

MODELLING AGE PATTERNS OF MARRIAGE IN UTTAR PRADESH: FINDINGS FROM NFHS

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ABSTRACT

In this paper female age at marriage in Uttar Pradesh is analyzed using the National Family Health Survey (NFHS) round-4 dataset by fitting the Coale's (1971) three-parameter marriage model. The three parameters a_0 (quantum) k (tempo) and c (proportion ever marrying) are estimated with the help of NUPTIAL sub-routine in FORTRAN. The Coale's model was the first to capture similarity in the schedules of the first marriage frequencies in population belonging to different cultural groups. The aforementioned survey data on ever-married sample is used to fit the standard nuptiality schedule at the state and district level. Findings are suggestive of the slowing marriage rates as compared to the standard marriage schedule as the rate of marriage declined 21 percent in the recent age cohort (20-24 years) as compared to older cohort (45-49 years). Similarly, the mean age at marriage in Uttar Pradesh increased from 18.59 years for women aged 45-49 years to 22.54 years among the females aged 20-24 years i.e. 3.95 years in 25 years' time. The Coale's nuptiality model has been derived by fitting the marriage frequencies in different populations as a function of age for each cohort. It has been empirically shown that Coale's nuptiality schedule provides best model fit to the observed marriage frequencies in wide variety of population sub-groups, hence the model is used to fit the data from Uttar Pradesh. The model does not converge if more than half of the females in a given age cohorts are unmarried in the sample.

Keywords: Nuptiality, Coale, Uttar Pradesh, India

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1. Introduction

The examination of female age patterns of marriage within any population holds considerable importance due to its profound connections with social, economic, and demographic transformations. Age at marriage significantly influences both fertility levels and the overall population growth rate in a country. Recent experiences in numerous less developed countries, witnessing declines in population growth rates, underscore the influence of age at marriage on population dynamics (Shavazi, 2008). This impact is not exclusive to less developed nations; many developed countries have also seen a crucial role played by an increase in the age at marriage in reducing population growth rates. In societies where reproduction predominantly occurs within marriage, alterations in marriage ages and the ensuing reduction in the proportion of married women are intricately linked to fertility (Judith, 1984; Rae, 2005).

In the Indian context, marriages are not only widespread but also occur at early ages. This trend is attributed to a combination of cultural beliefs and practices, such as the expectation that parents should marry off their daughters upon reaching menarche. Additionally, societal preferences favour early marriages, often linked to the prospect of obtaining higher dowries. Traditional marriage systems, designed to safeguard women's sexuality and maximize their reproductive value, align with parental and social interests by advocating for marriages close to puberty. Limited alternative opportunities, such as education and employment, further contribute to early marriage being the socially accepted choice for adult women. A significant contributor to India's high population growth is the persistent prevalence of low age at marriage in many states (Caldwell, 1983; McDonald, 1985). Age at marriage has become a focal point for scholars and policymakers, given the belief that early and universal marriage contributes to high fertility levels. Addressing the urgent task of slowing down India's population growth and promoting the socio-economic upliftment of women necessitates changes in prevailing marital behaviours. Encouraging late marriages is crucial, as early marriage often leads to the cessation of education for girls and their premature assumption of maternal, domestic, and childcare responsibilities.

In India the impact of persistently low ages at marriage on maintaining high fertility and population growth rates is widely acknowledged (Lestheghe, 1971; Ridley and Sheps, 1966). While the female age at marriage has seen a gradual increase since the middle of this century, it remains relatively lower as compared to countries with lower fertility rates. Intra-state variations in age at marriage are notable, particularly the visible north-south divide (Bhagat, 2002). Furthermore, variations exist based on factors such as caste, religion, and other socio-economic characteristics. Acknowledging the challenges of directly implementing laws and legislation, especially in states with socio-economic disparities, the government's approach can focus on factors amenable to social

intervention. The current paper aims to analyze the levels, patterns, and trends in female age at marriage in Uttar Pradesh. The findings from the study will contribute to a deeper understanding of changing nuptiality patterns in Uttar Pradesh.

