Levels, Patterns and Determinants of Age at First Marriage among Nepali Women: Insights from Nepal Demographic and Health Survey 2022

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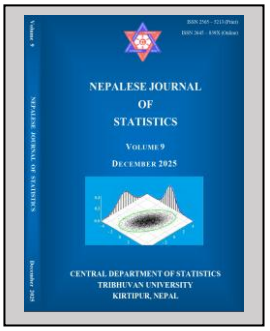

ABSTRACT

Background: Despite legislative efforts and developmental progress, early marriage persists in Nepal. This practice has adverse consequences, including poor maternal-child health, educational disruption, and reduced economic empowerment for women. However, current understanding of its spatial distribution and temporal trends is limited. A detailed assessment of its prevalence across demographic, socioeconomic, and geographical contexts is crucial for designing targeted programs to accelerate progress toward national development goals.

Objective: This study examines the levels, patterns, and determinants of age at first marriage (AFM) among Nepali women utilizing appropriate statistical methods.

Materials and Methods: This study analyzed the 2022 Nepal Demographic and Health Survey data. Univariate and bivariate analyses to identify levels and patterns, while Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA) were employed to assess determinants associated with timing of AFM.

Results: The prevalence of marriage before age 18 among Nepali women was 50.2%, exhibiting notable variation across socio-demographic, geographical, and cultural contexts. Analysis revealed key determinants: higher women education, urban residence, and Janajati ethnicity predicted later marriage (22.2, 18.2, 18.6 years). Conversely, the earliest mean ages (≤17.7 years) were observed among Dalit, Other Terai caste groups and Madhesh residents, a trend further associated with lower levels of husband's education.

Conclusion: Determinants associated with the timing of first marriage among Nepali women include; women's education level, place of residence, caste/ethnicity, husband's education, spousal age difference, and age at first menstruation. These findings can provide valuable insights for policymakers, enabling them to address critical challenges and develop targeted strategies to reduce early marriage prevalence in Nepal.

Keywords: Age at first marriage, analysis of covariance, determinants, multiple classification analysis, women.

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INTRODUCTION

Marriage is almost universal among Nepali women, typically occurring at young ages. Recent Nepal Demographic and Health Survey (NDHS) 2022 data reveal that about half (50.2%) of women were married before age 18, reflecting one of the lowest average ages at first marriage (AFM) in South Asia. Comparative regional data show Nepali women's AFM (18.5 years in 2022) lags behind neighboring countries like Bhutan (22.8 years), India (22.2 years), and Sri Lanka (23.8 years), though remains slightly higher than Bangladesh's exceptionally low 15.9 years (Zahangir & Zamilun, 2021). This early marital timing carries significant health implications, as physical immaturity elevates risks of maternal mortality, childbirth complications, and low birth weight (Azinar et al., 2022; Scott et al., 2021). Marriage before the age of 18 considered early marriage - EM (Jensen & Thornton, 2003) and remains legally prohibited in Nepal (MoLJPA, 2017). Despite this, its prevalence among Nepali women remains high. Since 1996, Nepali women's median AFM has risen just 2.1 years, rising from 16.4 to 18.5 years by 2022, indicating persistent challenges in delaying marriage. Traditional arranged marriages, prioritizing familial agreements over individual choice remain predominant with socio-cultural factors strongly influencing marital timing (Caltabiano & Castiglioni, 2008).

The AFM is one of the key factors in shaping women's reproductive behavior, as it is inversely proportional to the total number of children they will have in their life time (Shrestha & Shrestha, 2008). A study (Islam & Rahman, 2020) analyzing DHS data from 15 developing countries found women marrying at the age 18 or later had 54% lower likelihood of contributing to high fertility than those marrying earlier. The consequences of EM extend beyond health, encompassing education and gender equity. Marriage in childhood violates fundamental rights, as adolescents lack maturity for informed marital decisions (Ruchira & Persson, 2010), while reinforcing gender disparities and social marginalization (Male & Wodon, 2018; Walker, 2012). Early marriage followed by teenage childbearing poses significant health and economic challenges. These circumstances generate substantial costs for individuals, families, and society at large (Scott et al., 2021), while elevating health risks for both young mothers and their children (Alazbih et al., 2023). In Nepal, teenage pregnancy and early motherhood constitute major social and public health concerns (Shrestha, 2002) .

These issues disproportionately affect rural, less-educated women and are perpetuated by entrenched cultural norms, limited access to education, and scarce economic opportunities (Aryal, 1991; Singh, 1992; Subramanian, 2008). While some studies in Nepal (Aryal, 2007; Choe et al., 2005; Jafarey et al., 2020) and national reports (NDHS, 2017; NPC, 2020; NSO, 2024) have established broad correlations between AFM and socio-economic, demographic, and cultural factors, their

reliance on descriptive analyses and basic demographic models limits causal understanding. Crucially, no study has systematically examined AFM determinants using appropriate statistical methods applied to recent, nationally representative data (NDHS, 2022). This gap impedes evidence-based policymaking to address Nepal's persistently low AFM and its downstream effects in the recent days. Our study attempts to addresses this limitation by employing stepwise analysis procedure focusing on Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA) to analyze AFM's levels, patterns, and determinants. By leveraging NDHS 2022 data, we provide a contemporary assessment of AFM trends, quantified effects of key socio-economic, cultural and geographical predictors. The findings can equip policymakers with actionable insights to design targeted interventions, monitor progress, and accelerate efforts to delay marriage timing - a critical step toward improving women's health, education, and economic empowerment.

MATERIALS AND METHODS

Source of data

This study analyzed data from NDHS 2022, after getting approval from the Demographic and Health Survey (DHS) program. The NDHS 2022 is a nationally representative survey, used a two-stage stratified cluster sampling with 14 strata (urban and rural) across seven provinces, covering all most all districts. In the first stage, 476 primary sampling units (248 urban, 228 rural) were selected, followed by 30 households per unit, yielding 14,280 households. Interviews were completed with 14,845 women aged 15 - 49. For this study, the analysis focused on 11,082 married women aged 20 and above (5,905 urban, 5,177 rural). Women aged 15 to 19 were excluded to avoid bias, as the majority (78.4%) in this age group were neither married nor living with partners. The details about the sampling method, stratification and selection of enumeration areas are available in the NDHS 2022 report (NDHS, 2023).

