Impregnation at a young age will increase exposure to the risk of pregnancy and may hasten lifetime fertility by creating a high-density birth cohort. Child marriage, adolescent pregnancy are also the two issues that Nepal is still struggling with closely associated with reducing out of school, lack of autonomy, and limited economic opportunities (Sekine et al., 2017; World Health Organization [WHO], 2024). Nationally and institutionally, it is highlighted that early marriage is supported in some communities through social norms, gender disparity, and poor enforcement of legal provisions, and it has repercussions on female education and reproductive outcomes (UNICEF, 2024; UNICEF, 2025). The DHS-based studies also provide evidence that the low rates of decline in fertility among adolescents are connected to the continuing trends towards early marriage, which can support the importance of marriage timing in determining fertility in Nepal (The DHS Program, 2023).

Education has been well-known as being one of the most predictable determinants of reduced fertility by virtue of postponing marriage, raising reproductive health knowledge, and rebalancing aspirations and opportunity structures. Nevertheless, access and completion of education is disproportionate, especially in the case of indigenous populations and socially marginalized populations. Meanwhile, survival conditions influence fertility behavior of persons that have experienced child loss may be affected by child loss via replacement and insurance reactions. The demographic writing of Nepal is still characterized by intersection of fertility and maternal and child health risks and inequality in survival particularly among the population facing the barriers to service and socio-economic opportunity (MoHP, 2017; WHO, 2024).

Although a growing body of national study exists on fertility and its correlates, there is nonetheless definite gap in study: empirical study rarely addresses the dynamics of indigenous, community-specific fertility considering reproductive timing and education specifically in one marginalized group. The Danuwar are a native people whose evidence in the literature is still scanty, but in general, this is focused

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more on general social-economic conditions as opposed to models that can be used to analyze the timing, educational attainment, and fertility performance. Current literature reveals that women of experience interrelated socio-demographic and economic restrictions in reproductive health issues, which imply that fertility analysis will warrant attention to the targeted group (Devkota & Bohara, 2025). Prior study also identifies educational deficiency and service-related obstacles by women, yet fails to directly test how these limiting factors lead to fertility differentiation (Karki, 2007). Furthermore, the national-level fertility study in Nepal is usually based on the large surveys and might fail to take into consideration the community-specific marriage, spacing, and survival experiences (Sharma, 2015; Government of Nepal, 2024).

Based on this gap, this study aims at analyzing how reproductive timing (marriage timing and childbearing), education, employment, and child mortality experience are related to fertility outcome among women. This study uses community-level data as a context to present context-specific evidence to guide equity-based interventions to reduce reproductive health and social development based on Nepal population demographic and social inclusion priorities (Government of Nepal, 2024; UN DESA, 2025).

### **Methodology**

**Design and data source:** The design of the study is a quantitative cross-sectional study design to investigate fertility patterns and the determinants of fertility among the Danuwar community living in Lalitpur District, Nepal. The data analysis is done using a community-based primary survey data containing 289 women (early 2025), which is the entire analytical sample. The data set has standardized data on fertility behavior, education level, employment level, child mortality, marrying age and time of child bearing and then it is possible to conduct a systematic study of fertility differentials among this indigenous population.

**Outcome variable:** TFR is the main outcome variable and it is operationalized on the CEB and converted into a similar fertility index. TFR is a cumulative index of reproductive success and is commonly employed in demographic studies to give a summary of fertility behavior. This is a measure which is especially appropriate to test within-community fertility differences and establish socio-demographic differentials.

**Explanatory variables:** Explanatory variables were identified using the known demographic theories and already existing empirical data. The education of women reflects the socio-economic status and empowerment, which are closely related to the fertility decision-making. Economic participation and opportunity costs of childbearing is associated with employment status. Child mortality experience reflects on the conditions of survival and possible replacement fertility behavior. Age at marriage, SMAM is a measure of exposure to transition to a marital union and reproductive risk, and childbearing timing/spacing is the tempo dimension of fertility during the reproductive life course.