Up until sixty years ago, India grappled with severe population growth issues, exacerbated by frequent epidemics, famines, and other calamities. During this period, population expansion was perceived as a long-term challenge intricately linked to the traditional society's standards of living, nutrition, health hazards, social institutions, and family values. The problems of fertility and mortality were intertwined and shaped by prevailing conditions. However, starting in the fifties, the declining mortality rates and relatively stable or slowly changing rates of marriage and fertility began to mutually reinforce each other, impacting social, economic, and demographic structures. With significant reductions in mortality concentrated in infancy and childhood, growing cohorts progressed through youth and adolescence to reach the ages of marriage, family formation, and labour-force participation. Despite government programmes aiming to raise the minimum age at marriage, early marriage and high rates of childbearing persisted, leading to major increases in new cohorts of infants. The demographic transitions of the later twentieth century posed a unique challenge for planning and programme implementation, prompting the government to develop initiatives to provide family planning information and facilities while advocating for an increase in the minimum age at marriage. Achievements in raising the age at marriage through legislation were limited, particularly in regions experiencing rapid social, economic, and political changes. The field of nuptiality has been relatively overlooked in population studies, especially in micro studies. In the era of family planning, the dynamics of nuptiality are less understood. The Reproductive and Child Health approach calls for studying the factors influencing the formation and dissolution of legal marriages and sexual unions in the population. Particular attention should be given to studying the relationship between education, economic variables, and nuptiality across cultures and regions. Moreover, examining the connection between nuptiality and fertility under changing socio-cultural environments is crucial. The age at marriage is closely related to fertility, especially in countries like India where universal and early marriage has been prevalent, and cohabitation outside marriage is uncommon. The age at which a woman gives birth to her first child is primarily linked to her age at marriage and influences subsequent childbearing within the reproductive span.

Efforts to achieve a reduction in fertility, as proposed in the World Population Plan of Action (1974), emphasized the establishment of an appropriate lower limit for age at marriage. Raising the age at marriage, particularly in high fertility countries, was seen as a measure to dampen future population growth. The 'National Population Policy' announced by the Government of India in 1976

highlighted the demographic impact of raising the age at marriage, emphasizing responsible parenthood and the health of mothers and children. A corresponding legislation was enacted in February 1978, raising the marriageable age for girls from 15 to 18 years and for boys from 18 to 21 years. To be gender neutral this has been recently recommended to be 21 years for both sexes. Despite the legal changes, early marriages persist in Indian society especially in rural areas, and efforts by the government, voluntary organizations, and social reformers have faced challenges.

2. Literature Review

Ansley J. Coale's 1971 work illustrates consistent age patterns of first marriage over time and across countries. The proportion of ever-married curves, representing the cumulative distribution of first marriage frequencies among diverse socio-economic groups, exhibit uniformity. These curves can be expressed in terms of a standard curve by adjusting the origin, horizontal scale, and vertical scale. Research on female age at marriage in developing countries faced limitations until the availability of demographic and health surveys. Recent literature reveals that, despite a trend towards later marriage, Asian countries exhibit significant variations in marriage patterns (Jones, 2010; Peng, 2007; ORG, 2001; Jeofrey, 2014). In South Asia, the age at marriage for females increased from under 15 in the early 20th century to well over 15 years or even the age 20 years by the start of the 21st century. The trend is similar in India, while Sri Lanka experienced a rise from 18.1 years in 1901 to 25.5 in 1993. Korean women marry later than their South Asian counterparts, while the Philippines follow more typical age patterns. The average female age at marriage in Korea is 31.26 years while in Philippines it is 27 years. However, the universality of marriages (95% or more of women eventually marry) remains consistent across all Asian countries. Historically, changes in nuptiality patterns played significant roles in European demographic transitions, with late marriage and widespread celibacy reducing fertility in Western Europe. In contrast, early and nearly universal marriages, along with a decline in marital fertility, characterized other parts of Europe. Early demographic transitions in developed countries witnessed shifts towards later marriages and lower proportions of ever-married at different ages. Recent evidence supports the argument that nuptiality reductions have a retarding effect on fertility. Marital factors, analyzed in Asian countries by Cho and Retherford (1976), contributed substantially to fertility reduction. Changes in age at marriage played a role in the decline of Sri Lanka's crude birth rate. Age at marriage affects fertility through its impact on the fertility schedule, family building pattern, and length of generation. Goode's (1963) modernization theory emphasizes the impact of industrialization on marriage patterns, with factors such as education, occupational roles, and urbanization influencing marriage timing. Empirical studies in Asian countries support this theory. Additionally, religion, caste or