Study variables

The outcome variable of this study was women's AFM (in years) among those aged 20 and above (current age of women) at the survey time. It was analyzed using two approaches: i) Descriptive analysis and ii) Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA). In descriptive analysis, univariate (some basic statistics) and bivariate (cross-tabulation) of the outcome variable were analyzed. In ANCOVA and MCA, the dependent variable - AFM was treated as continuous variable and was used to analyze levels and patterns across all predictors. Altogether fourteen probable explanatory variables, including the current age of women were explored for ANCOVA and MCA. The selection of explanatory variables was guided by three key considerations: (i) their availability in the NDHS 2022 dataset, (ii) literature on developing countries (Scott et al., 2021; Shrestha & Khanal, 2023; Walker, 2012; Westoff, 2003), and (iii) consultations with subject matter experts. A complete list of these variables is provided in Annex I. Based on empirical and theoretical considerations, and using stepwise selection procedure, only seven categorical variables (women's level of education, caste/ethnicity, region of residence, place of residence, husband's education level, age at first menstruation, spouse age difference), illustrated in Fig. 1 were selected as explanatory variable for ANCOVA and MCA. Additionally, one adjusting

covariates, namely current age of women, was selected as the explanatory variables for measuring their associations with AFM of women.

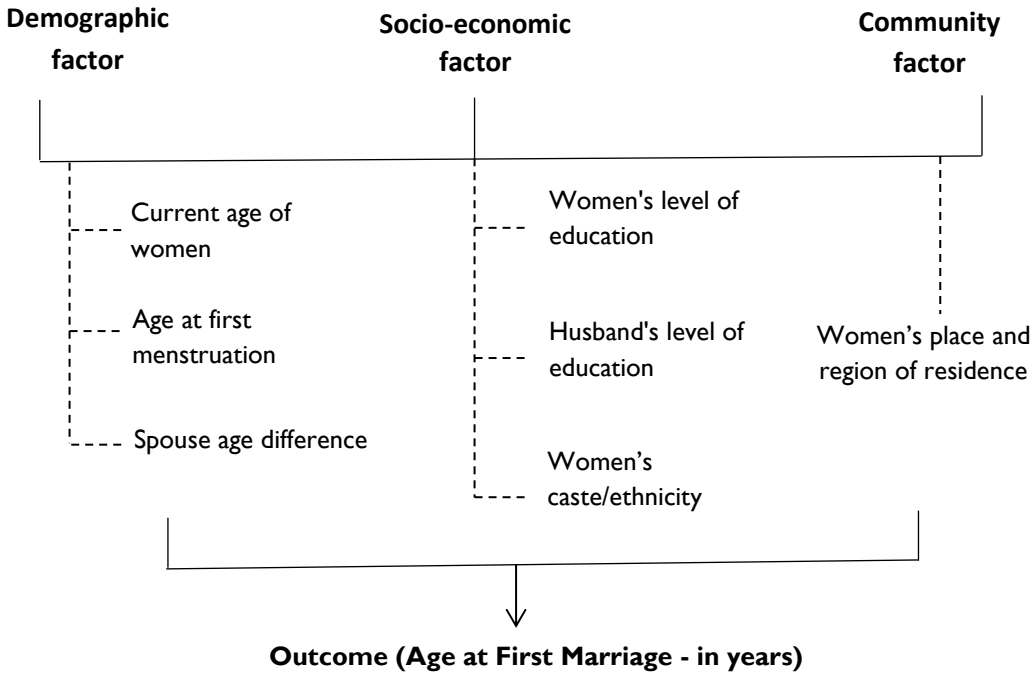

Fig.1. Thematic predictors – represent by demographic, socioeconomic and community factors influencing for AFM of Nepali women, NDHS 2022.

Measurement of variables

In this study, women's AFM was treated as dependent variable. Seven independent variables were explored for their association with AFM. Detailed descriptions of the variables, their categories, and coding are provided in Annex I.

Statistical models

We analyzed the response variable - AFM as a continuous outcome variable using ANCOVA followed by MCA. ANCOVA was chosen because it is generally preferred than the linear regression (Neter et al., 1996), and also optimally handles categorical predictors and continuous covariates while controlling for confounding effects and reducing error variance in multi-group comparisons (Cohen et al., 2014; Jason Newsom et al., 2013). MCA was then applied to complement ANCOVA as it relaxes linearity assumptions, and eliminating dummy variable traps inherent in categorical predictor analysis (Retherford, 1993). This sequential approach provides a comprehensive analytical framework for examining both categorical and continuous determinants of AFM. The mathematical expression of MCA is given by the following equation (i) (Nagpaul, 2001, as cited in Suseł, 2011, p. 184).

$$y_{ij\ldots n} = \mu + \alpha_i + \beta_j + \cdots + e_{ij\ldots n,} \quad (1)$$

where, $Y_{ij\ldots n}$ is the value of function of n observations belonging to i^{th} category of the explanatory variable A, j^{th} category explanatory variable B and so on. Likewise, μ is mean value of response variable. The α_i is effect of i^{th} category of A on $y_{ij\ldots n}$, β_j is effect of j^{th} category of B on $y_{ij\ldots n}$, and $e_{ij\ldots n}$ is random error. The statistical analysis for ANCOVA was performed by STATA version 18.0 and MCA was performed by using IBM SPSS version 27.0.

RESULTS

Trends of age at first marriage in Nepal: NDHS 1996 – 2022

The NDHS completed six survey waves between 1996 and 2022 (1996, 2001, 2006, 2011, 2016, 2022). Our analysis examined trends in both the median AFM (20-49 years) and proportions of never-married women (15-49 years) across all survey rounds. Table 1 reveals that while the 20-24 age group experienced a slight decline in median marriage age in 2001 compared to 1996, all other five-year age groups showed consistent increases from 1996 to 2022. This pattern shows that younger cohorts are marrying later than older ones. Fig. 2 illustrates this progression clearly: the median marriage age rose from 16.4 years in 1996 to 18.5 years in 2022, with the 2016 and 2022 surveys being the first to consistently record median ages above 18 years. Table 2 presents complementary findings regarding never-married proportions. The most pronounced increases occurred among 15-19 and 20-24-year-olds in each successive survey, while changes for 25-29-year-olds were more modest and inconsistent. Overall, younger cohorts consistently showed significantly higher never-married proportions than older age groups. The combined evidence from Tables 1 and 2 reveals a strong association between rising never-married proportions and delayed first marriage, particularly evident among women aged 20-34 years. These parallel trends suggest a fundamental shift in marriage timing patterns among younger generations of Nepali women.