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TFR is a "period" measure (births in a specific year), while CEB is a "cumulative/cohort" measure (total births over a lifetime). Calculating a TFR from a small cross-sectional sample of CEB data requires specific demographic techniques (like the Brass P/F ratio). If the authors simply averaged the number of children, they are reporting Mean CEB, not TFR. This distinction is vital for demographic accuracy

**Statistical analysis:** The background characteristics of the study population were summed up with the help of the statistical analysis. The one-way Analysis of Variance (ANOVA) was used to determine the difference among the mean TFR among groups of important socio-demographic factors. Later, the multiple linear regression analysis was carried out to determine the independent values of education, employment, child mortality experience, age at marriage, and childbearing timing on fertility outcomes. ANOVA F-tests and basic diagnostic tests were used to determine model adequacy. The statistical results were complemented fitted regression lines.

**Mathematical Model:** In the equation: In the regression equation,  $CBT_i$  (Childbearing Timing) represents age at first birth measured in completed years and was treated as a continuous variable.

$$TFR_i = \beta_0 + \beta_1 EDU_i + \beta_2 EMP_i + \beta_3 CM_i + \beta_4 SMAM_i + \beta_5 CBT_i + \epsilon_i$$

**Ethical concerns:** The study was conducted according to the set of the ethical considerations accepted by the corresponding academic organizations. All the respondents consented to the study as it was explained to them, and the confidentiality of every individual respondent was guaranteed.

## Results

Table 1 shows the average count of children borne was 2.41 (SD = 1.62), and the reported fertility was 0-8 births, which showed a significant difference in the reproductive performance. The average age at which people married was 20.9 years (SD 3.4) and SMAM was a little higher as 21.6 years (SD 1.5) expressing the early and near-universal marriage trends in the community.

The childbearing timing or spacing had a mean difference of 4.6 years (SD = 2.1), which indicated moderate age differences between reproductive events. The general educational attainment was low: 60.9 percent of women had lower education and the average years of schooling was 5.6 (SD=1.4). The female participation in the labor force was low with only less than half of the respondents (45.7%) being currently employed.

Child mortality experience was still statistically significant. About 22.1 percent of women said they had actually lost a child and 20.1 percent had a dead child, which highlights the ongoing difficulty in survival. The average child mortality rate was 5.8 (SD = 2.1). The socio-economic status was average, with the mean monthly household income amounting to NPR 24,300 (SD = 18,700), which is equal to NPR 2.43 hundred thousand (SD = 1.87).

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Table 1.  
*Background characteristics of the study population (N = 289)*

Variable	Category / Measure	n (%) or Mean $\pm$ SD
Fertility outcome	Total births (Children Ever Born)	2.41 $\pm$ 1.62
	Range	0–8
Age at marriage	Mean age at marriage (years)	20.9 $\pm$ 3.4
Childbearing timing	Age gap	4.6 $\pm$ 2.1
Education status	Reduced education (Yes)	176 (60.9)
	Reduced education (No)	113 (39.1)
Employment status	Currently employed	132 (45.7)
	Not employed	157 (54.3)
Child mortality experience	Ever lost a child (Yes)	64 (22.1)
	No child loss	225 (77.9)
Any dead child	Yes	58 (20.1)
	No	231 (79.9)
Household income	Monthly family income (NPR)	24,300 $\pm$ 18,700
	Income ( $\times$ 10,000 NPR)	2.43 $\pm$ 1.87
Education	Mean Years of Schooling (MYS)	5.6 $\pm$ 1.4
Marriage timing	SMAM	21.6 $\pm$ 1.5
Child mortality	Child Mortality Rate (per 1,000)	5.8 $\pm$ 2.1

The total Ordinary Least Squares (OLS) regression relation was statistically significant as presented by ANOVA values. The model described about 15.3 percent of all changes in fertility results ( $R^2 = 0.153$ ). This means only 15.3% of the variation in fertility is explained by the chosen variables (education, employment, etc.). While common in social science, it suggests that 84.7% of the variation is caused by factors *not* in the model—such as contraceptive use, son preference, or cultural rituals which should be acknowledged as a limitation. The F-test ( $F(7, 140) = 3.63, p = 0.0013$ ) verified the joint significance of the explanatory variables, indicating that the set of socio-demographic predictors included gave a significant explanation of the variation in total fertility rate in women. These findings support the adoption of the multivariate regression model in order to determine the independent effects of education, employment, child mortality experience, timing of marriage, and timing of child bearing on fertility behavior.