ethnicity, and social institutions, including family systems and marriage norms, play influential roles in shaping age at marriage patterns in certain developing countries.

Based on the above literature, in Indian context it is evident that the availability of data on female age at marriage was a major challenge in estimating the marriage rates and the propensity of female marriages. This was overcome with the launch of National Family Health Surveys (NFHS). Prior to it, census data, which were available once in ten years, was the only source of data for estimating the marriage rates using in-direct technique proposed by John Hajnal in 1965. Thereby, the findings from the study will act as baseline estimates on age at marriage in districts of Uttar Pradesh.

3. Objective of the Study

The main objective of this paper is to examine the age patterns of women at marriage in the districts of Uttar Pradesh and provide estimates of mean age at marriage, which will serve as baseline estimates, as NFHS-4 being the first district level survey covering all districts. The other objective is to specifically estimate the three parameters ‘a0’, ‘k’ and ‘c’ used in the three-parameter Coale’s Marriage model at the State & district level using NFHS-4 data.

4. Data & Methodology

This section provides the detail regarding the data set used for fitting the marriage model as-well-as model specification.

Data

The National Family Health Survey round-4 conducted in 2015-16 created an important demographic and health database which facilitated implementation and monitoring of population health programmes in the country. Availability of raw data to researchers has also helped to carry out research in the different areas of population and health. NFHS-4 obtained direct data on age at first marriage and age at cohabitation from ever-married women aged 13-49 years at the time of survey and also collected information on the age of the never married women in the surveyed households. The above data set is used to carry out the current analysis.

Methodology

The three-parameter marriage model developed by A. J. Coale is fitted to survey data on marital status distribution by age and distribution of age at marriage for ever-married women. Coale showed that the risk of first marriage for the standard population is very closely fitted by a double exponential function

$$r_s(x) = 0.174 e^{\{-4.411\{e^{(-0.309x)}\}\}}$$

Where is the risk of first marriage in standard population at age x .

The standard schedule is based on Swedish nuptiality for the period 1865-69. In a cohort where onset of marriage is at age a_0 and where the time scale of marriage is compressed by factor k (rate of marriage), the risk of marriage $r(a)$ at age 'a', among those who marry, is

$$r(a) = \left(\frac{0.174}{k}\right) e^{\{-4.411\{e^{-\frac{0.309}{k}(a-a_0)}\}\}}$$

A year later in 1972 Coale and McNeil gave an analytical model for the study of first marriage that fits the Swedish standard as under

$$g_s(x) = 0.1946e^{\{-0.174(x-6.06)-e^{-0.2881(x-6.06)}\}}$$

Here $g_s(x)$ is the probability density function of the age at first marriage in the standard population at age x . Coale and McNeil also gave a method for relating observed schedule of nuptiality to standard schedule by choosing the origin, the horizontal scale, and the vertical scale. These transformations were described by Coale as a_0 , k and c . The parameter a_0 is age at which a consequential number of first marriages occur; it is to remind here that this is not the minimum age at first marriage. 'k' is the rate at which marriages occur in a given population relative to Swedish standard and 'c' is the proportion of the cohort ultimately marrying.