Table 1. Median age at first marriage of women by current age (15-49) years.

Age of women at survey time	Median age at first marriage					
	NFHS-1996	NDHS-2001	NDHS-2006	NDHS-2011	NDHS-2016	NDHS-2022
20 - 24	17.1	16.8	17.9	18.9	19.0	19.6
25 - 29	16.5	16.9	17.3	17.9	18.5	18.9
30 -34	16.4	16.7	17.3	17.6	17.8	18.5
35 -39	16.2	16.6	16.9	17.4	17.4	18.0
40 - 44	15.8	16.4	16.8	17.2	17.7	17.6
45 - 49	15.5	16.1	16.5	17.2	17.5	18.2

Source: Nepal Family Health Survey 1996, Nepal Demographic and Health Survey (NDHS): 2001, 2006, 2011, 2016 & 2022.

Table 2. Percentage of never married women in Nepal.

Age at survey time	NFHS-1996	NDHS-2001	NDHS-2006	NDHS-2011	NDHS-2016	NDHS-2022
15 – 19	56.0	59.7	67.7	71.0	72.5	78.4
20 – 24	14.8	17.1	17.9	22.6	24.4	31.3
25 – 29	4.6	4.5	4.4	7.0	4.9	8.1
30 -34	1.9	2.5	1.6	2.0	2.4	2.4
35 -39	1.5	1.9	1.4	1.4	0.8	1.3
40 – 44	1.1	1.1	1.3	1.2	1.3	0.8
45 - 49	1.4	1.4	1.2	1.3	1.3	1.4

Source: Nepal Family Health Survey 1996, Nepal Demographic and Health Survey (NDHS): 2001, 2006, 2011, 2016 & 2022.

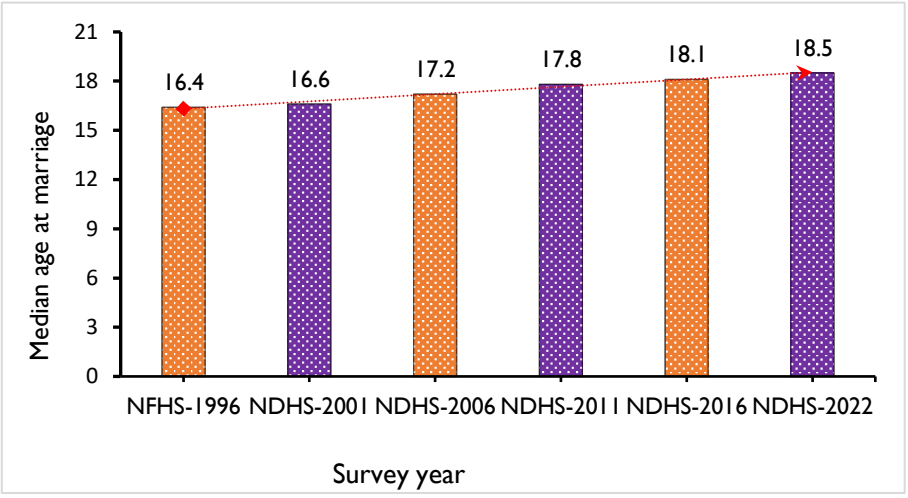

Fig. 2. Median age at first marriage of Nepali women aged 20-49 by survey years, NFHS 1996 – 2022.

Source: Nepal Family Health Survey 1996, Nepal Demographic and Health Survey (NDHS): 2001, 2006, 2011, 2016 & 2022

Differentials of age at first marriage

In this section we have presented the differentials in the AFM. The current ages of women are classified into three groups: 20-29, 30-39 and 40-49 years. The response variable is compared across six major explanatory variables within these current age groups. Table 3 presents a cross-tabulation showing the percentage of early marriages, changing patterns in the mean AFM, and the mean age differences among women according to their current age groups.

Table 3. Marital status of women by selected determinants, NDHS 2022.

Covariates	Percentage at marriage (< 18 yrs.) current age group			Mean age at marriage - current age group			Difference in mean of current age group	
	20-29	30-39	40-49	20-29	30-39	40-49		
	(1)	(2)	(3)	(4)	(5)	(6)	(7) = (4-5)	(8) = (5-6)
Women's education level								
Higher	3.32	3.05	1.11	21.25	23.89	22.70	-2.64	1.19
Secondary	17.80	6.61	2.43	18.96	20.36	20.51	-1.40	-0.15
Basic	26.44	22.64	10.20	16.92	17.58	17.96	-0.66	-0.38
No education	10.13	25.59	29.81	16.45	16.64	17.14	-0.19	-0.50
Place of residence								
Urban	16.75	17.85	13.63	18.16	18.47	18.01	-0.31	0.46
Rural	18.29	18.87	15.40	17.73	17.90	17.61	-0.17	0.29
Women's caste/ethnicity								
Janajati	13.86	15.42	12.37	18.58	19.13	18.74	-0.55	0.39
Brahmin/ Chhetri	13.79	15.99	14.09	18.31	18.65	18.05	-0.34	0.60
Dalit	27.61	32.03	28.21	17.13	16.72	16.53	0.41	0.19
Terai caste	25.44	23.08	18.42	17.09	16.66	16.25	0.43	0.41
Muslim	25.47	27.91	16.53	17.03	16.19	15.98	0.84	0.21
Province								
Bagmati	11.51	12.89	13.36	18.91	19.96	18.97	-1.05	0.99
Koshi	14.37	12.03	9.86	18.45	19.52	19.40	-1.07	0.12
Madhesh	26.44	24.59	20.21	16.82	16.47	16.01	0.36	0.46
Gandaki	12.81	18.20	13.75	18.49	18.43	18.31	0.06	0.12
Lumbini	16.22	19.63	13.22	18.25	18.24	17.73	0.01	0.50
Karnali	21.58	21.58	13.95	17.38	17.02	17.27	0.36	-0.24
Sudurpash chim	17.09	18.38	15.86	18.06	17.79	17.06	0.27	0.73