Table 2 shows the findings of the ANOVA testing the variations in TFR among women in the study population ( $N = 289$ ) based on the major socio-demographic and reproductive background variables. The results show statistically significant fertility differentials in all the variables that were tested. There was a significant relationship between educational status and fertility. Women who had lower education had much higher mean TFR than those who were not reduced in education ( $F = 18.74, p < 0.001$ ), which revealed that fertility behavior had a strong educational gradient. Fertility also had a strong relation with employment status wherein women who were currently employed were reported lower fertility than their non-employed counterparts ( $F = 4.21, p = 0.041$ ).

Women who had lost any child in their lifetime were found to be very fertile as compared to those who had not lost a child ( $F = 15.32, p < 0.001$ ). Likewise,

reporting of any dead child was linked with the high fertility level ( $F = 12.48$ ,  $p = 0.001$ ) which implied that there was some evidence of replacement or insurance fertility in the community.

Fertility (CEB) is naturally higher in older women. The study must ensure that the regression model controls for the current age of the woman; otherwise, the effects of education or marriage timing might be confounded by the fact that older women simply had more "time" to bear children. There was also a notable relationship between marriage timing and fertility. Females married before the SMAM  $< 21.6$  years had much more than those who married at a later age ( $F = 9.67$ ,  $p = 0.002$ ). Moreover, childbearing timing, represented by an age-gap or spacing proxy was also significantly and positively correlated with fertility, where women below the mean spacing reported a higher TFR ( $F = 16.81$ ,  $p < 0.001$ ). ANOVA show that fertility of women differs significantly based on education level, economic engagement, child survival rates, marriage age, and child bearing rates.

Table 2:

*ANOVA of TFR by background Characteristics (N = 289)*

Background Variable	Grouping	F-statistic	p-value
Education status	Reduced education (Yes)	18.74	<0.001
	Reduced education (No)		
Employment status	Employed	4.21	0.041
	Not employed		
Child mortality experience	Ever lost a child (Yes)	15.32	<0.001
	No child loss		
Any dead child	Yes	12.48	<0.001
	No		
Marriage timing (SMAM)	< 21.6 years	9.67	0.002
	$\geq 21.6$ years		
Childbearing timing	Below mean	16.81	<0.001

Note: Each of the background variables has used one-way ANOVA. The cut-offs of continuous variables are clustered in groups, which are dependent on sample means. Figure set: background characteristics by TFR.

Figure 1 shows the average TFR in women based on their education levels among the study population. Those women who are less educated have higher mean TFR than women who are not less educated showing that there is an evident educational gradient regarding fertility levels. This is a similar pattern with the descriptive and ANOVA results and indicates that low education level relates to high fertility among the study sample.