Rodriguez and Trussell in the year 1980 came up with alternative formulation of the Coale's marriage model under the premise that the three parameters are not easily interpretable and do not provide easy comparison across cohorts or populations. They came up with new standard with mean 0 and variance 1 with the probability density function of age at first marriage () as:

$$g_0(z) = 1.2813 e^{\{-1.145(z+0.805)-e^{-1.896(z+0.805)}\}}$$

This formulation shows that the age at first marriage is distributed as a linear function of the logarithm of a standard gamma random variable. It is this form of the Coale's model that Rodriguez and Trussell wrote a computer programme for fitting nuptiality schedule to survey data. This paper uses the NUPTIAL Version 2.3.0 developed on 22nd January, 1987 written by German Rodriguez and James Trussell. The NUPTIAL sub-routine is written in FORTRAN and the estimates are optimized using maximum likelihood procedure. Detailed descriptions are available in World Fertility Survey, Technical Bulletin 7, available from International Statistical Institute (ISI) Research Centre in The Hague.

5. Findings & Discussions

Table 1 at annexure provides the maximum likelihood estimates of the parameters from Coale's model using ever-married sample from NFHS-4 in Uttar Pradesh. The model goodness of fit is also presented and discussed. Test for homogeneity of cohorts are also presented in the table to study whether within cohort marriage rates follow the uniform pattern or it varies. In the data on ever-married sample the age at marriage is truncated by the survey date for those individuals who are yet to experience the marriage. For this reason, estimates on age at marriage may be unstable in cohorts where less than half of the women are married by the survey date. The estimates of mean and standard deviation of cohorts still undergoing through the marriage process may not necessarily fit the complete experience of the same cohort once it finishes marrying, reason we may see unstable parameter estimates for such cohorts.

The parameter estimates were not stable for 15-19 years age cohorts, the reason they are not presented in Table 1. The estimates for mean and standard deviation for cohort ages 30-34 years until 45-49 years are not very reliable as the cohorts are not homogenous, signifying that nuptiality may be varying and different single-year cohorts in these age-groups have not followed the same nuptiality schedule. This indicates lack of model fit to the common nuptiality schedule. Contrary to this, recent cohorts 20-24 years and 25-29 years fit the data well as is indicated by both the goodness of fit statistics as well as test for homogeneity of cohorts. This indicates that these cohorts may be considered to have followed the same nuptiality pattern. The likelihood ratio statistics for homogeneity of each of the four 5-year cohorts in the NFHS-4 sample for Uttar Pradesh, as well as the corresponding degrees of freedom and associated p-values, are also shown in Table 1. The homogeneity of recent cohorts indicates that nuptiality is not changing very much in recent times in Uttar Pradesh. Looking at the estimates of 'k' one can easily conclude about the quality issues with regard to all the cohorts. Data is consistent and reflective of the general understanding of marriage rates being faster in Uttar Pradesh as compared to Swedish standard, which is contextual. Looking at the mean value for ages 20-24 years and comparing it with older cohort 45-49 years we can presumably say that age at marriage has increased 3.95 years in 25 years' time.

Table 2 at annexure presents the district level estimate of the age pattern of marriage in Uttar Pradesh. The NFHS-4 provides the data on 71 districts of Uttar Pradesh. The findings from the districts level suggest that the model converged with regard to the data from 39 districts while the iterations failed on data from 32 districts, mostly from central and eastern Uttar Pradesh. This is also a reflection on the quality of data collected. Table 2 shows cohorts being homogenous and fit the model well across cohorts in the 39 districts where estimates are available. The marriage rates are faster in all the 39 districts across cohorts as compared to standard schedule which is in the expected direction.

Nuptiality within cohorts is not changing as the cohorts are homogenous across 39 districts where the model converged.

6. Conclusion

The Coale's marriage nuptiality schedule fits the data fairly well across cohorts for the data on ever-married samples available from the fourth round of NFHS for Uttar Pradesh. The parameter estimates of the model are representative of the nuptiality patterns in Uttar Pradesh, typically signifying universality of marriages in the districts of Uttar Pradesh. As compared to Swedish standard marriages in Uttar Pradesh occurred at an accelerating rate during NFHS-4 period; however, there are signs of slowing down in the districts as well as state. The mean age at marriages has increased in Uttar Pradesh as reflected by the mean values of the recent cohorts, from NFHS-4 dataset. Maximum increase in the mean age at marriage in 25 to 30 years were recorded in Etah (5.8 years) followed by Mathura & Etawah (5.1 years), and Sitapur (4.7 years) districts.