Husband's education level								
Higher	8.57	8.71	7.00	19.93	21.64	19.57	-1.71	2.07
Secondary	18.63	13.91	8.43	18.38	19.04	18.48	-0.67	0.57
Basic	19.80	21.68	14.74	17.43	17.50	17.72	-0.07	-0.22
No education	13.28	24.48	28.51	16.47	16.61	17.09	-0.14	-0.48
Women's age at first menstruation								
>= 14 yrs.	15.08	17.24	14.90	18.16	18.34	18.01	-0.18	0.33
< 14 yrs.	20.14	19.66	13.38	17.79	18.09	17.59	-0.30	0.50
Spouse age difference								
<= 2 yrs.	15.07	15.62	11.26	18.50	18.86	18.44	-0.36	0.42
> 2 yrs.	19.64	19.97	15.29	17.62	17.83	17.52	-0.21	0.31

In general, the practice of EM is more prevalent among the women in the current age group 40-49 compared to those in the 30-39 and 20-29 age groups across all determinants. Overall, the percentage of EM is approximately 53.6%, 50.8% and 47.3% among women in the 40-49, 30-39 and 20-29 age groups, respectively. The description of the summary measures with respect to different independent variables are presented in the following sub-sections.

Women's educational attainment

Women's educational attainment has a notable positive impact on delaying EM. The mean AFM among women with higher education in the current age groups 20-29, 30-39 and 40-49 is 21.25, 23.89 and 22.70 years, respectively. Women aged 20-29 with higher education delay marriage by 2.29, 4.33 and 4.8 years compared to those with secondary, basic and no education, respectively. The highest mean AFM (23.9 years) is observed among women with higher education in the 30-39 age group, followed by 22.7 years among those with the same education level in the 40 - 49 age group. In contrast, EM is most prevalent among women with no education, with a mean AFM of 16.5 years in the 20-29 age group and 16.9 years for those with basic education in the same group.

Caste/ethnicity

When analyzed by caste/ethnicity, Janajati women in the 20-29 age group delay marriage by 0.27 years compared to their Brahmin/Chhetri counterparts and by 1.45, 1.49 and 1.55 years compared to Dalit, Terai caste and Muslim women, respectively. Moreover, EM is more prevalent in the 30-39 age group compared to the 20-29 age group, with mean AFMs of 16.72 years (Dalit), 16.66 years (Terai caste) and 16.19 years (Muslim) in the former group, all lower than their counterparts in the younger age group. Among women aged 40-49, the mean AFM is 16.53 years

(Dalit), 16.25 years (Terai caste) and 15.98 years (Muslim), the lowest among all corresponding age groups.

Place and regional differences

The mean AFM in Nepal varies by residence (urban/rural) and regions (provinces). Rural residents marry before the age of 18 across all current age group, while urban residents marry at 18 and older. Regionally, Madhesh shows the lowest AFM (below 17 years) across all current age groups. Similarly, in Karnali and Sudurpashchim, the mean AFM is below 18 years across all age groups, except for women aged 20-29 in Sudurpashchim. The mean AFM is higher in Bagmati (19.96 years) and Koshi (19.52 years) in the 30-39 age group. In Lumbini and Gandaki, the mean AFM exceeds 18 years in all age groups, except for women aged 40-49 in Lumbini.

Husband's education level

Husband's education level is directly proportional to the mean AFM of women. When husbands have higher or secondary education, the mean AFM of women exceeds 18 years. However, when husbands have basic or no education, the mean AFM of women is below 18 years. The highest mean AFM (21.64 years) is observed among women aged 30-39 with husbands who have higher education, followed by 19.93 years (20-29 age group) and 19.57 years (40-49 age group). On the other hand, for husbands with lower education levels, the mean AFM of women remains below 18 years across all age groups.

Age at first menstruation

The impact of the age at first menstruation on the mean AFM of women is not much difference across all age groups compared to the influence of spousal age differences. However, women who experienced first menstruation before age 14 tend to marry earlier.

Spouse age difference

A remarkable difference in the mean AFM is observed when women are classified by spousal age difference. In cases where the spousal age difference is greater than two years, the mean AFM for women in all age groups is below 18 years. In contrast, when the spousal age difference is two years or less, the mean AFM in the 20-29, 30-39 and 40-49 age groups is 18.50, 18.86 and 18.44 years, respectively.

Levels, patterns and determinants of age at first marriage

Evaluating the impact of multiple explanatory variables on AFM (measured in years) is indeed challenging, particularly when most variables are categorical and few continuous covariates as adjusting variables. This complexity arises from potential inter-correlation among the explanatory variables. Hence, in this study, we applied the statistical method ANCOVA, which is an effective technique for measuring the impact of each categorical explanatory variable on the response variable, while controlling the effect of continuous covariates.

In this analysis, we also performed a two-way interaction analysis with all selected categorical covariates, resulting in a total of 21 interaction terms. Of these, only four were significant at the 1% level of significance. However, these significant terms had negligible partial eta squared (η^2) values, with three being < 0.005 and one at 0.008. Hence, all 21 interaction terms were excluded in the final ANCOVA model. Table 4 presents the ANCOVA results. It indicates that 26.3% of the variation in AFM is explained by explanatory variables, along with each individual partial eta squared (η^2) value. The variables "age" (current age of women) and "age-squared" (a function of age) were treated as covariates. The covariate age-squared was included in the model to minimize the potential curvilinear relationship of current age and AFM. The η^2 value of age-squared is 0.003, whereas the η^2 value of age is 0.005. Women's education contributes the largest net effect, accounting for 10.4% of the total variation in AFM after controlling for other variables. Likewise, the region of residence explains 2.7% of the total variation in AFM, followed by spouse age difference (1.9%) and caste/ethnicity (1.4%). These variables show a significant relationship with AFM. The remaining variables, such as place of residence (0.1%) and husband's education (0.4%) have a smaller net effects on the total variation in AFM, indicating that they are weaker predictors compared to the others.

Table 4. Results of ANCOVA measuring the impact of each categorical covariate.