Figure 1:  
*Mean TFR by education status*

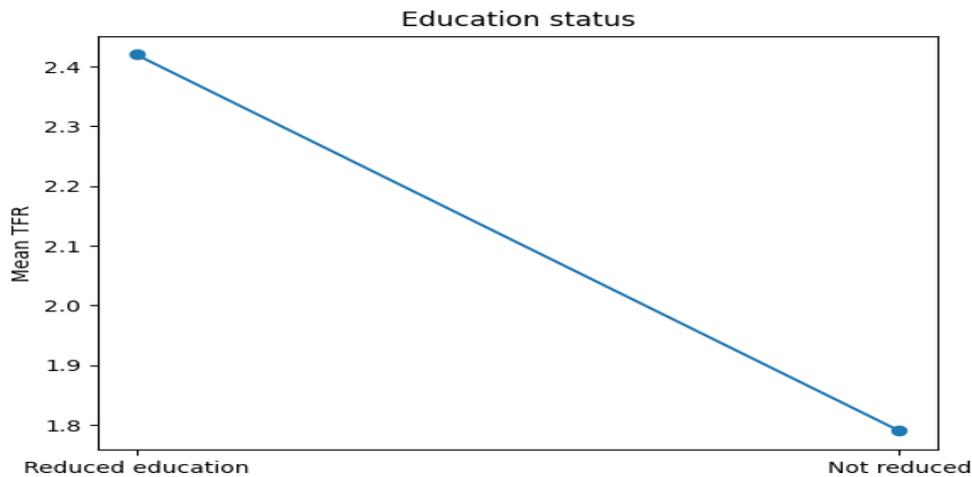


Figure 2 shows the average TFR by the employment status. The mean TFR among employed women is lower than that of non-employed women causing the opposite result, labor force participation and fertility levels are inversely related in the population under study. This trend is also congruent with the outcomes of ANOVA and it points to the importance of economic involvement in determining fertility behavior.

Figure 2.  
*Mean TFR by employment status*

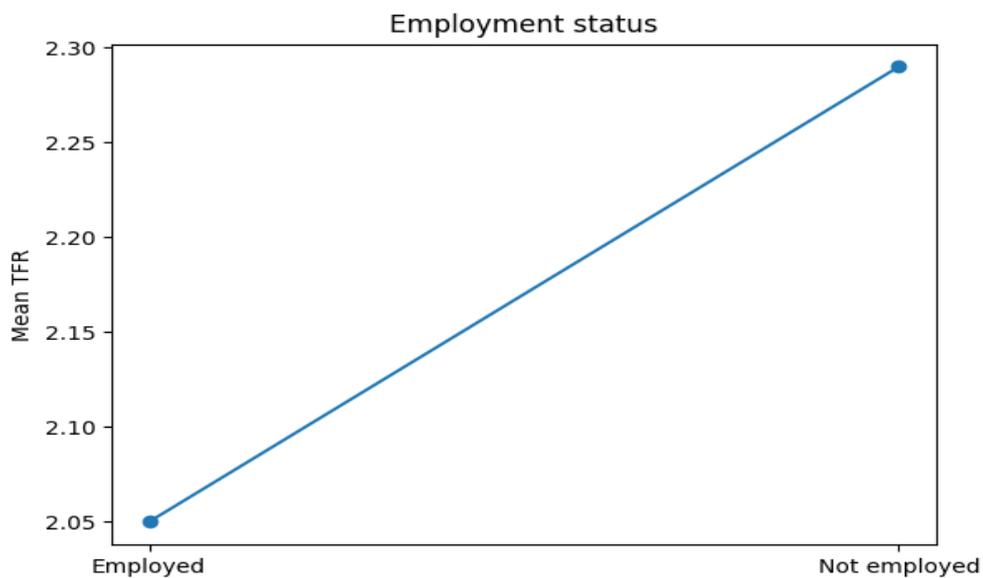


Figure 3 indicates the average TFR to child mortality experience. There is an overt fertility difference based on child survival experience with women who have lost a child having higher mean TFR than women with no child loss. The trend is aligned with the results of ANOVA and indicates the possibility of replacement or insurance fertility behavior among the population of the study.