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Annexure

Table 1: Maximum Likelihood Estimates of the Coale-McNeil's three-parameter Marriage model based on NFHS-4 data: Uttar Pradesh

NFHS-4 Cohort	Parameter Estimates				Standard Error		Goodness of Fit			Homogeneity of Cohort		
	Mean	SD	a ₀	k	Mean	SD	chi Sq	DF	p value	chi Sq	DF	p value
15-19	NS	--	--	--	--	--	--	--	--	--	--	--
20-24	22.54	5.14	13.66	0.78	--	--	1483.5	53	0.85	122.55	42	0.85
25-29	20.73	5.48	11.28	0.83	0.07	0.06	832.2	78	0.85	194.72	62	0.85
30-34	19.02	4.59	11.09	0.69	0.05	0.04	724.06	103	0.85	148.03	82	0.00
35-39	18.64	4.23	11.28	0.65	0.04	0.03	934.11	128	0.00	199.18	102	0.00
40-44	18.23	4.00	11.31	0.61	0.04	0.03	811.12	147	0.00	226.20	119	0.00
45-49	18.59	4.23	11.28	0.64	0.05	0.04	781.76	175	0.00	184.25	141	0.01

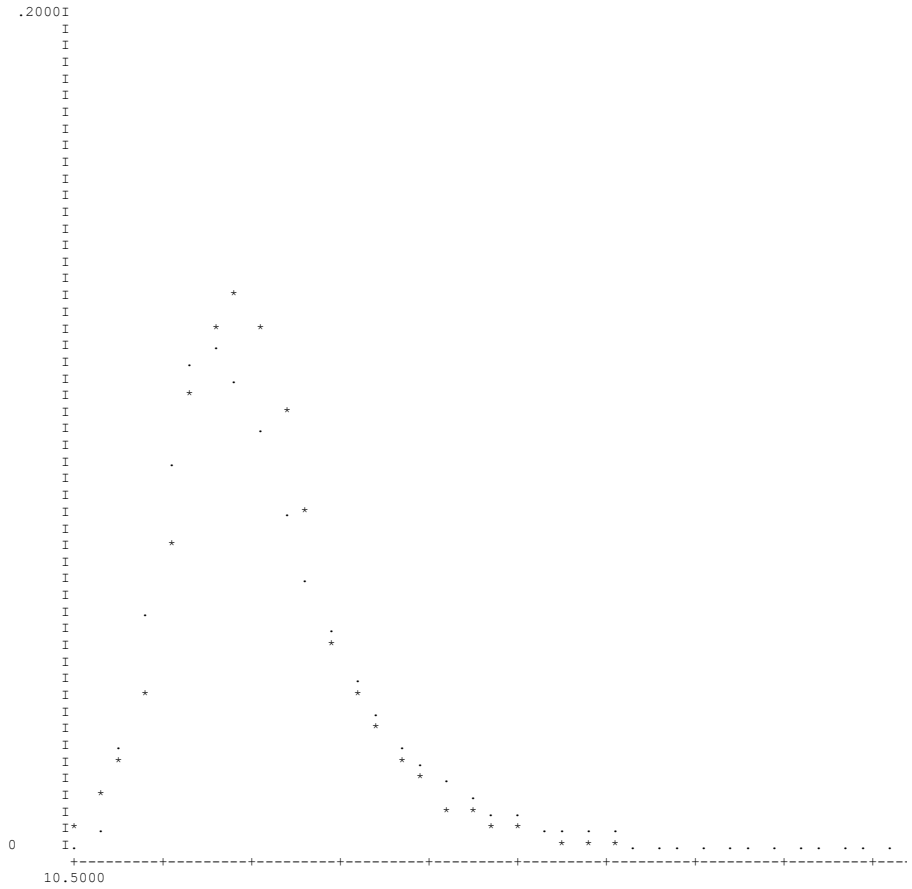
NS=optimization failed due to less number of cases in the age cohort