SV	SS	DF	MS	F-test	P-value	Partial (η^2)
Corrected model	32716.42[a]	21	1557.925	172.263	< 0.001	0.263
Intercept	6572.54	1	6572.537	726.741	< 0.001	0.067
Women's education	10595.65	3	3531.885	390.529	< 0.001	0.104
Region of residence	2529.12	6	421.520	46.608	< 0.001	0.027
Caste/ethnicity	1312.27	4	328.067	36.275	< 0.001	0.014
Spouse age difference	1750.63	1	1750.633	193.572	< 0.001	0.019
Place of residence	103.77	1	103.770	11.474	.001	0.001
Husband's education	357.30	3	119.101	13.169	< 0.001	0.004
Age at first menstruation	728.63	1	728.629	80.566	< 0.001	0.008
Age squared	265.24	1	265.236	29.328	< 0.001	0.003
Age	438.17	1	438.169	48.449	< 0.001	0.005
Error	91550.95	10123	9.044			
Total	3438592.00	10145				
Corrected total	124267.37	10144				

R Squared = 0 .263 (Adjusted R-Squared = 0.262); SV = source of variation; DF = degree of freedom; SS = sum of square; MS = mean square

Table 5 presents the results of the MCA for all explanatory variables after adjusting the effect of continuous covariate (current age of woman in years). The MCA was used to study the levels and patterns of association between categories of each independent variables and dependent variable. The eta (η) value provides a summary of unadjusted correlation ratio, and beta (β) provides the adjusted correlation coefficient. The difference between η and β indicates the strength of inter-correlation between predictors (Zahangir & Zamilun, 2021). For the variable of woman education presented in Table 5, the mean AFM is higher for women with higher education compared to those with secondary, basic, and no education. The difference in mean AFM between women with no education and those with higher education (the reference categories) is smaller in the adjusted mean than in the unadjusted mean. This pattern holds true for all other levels of education and variables, except for variable of age at first menstruation. This suggests that multivariate adjustment reduces the differences in mean AFM across the categories of each predictor.

The maximum difference in unadjusted mean AFM (in years) is observed to be 5.93, calculated between women with higher education (22.84) and those with no education (16.91). The statistical adjustment decreases this difference to 5.25 years. Additionally, the values of η (0.410) and β (0.385) are closer to each other, possess the highest predictive power even after adjusting for other variables, and also the indication of no inter-correlation between women's education and other predictors. However, the effect of husband's education is not pronounced. The large difference (more than one-fourth) between the η (0.266) and β (0.064) values indicates the possibility of inter-correlation between husband's education with other predictors. The difference of unadjusted mean and the adjusted mean for the variable caste/ethnicity across all levels are similar to those observed for women's education, with the smaller difference of eta and beta values. Likewise, the largest difference in unadjusted mean AFM across regions of residence is 2.9 years, observed between women in Bagmati (19.44 years) and those in Madhesh (17.38 years). After adjustment, the difference decreases to 1.43 years with the η (0.272) and β (0.159) indicating no inter-correlation with other predictors.

Similarly, urban women have a higher unadjusted mean AFM compared to their rural counterparts. However, the adjustment remarkably reduces the difference from 0.53 to 0.21 with higher difference in η (0.076) and β (0.029) values, demonstrating potential inter-correlation with other predictors. For the variable of age at first menstruation, the adjusted mean AFM shows a larger difference compared to the unadjusted mean. The higher difference between the η (0.044) and β (0.078) values indicating potential inter-correlation with other predictors. Finally, the unadjusted mean AFM for the variable of spouse age difference is higher for those with a spouse age difference of two years or less (18.64 years) compared to those with a spouse age difference above two years (17.7 years). After computing statistical adjustment, the difference decreases from 0.94 to 0.84 years. The close values of η (0.131) and β (0.121) indicate no inter-correlation of this variable with the other predictors. In the study, inter-correlation among some socio-demographic variables was observed within the MCA framework by assessing the differences between η and β

values. A larger gap between these measures indicates overlapping explanatory power (Zahangir & Zamilun, 2021). However, no exact threshold is specified in the statistical literature. In this study, the differences ranged from 0.01 to 0.20, indicating that some multicollinearity exists among limited variables, but it has only a modest impact on the adjusted estimates.

Table 5. Results of MCA of age at first marriage of women in Nepal.

Covariates	No. of respondents	Predicted Mean		Deviation	
		Unadjusted	Adjusted	Unadjusted	Adjusted
Women's education level ($\eta = 0.410, \beta = 0.385$)					
Higher	348	22.84	22.20	4.761	4.125
Secondary	3102	19.55	19.55	1.478	1.474
Basic	3347	17.38	17.41	-0.699	-0.667
No education	3348	16.91	16.95	-1.165	-1.128
Place of residence ($\eta = 0.076, \beta = 0.029$)					
Urban	5411	18.32	18.17	0.250	0.097
Rural	4734	17.79	17.96	-0.285	-0.110
Caste/ethnicity ($\eta = 0.246, \beta = 0.113$)					
Janajati	3564	18.87	18.60	0.797	0.524
Brahmin/Chhetri	3466	18.38	17.88	0.309	-0.190
Dalit	1629	16.88	17.71	-1.191	-0.369
Terai caste	1175	16.79	17.60	-1.289	-0.477
Muslim	311	16.60	17.92	-1.473	-0.152
Region of residence ($\eta = 0.272, \beta = 0.159$)					
Bagmati	1434	19.44	18.81	1.363	0.731
Koshi	1544	19.08	18.86	1.004	0.782
Madhesh	1575	16.54	17.38	-1.538	-0.690
Gandaki	1197	18.40	18.06	0.330	-0.010
Lumbini	1580	18.16	18.13	0.083	0.058
Karnali	1355	17.24	17.43	-0.833	-0.646
Sudurpashchim	1460	17.75	17.82	-0.328	-0.255
Husband's education ($\eta = 0.266, \beta = 0.064$)					
Higher	683	20.59	18.83	2.514	0.752
Secondary	3854	18.64	18.14	0.568	0.070
Basic	4282	17.55	17.94	-0.529	-0.134
No education	1326	16.84	17.92	-1.235	-0.158

Age at first menstruation ($\eta = 0.044, \beta = 0.078$)					
>= 14 yrs.	5801	18.21	18.31	0.132	0.238
< 14 yrs.	4344	17.90	17.76	-0.177	-0.317
Spouse age difference ($\eta = 0.131, \beta = 0.121$)					
<= 2 yrs.	4053	18.64	18.59	0.562	0.518
> 2 yrs.	6092	17.70	17.73	-0.374	-0.345

DISCUSSION

This study employed descriptive statistics, ANCOVA and MCA to examine the levels, patterns and determinants associated with AFM. The results (Tables 3 - 5) highlight how socio-economic, demographic, and cultural factors shape marriage timing of Nepali women. Despite a gradual increase in median AFM from 16.4 years in 1996 to 18.5 years in 2022, EM remains prevalent, particularly among rural, less-educated women and disadvantaged caste such as Dalit and Other Terai and Muslim. EM can lead to adverse sexual and reproductive health outcomes. Young brides face greater reproductive health risks due to their limited power to demand safe sex, resulting in higher rates of sexually transmitted infections (STIs) and accidental pregnancies (Zahangir & Zamilun, 2021). Early pregnancies further intensify risks, contributing to maternal and child health complications, which impose significant economic and social burdens on households (Parsons et al., 2015). Additionally, teen pregnancies often result in school dropouts, limiting educational attainment and future career opportunities for young women (Sekine & Hodgkin, 2017). Conversely, delayed marriage enhances women's decision-making autonomy in family planning and partner selection, reducing these risks.