Figure 3.  
*Mean TFR by child mortality experience*

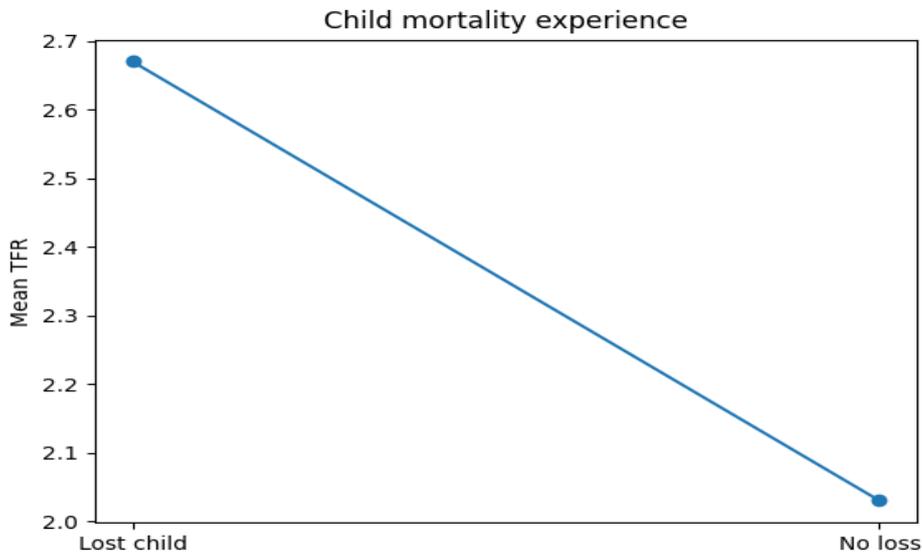


Figure 4 shows that the average TFR using experience of any dead child. Compared to women with no reported deaths of children, women who reported having any dead child have higher mean TFR. This trend is consistent with the findings of the ANOVA and also augers the fact that there was replacement or insurance fertility behavior among the study population.  
 Figure 4. Mean TFR by any dead child

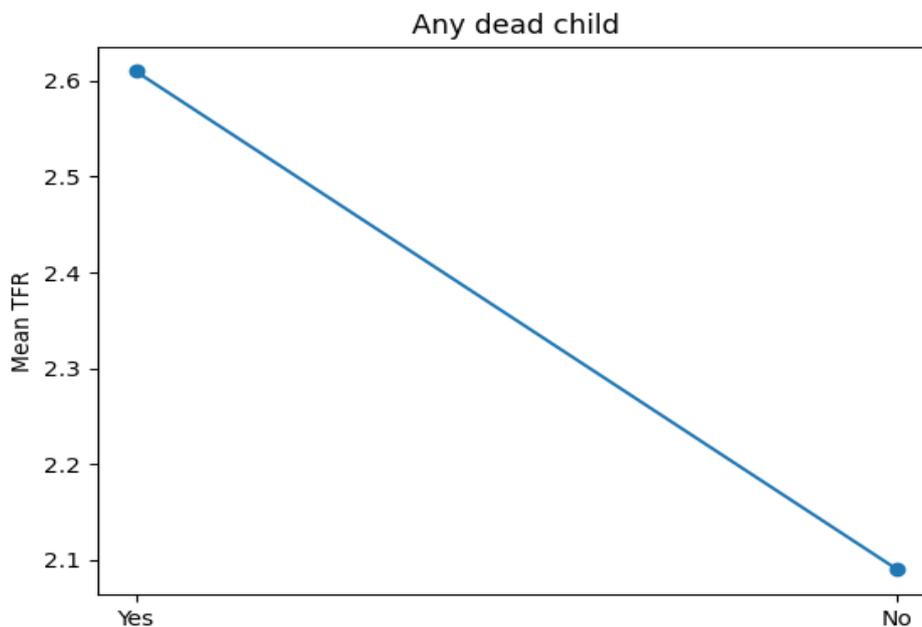


Figure 5 displays the average TFR by the age at marriage, in terms of SMAM. Women that get married before the SMAM average have greater mean TFR than those who get married later in life. Such a trend points at the correlation of previous marital exposure and cumulative fertility in the study group.

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Figure 5.  
*Mean TFR by marriage timing (SMAM)*

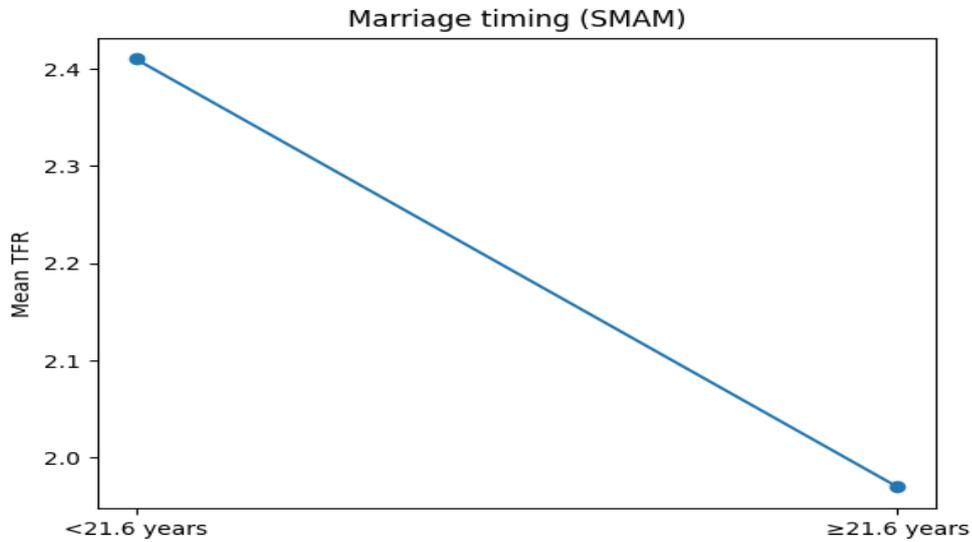
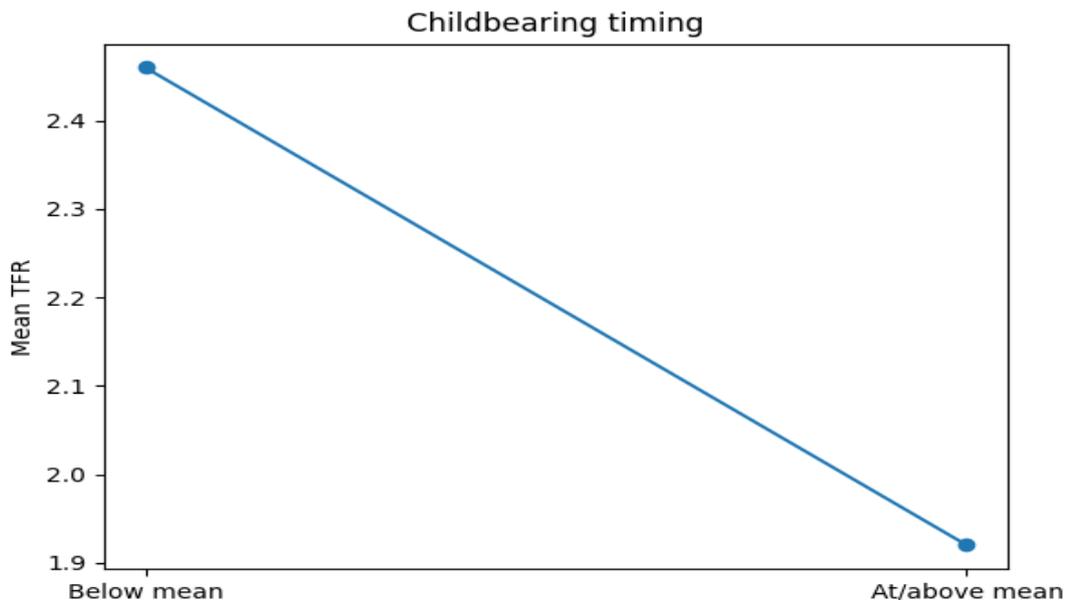


Figure 6 shows that average TFR by the age at which mothers bear children in terms of an age-gap. The women who have smaller childbearing intervals have a greater mean TFR than the ones with larger intervals. This trend implies the significance of fertility in determining cumulative reproductive returns in the study population.

Figure 6.  
*Mean TFR by childbearing timing*



Note: The figures are mean TFR of categories of chosen background characteristics. The patterns observed are in line with the outcomes of the one-way ANOVA analysis (Table 2).

### Discussion

This study gives fresh empirical findings on fertility trends and socio-demographic predictors of fertility among the women. The descriptive findings reveal moderate fertility (mean TFR = 2.41), early and close-to-universal marriage, low level of education, low female participation in the labor force significant. Population that is in a middle stage of the fertility transition, with traditional reproductive expectations overlapping new socio-economic limitations.

Education became one of the key determinants of fertility. Reduced education was associated with women having much higher fertility levels and this was found in descriptive statistics, ANOVA and graphical analysis. This is in line with the theory of demographic transition that puts much emphasis on education as a significant process where fertility reduces through delays in marriage, greater awareness around contraceptives and changed reproductive preferences (Caldwell, 1980; Bongaarts, 2003). Nepal has also reported high educational inequalities in the fertility rate, especially among the marginalized and indigenous populations (Acharya, 2010; KC et al., 2017).