Education emerges as the most influential factor for the timing of marriage decision. Our study found women with higher education marry later, aligning with other's findings from Nepal (Aryal, 2007; Choe et al., 2005), South Asia (Ehsan et al., 2021), and sub-Saharan Africa (Amoo, 2017). Conversely, lack of education perpetuates EM, limiting women's autonomy and economic opportunities (Male & Wodon, 2018). Husband's higher education similarly delays AFM (Rasul et al., 2022), reinforcing household-level benefits of education. Rural-urban disparities in EM align with broader patterns observed across developing nations. Consistent with earlier studies in Nepal (NDHS, 2017) and other developing countries (Sekine & Hodgkin, 2017; Westoff, 2003). Our study identified that rural women demonstrate significantly higher prevalence of early marriage (EM) compared to their urban counterparts. This rural-urban divide reflects the intersection of multiple determinants identified in our study and previous research (Anggreni et al., 2023; Shrestha & Khanal, 2024), where educational access, economic constraints, and geographic isolation collectively perpetuate traditional marriage practices. Regional disparities further underscore socio-cultural influences. Provinces like Madhesh, Sudurpashchim, and Karnali exhibit higher EM rates, tied to poverty, traditional norms, and lower human development (Bajracharya & Amin, 2010; Jafarey et

al., 2020). In contrast, urban and more developed regions (e.g., Gandaki, Koshi) show greater adherence to legal marriage ages, reflecting modernization effects (NPC, 2020).

Our study further reveals how biological and marital age dynamics further shape marriage timing in Nepal. We identify a significant positive relationship between menarche onset and AFM, where earlier pubertal development corresponds with earlier marriage - a pattern consistent across many developing contexts (Aryal, 2012; Field & Ambrus, 2008; Ibitoye et al., 2017). Additionally, other study claimed that relationship between puberty and sexual debut may serve as a catalyst for EM, with physical maturation and genetic factors influencing the decision to marry (Gustafson & Fransson, 2015), aligned with the findings of our study. Likewise, greater spousal age gaps are linked to EM, especially among uneducated women and those from marginalized communities. Another study indicated that families perceiving daughters as economic burdens favor to earlier marriages with older spouses (Carmichael, 2011), a similar result correlated with our findings - indicating wider spousal age gaps significantly increase the likelihood of EM, particularly among Nepal's most vulnerable subgroups: uneducated women, Dalit and Terai caste groups, and residents of Madhesh province. This pattern reflects the intersection of socio-economic disadvantage and cultural norms discussed earlier. Economic hardship often drives families to marry daughters young, perceiving them as burdens (Berardo et al., 1993). These results align with our provincial analysis showing Madhesh's high EM rates, and echo the educational disparities. The inverse relationship between household socio-economic status and spousal age difference further confirms our earlier findings about economic factors in marriage timing. While spousal age gaps remain common across developing countries (Casterline et al., 1986), Nepal's context is unique in how these gaps concentrate among least educated women, marginalized castes and geographically disadvantaged regions.

Overall, our study reveals a complex relationship of factors shaping marriage timing among Nepali women, where socio-cultural norms, educational disparities, and biological markers collectively influence marital decisions. The persistent patterns of EM among rural, less-educated, and disadvantaged caste groups - particularly in Madhesh, Sudurpashchim, and Karnali provinces underscore how geographic and social inequalities perpetuate intergenerational cycles of disadvantage. The compounding effects of wide spousal age gaps, early menarche, and economic pressures create particularly vulnerable circumstances for Dalit and Terai adolescents. These findings mutually suggest that effective interventions should simultaneously address targeted strategic policy aimed at delaying marriage and improving the socio-economic conditions of women in Nepal.

Limitations

While this study provides valuable insights into factors associated with Nepali women's AFM using the nationally representative NDHS 2022 dataset and appropriate statistical techniques, it has certain limitations. First, the NDHS data lack detailed family background information at the time of marriage, which may influence marriage decisions. Second, the assumption that respondents'

current background characteristics reflect their situation at marriage may not always be accurate. Third, self-reported age at marriage may subject to recall bias. Finally, the study does not capture the qualitative dimensions of marriage decision-making, which may provide deeper contextual understanding.

CONCLUSION

This study reveals how multiple factors work together shaping marriage timing among Nepali women, where socio-cultural norms, educational disparities, and biological markers collectively influence marital decisions. The findings show that almost half (50.2%) of Nepali women married before age 18. The levels and patterns of AFM show that women with higher education marry later (22.8 years) than those with no education (16.9 years), and similar patterns are observed across caste/ethnicity and regions, with the largest regional gap between Bagmati (19.4 years) and Madhesh (17.4 years). Urban women and those with smaller spouse age differences (≤ 2 years) have slightly higher AFM, which are contrasts with the pattern seen among women who experienced early puberty. These findings highlight the need for interventions directly to the observed patterns. The lower age at first marriage among women with limited education underscores the importance of expanding educational access for girls. Variation in AFM across caste, region, and rural–urban residence emphasizes the need for community awareness programs to challenge harmful cultural norms. Targeted efforts in high-prevalence regions, focusing on education and social awareness, are likely to be most effective in delaying marriage. To effectively address early marriage, authorities should strictly enforce the legal minimum marriage age of 18 with proper monitoring, ensure all girls complete at least secondary education. Monitoring marriage timing is crucial as it directly impacts fertility rates, health outcomes, and gender equality - all of which are essential for Nepal's sustainable development. By pursuing these coordinated actions, Nepal can protect girls' rights, improve public health outcomes, and support long-term socio-economic progress.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

AUTHOR CONTRIBUTION

IKS conceptualized and designed the study, acquired and analyzed the data, and drafted the initial manuscript. SPK supervised the research, critically reviewed all stages of the work, and provided methodological guidance. Both authors contributed to revising the manuscript and agreed the final version for publication.

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DATA AVAILABILITY

The dataset used in this study are available through the DHS Program upon request and approval. Researchers may access the data by applying through the official website www.dhsprogram.com.

ETHICAL STATEMENT

This study analyzed the data from Nepal DHS 2022, accessed with approval from the DHS Program. As the survey maintains strict participant confidentiality and informed consent protocols, no additional ethical clearance was required for this analysis.

REFERENCES

Alazbih, N. M., Kaya, A. H., Mengistu, M. Y., & Gelaye, K. A. (2023). Determinants of time to first marriage and birth intervals among women of child bearing age in Dabat Health and demographic surveillance system site, Northwest Ethiopia. *PLOS ONE*, *18*(2), e0281997. https://doi.org/10.1371/journal.pone.0281997

Amoo, E. O. (2017). Trends and determinants of female age at first marriage in sub-Saharan Africa (1990-2014): What has changed? *African Population Studies, 31*(1). https://doi.org/10.11564/31-1-1024

Anggreni, D., Notobroto, H. B., & Soedirham, O. (2023). Determinant factors of early marriage in developing countries: A literature review. *Journal of Public Health in Africa*, *14*(2), 10. https://doi.org/10.4081/jphia.2023.2543

Aryal, R. H. (1991). Socioeconomic and cultural differentials in age at marriage and the effect on fertility in Nepal. *Journal of Biosocial Science*, *23*(2), 167–178. https://doi.org/10.1017/S0021932000019192

Aryal, T. R. (2007). Age at First Marriage in Nepal: Differentials and Determinants. *Journal of Biosocial Science*, *39*(5), 693–706. https://doi.org/10.1017/S0021932006001775

Aryal, T. R. (2012). Age at Menarche and Its Relation to Ages at Marriage, First-Birth and Menopause among Rural Nepalese Females. *Nepal Journal of Science and Technology*, *12*, 276–285. https://doi.org/10.3126/njst.v12i0.6513

Azinar, M., Fibriana, A. I., Nisa, A. A., Zen, M., Indrianto, G. S., Sholahuddin, I., Tamalla, P. N., & Permatasari, C. (2022). Early Marriage in Women and the Risk of Low Birth Weight. *Unnes Journal of Public Health*. https://doi.org/10.15294 /ujph.v11i1.51231

Bajracharya, A., & Amin, S. (2010). Poverty, marriage timing, and transitions to adulthood in Nepal: A longitudinal analysis using the Nepal Living Standards Survey. *Population Council*. https://doi.org/10.31899/pgy3.1022

Berardo, F. M., Appel, J., & Berardo, D. H. (1993). Age dissimilar marriages: Review and assessment. *Journal of Aging Studies*, *7*(1), 93–106.

https://doi.org/10.1016/0890-4065(93)90026-G

Caltabiano, M., & Castiglioni, M. (2008). Changing Family Formation in Nepal: Marriage, Cohabitation and First Sexual Intercourse. *International Family Planning Perspectives*, *34*(01), 030–039. https://doi.org/10.1363/3403008

Carmichael, S. (2011). Marriage and power: Age at first marriage and spousal age gap in lesser developed countries. *The History of the Family*, *16*(4), 416–436. https://doi.org/10.1016/j.hisfam.2011.08.002

Casterline, J. B., Williams, L., & McDonald, P. (1986). The Age Difference Between Spouses: Variations among Developing Countries. *Population Studies*, *40*(3), 353–374. https://doi.org/10.1080/0032472031000142296

Choe, M. K., Thapa, S., & Mishra, V. (2005). Early Marriage and Early Motherhood in Nepal. *Journal of Biosocial Science*, *37*(2), 143–162. https://doi.org/10.1017/S0021932003006527

Cohen, P., West, S. G., & Aiken, L. S. (2014). *Applied multiple regression/Correlation analysis for the behavioral sciences*. Psychology Press.

Ehsan, H., Ghafoorī, N., & Akramī, S. O. (2021). The Impact of Poverty and Education on Female Child Marriage in Afghanistan Evidence from 2015 Afghanistan Demographic and Health Survey. *19 Mayıs Sosyal Bilimler Dergisi*, 2(2), 418–431. https://doi.org/10.52835/19maysbd.897102

Field, E., & Ambrus, A. (2008). Early Marriage, Age of Menarche, and Female Schooling Attainment in Bangladesh. *Journal of Political Economy*, *116*(5), 881–930. https://doi.org/10.1086/593333

Gustafson, P., & Fransson, U. (2015). Age Differences Between Spouses: Sociodemographic Variation and Selection. *Marriage & Family Review*, *51*(7), 610–632. https://doi.org/10.1080/01494929.2015.1060289

Ibitoye, M., Choi, C., Tai, H., Lee, G., & Sommer, M. (2017). Early menarche: A systematic review of its effect on sexual and reproductive health in low- and middle-income countries. *PLOS ONE*, *12*(6), e0178884. https://doi.org/10.1371/journal.pone.0178884

Islam, Md. A., & Rahman, A. (2020). Age at first marriage and fertility in developing countries: A meta analytical view of 15 Demographic and Health Surveys. *Clinical Epidemiology and Global Health*, *8*(3), 775–779. https://doi.org/10.1016/j.cegh.2020.01.018

Jafarey, S., Mainali, R., & Montes-Rojas, G. (2020). Age at marriage, social norms, and female education in Nepal. *Review of Development Economics*, *24*(3), 878–909. https://doi.org/10.1111/rode.12692

Jason Newsom, Jones, R. N., & Hofer, S. M. (2013). *Longitudinal data analysis: A practical guide for researchers in aging, health, and social sciences*. Routledge.

Jensen, R., & Thornton, R. (2003). Early Female Marriage in the Developing World. *Gender and Development*, *11*(2,), 9–19. http://www.jstor.org/stable/4030636

Male, C., & Wodon, Q. (2018). Girls' Education and Child Marriage in West and Central Africa: Trends, Impacts, Costs, and Solutions. *Forum for Social Economics*, *47*(2), 262–274. https://doi.org/10.1080/07360932.2018.1451771

MoLJPA. (2017). The National Civil (Code) Act, 2017. Ministry of Law, Justice and Parliamentary Affairs, Kathmandu, Nepal.