Fertility was also negatively related to the employment status, with employed women also reporting lower means of the TFR. The economic fertility theories, which argue that the participation of women in the labor force increases the opportunity cost of having a child and decreases the desired family size (Becker, 1991; Bloom et al., 2009). Regarding Nepal, women, particularly the non-privileged groups, may have limited employment options, which may limit the potential to use economic participation to reduce fertility (Adhikari & Ghimire, 2015).

One of the best correlates of fertility was found to be child mortality experience. Those women who ever had a dead child or reported any dead child demonstrated a much greater fertility which is evidence of replacement or insurance fertility behavior. This connection is established in the demographic literature, especially where the child survival is still questionable (Preston, 1978; Bongaarts & Casterline, 2013). This has been seen in the context of Nepal as well as other South Asian settings where parents can raise fertility due to loss of children or perceived risks of death (Rutstein & Winter, 2014; Ghimire & Axinn, 2010).

The time of marriage and the rate of child bearing also had a big role to play. Females who married a significantly earlier than SMAM threshold and those with a shorter maternal interval had a greater cumulative fertility. The risks of reproduction are increased with early marriages, and the risks of fertility increases are also accelerated with short spacing, which supports the increased TFRs (Bongaarts, 1978; Singh et al., 2010). These data are aligned with Nepalese data that has shown the high fertility among socially disadvantaged groups in the country to be continuing to be fueled by a high number of early marriages (UNFPA, 2017; MoHP, 2022).

The multivariate OLS was found to be significant, and it accounted 15.3 percent of change in the outcome of fertility. Even though that is a small amount of explained variance, this is what can be expected of cross-sectional fertility models, which rely solely on socio-demographic variables (Bongaarts & Watkins, 1996). The

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bivariate ANOVA and the multivariate results contributes to the assurance of the strength of the identified relationships.

Findings indicate the significance of education, economic involvement of women, child survival, the timing of marriage and the rate of fertility in determining fertility behavior. The policy intervention to enhance the education of girls, marriage delay, increased women employment opportunities and enhanced child survival programs may help in the fertility decline and better reproductive health among marginalized groups of Nepal.

### **Conclusion and recommendations**

This study has explored the fertility patterns and socio-demographic predictors of fertility patterns among women with the help of cross-sectional survey data and bivariate and multivariate analysis. The results show that fertility is still moderate and heterogene in the community as it depends on the level of education, employment, child mortality, marriage timing and tempo of bearing children. Less educated women in early marriages with fewer birth intervals, less economic roles and having child loss incidents were always associated with high fertility. The statistically significant OLS model and the supporting ANOVA value and the graphical findings demonstrate that the reproductive behavior a middle phase of fertility transition, in which the traditional norms are still in existence with the influence of socio-economic factors emerging. This study highlights the significance of reproductive timing and socio-economic status of women in determining fertility among disadvantaged indigenous communities in Nepal.

Community-based interventions that enhance the education of girls and increase their age at marriage are important in shaping the reproductive preferences to avoid early exposure to childbearing. Meanwhile, women participation in the economy and child survival programs would reduce the opportunity costs of childbirth and decrease child loss replacement behaviors. The combined programs can potentially sustain long-term fertility decline and enhance reproductive health results among marginalized populations.

### **Author contributions**

Bijaya Mani Devkota and Pradeep Kumar Bohara contributed to the study's conception, data extraction, data analysis, and drafted the manuscript. The manuscript was critically revised by Bijaya Mani Devkota to ensure its quality and accuracy. Both authors agreed to submit the article in its current form.

### **Study approval**

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### **Data availability statement**

The data used in this study was duly authorized by the University Grants Commission(UGC).

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The dataset will be made available upon reasonable request through the UGC after the publication of this report.

### Conflict of interest

The authors declare no conflict of interest related to this study.

### ORCID:

Bijaya Mani Devkota, PhD

 <https://orcid.org/0009-0005-1533-2678>

Pradeep Kumar Bohara

 <https://orcid.org/0009-0009-9700-270X>

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