Ministry of Health and Population Nepal, New ERA, & ICF. (2017). Nepal Demographic and Health Survey 2016. Kathmandu, Nepal: Ministry of Health and Population [Nepal]. Available from: http://www.newera.com.np

Ministry of Health and Population Nepal, New ERA, & ICF. (2023). Nepal Demographic and Health Survey 2022. Kathmandu, Nepal: Ministry of Health and Population [Nepal]. Available from: http://www.newera.com.np

Neter, J., Kutner, M. H., Nachtsheim, C. J., & Wasserman, W. (1996). *Applied linear statistical models*.

NPC. (2020). Nepal Human Development Report 2020. Government of Nepal: National Planning Commission (NPC). www.npc.gov.np

NSO. (2024). Nepal Living Standards Survey IV 2022-23. National Statistics Office. https://nsonepal.gov.np

Parsons, J., Edmeades, J., Kes, A., Petroni, S., Sexton, M., & Wodon, Q. (2015). Economic Impacts of Child Marriage: A Review of the Literature. *The Review of Faith & International Affairs*, *13*(3), 12–22. https://doi.org/10.1080/15570274.2015.1075757

Rasul, A., Nasir, J. A., Akhtar, S., & Hinde, A. (2022). Factors associated with female age at first marriage: An analysis using all waves of the Pakistan Demographic and Health Survey. *PLOS ONE*, *17*(3), e0264505. https://doi.org/10.1371/journal.pone.0264505

Retherford, R. D. (with Choe, M. K.). (1993). *Statistical models for causal analysis*. Wiley.

Ruchira, T. N., & Persson, L. A. (2010). Dowry and Spousal Physical Violence Against Women in Bangladesh. *Journal of Family Issues*, *31*(6), 830–856. https://doi.org/10.1177/0192513X09357554

Scott, S., Nguyen, P. H., Neupane, S., Pramanik, P., Nanda, P., Bhutta, Z. A., Afsana, K., & Menon, P. (2021). Early marriage and early childbearing in South Asia: Trends, inequalities, and drivers from 2005 to 2018. *Annals of the New York Academy of Sciences*, *1491*(1), 60–73. https://doi.org/10.1111/nyas.14531

Sekine, K., & Hodgkin, M. E. (2017). Effect of child marriage on girls' school dropout in Nepal: Analysis of data from the Multiple Indicator Cluster Survey 2014. *PLOS ONE*, *12*(7), e0180176. https://doi.org/10.1371/journal.pone.0180176

Shrestha, I. K., & Khanal, S. P. (2023). Systematic Review on Factors Associated with Female Age at Marriage. *Nepalese Journal of Statistics*, *7*, 67–91. https://doi.org/10.3126/njs.v7i1.61058

Shrestha, I. K., & Khanal, S. P. (2024). Factors associated with time to first birth after marriage: A systematic review. *BIBECHANA*, *21*(2), 180–194. https://doi.org/10.3126/bibechana.v21i2.62448

Shrestha, G., & Shrestha, S. L. (2008). Nonparametric Distribution Fitting of Age at First Marriage of Nepalese Women through Scatter Plot Smoother. *Nepal Journal of Science and Technology*, *9*, 179–186. https://doi.org/10.3126/njst.v9i0.3184

Shrestha, S. (2002). Socio-cultural factors influencing adolescent pregnancy in rural Nepal. *International Journal of Adolescent Medicine and Health*, *14*(2), 101–109. https://doi.org/10.1515/ijamh.2002.14.2.101

Singh, M. (1992). Changes in Age at Marriage of Women in Rural North India. *Journal of Biosocial Science*, *24*(1), 123–130. https://doi.org/10.1017/S0021932000006866

Subramanian, P. K. (2008). Determinants of the Age at Marriage of Rural Women in India. *Family and Consumer Sciences Research Journal*, *37*(2), 160–166. https://doi.org/10.1177/1077727X08327257

Suseł, A. (2011). Multiple classification analysis. Theory and application to Demography. *Acta Universitatis Lodziensis. Folia Oeconomica*, *255*.

Walker, J.-A. (2012). Early Marriage in Africa—Trends, Harmful Effects and Interventions. *African Journal of Reproductive Health / La Revue Africaine de La Santé Reproductive*, *16*(2), 231–240. http://www.jstor.org/stable/23318031

Westoff, C. F. (2003). Trends in Marriage and Early Childbearing in Developing Countries. *DHS Comparative Reports No. 5.*, *Calverton, MD, USA: Macro International Inc.*

Zahangir, S. M., & Zamilun, N. M. (2021). Age at First Marriage of Women in Bangladesh: Levels, Trends and Determinants. In A. Klimczuk (Ed.), *Demographic Analysis—Selected Concepts, Tools, and Applications*. IntechOpen. https://doi.org/10.5772/intechopen.96264

Annex I

Description of explanatory variable with categories and code label

SN	Variable	Category (code label)	SN	Variable	Category (code label)
1	Women's current age	Numerical	8	Caste/ethnicity	0 = Janajati; 1 = Brahmin/Chhetri; 2 = Dalit; 3 = Terai caste; 4 = Muslim
2	Region of residence	0 = Bagmati; 1 = Koshi; 2 = Madhesh; 3 = Gandaki; 4 = Lumbini; 5 = Karnali; 6 = Sudurpashchim	9	Media exposure	0 = Yes; 1 = No
3	Place of residence	0 = Urban; 1 = Rural	10	Economic condition	0 = Rich; 1 = Middle; 2 = Poor
4	Ecological belt	0 = Hill; 1= Mountain; 2 = Terai	11	Husband education	0 = Higher; 1 = Secondary; 2 = Basic; 3 = No education
5	Women's education	0 = Higher; 1 = Secondary; 2 = Basic; 3 = No education	12	Husband's occupation	0 = Professional/Sales & service; 1 = Agriculture; 2 = Others; 2 = Not working
6	Women's occupation	0 = Professional/Sales & service; 1 = Agriculture; 2 = Others; 3 = Not working	13	Age at first menstruation	0 = (>= 14 yrs.), 1= (< 14 yrs.)
7	Religion	0 = Non-hindu; 1 = Hindu	14	Spouse age difference	0 = (2 yrs.), 1= (> 2 yrs.)

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