Table 2: District Level Maximum Likelihood Estimates of the Coale-McNeil's three parameter Marriage Model based on NFHS-4 data: Uttar Pradesh

District	NFHS-4		Parameter Estimates				Standard Error		Goodness of Fit			Homogeneity of Cohort		
	Cohort	Mean	SD	a ₀	k	Mean	SD	chi Sq	DF	p value	chi Sq	DF	p value	
Agra	15-19	NS	-	-	-	-	-	-	-	-	-	-	-	
	20-24	NS	-	-	-	-	-	-	-	-	-	-	-	
	25-29	20.8	5.2	11.8	0.8	0.4	0.3	140.5	43.0	1.0	28.9	34.0	0.7	
	30-34	19.2	4.0	12.2	0.6	0.3	0.2	93.0	95.0	0.5	73.7	77.0	0.6	
	35-39	18.4	3.6	12.1	0.6	0.2	0.2	134.3	113.0	0.1	103.1	92.0	0.2	
	40-44	18.3	3.9	11.5	0.6	0.3	0.2	99.8	118.0	0.9	79.7	96.0	0.9	
	45-49	18.8	3.9	11.9	0.6	0.3	0.2	109.6	108.0	0.4	63.7	88.0	1.0	
	15-19	NS	-	-	-	-	-	-	-	-	-	-	-	-
	20-24	22.4	5.6	12.9	0.8	0.8	0.6	57.9	48.0	0.2	38.1	38.0	0.5	
Aligarh	25-29	20.9	5.3	11.6	0.8	0.4	0.3	96.6	78.0	0.1	46.2	62.0	0.9	
	30-34	19.1	4.1	12.0	0.6	0.3	0.2	104.4	88.0	0.1	86.9	72.0	0.1	
	35-39	18.6	3.6	12.5	0.5	0.2	0.2	94.2	98.0	0.6	58.4	80.0	1.0	
	40-44	18.8	4.0	11.8	0.6	0.3	0.2	110.5	44.0	0.3	81.6	84.0	0.6	
	45-49	18.4	3.7	12.0	0.6	0.2	0.2	100.0	103.0	0.6	52.5	84.0	1.0	

Etah	15-19	23.6	5.6	13.8	0.9	5.9	3.2	9.2	13.0	0.8	8.0	10.0	0.6	
	20-24	22.6	5.8	12.2	0.9	1.1	0.9	58.3	37.0	0.0	39.8	30.0	0.1	
	25-29	19.4	4.1	12.4	0.6	0.4	0.4	71.5	65.0	0.3	61.9	53.0	0.2	
	30-34	18.3	4.3	10.8	0.7	0.4	0.3	104.7	93.0	0.2	66.2	76.0	0.8	
	35-39	17.9	3.4	12.0	0.5	0.3	0.2	67.5	73.0	0.7	53.9	60.0	0.7	
	40-44	17.4	3.7	10.9	0.6	0.4	0.3	83.1	93.0	0.8	56.8	76.0	1.0	
	45-49	17.8	3.1	12.4	0.5	0.3	0.3	72.5	83.0	0.8	48.8	68.0	1.0	
	15-19	NS	-	-	-	-	-	-	-	-	-	-	-	-
	20-24	22.7	5.5	13.2	0.8	1.2	0.8	32.6	38.0	0.7	28.0	30.0	0.6	
Etawah	25-29	20.1	4.5	12.3	0.7	0.4	0.4	82.1	73.0	0.2	56.4	58.0	0.5	
	30-34	18.3	3.7	11.8	0.6	0.4	0.3	92.1	83.0	0.2	62.8	68.0	0.7	
	35-39	17.5	3.7	11.0	0.6	0.3	0.3	93.2	88.0	0.3	71.3	72.0	0.5	
	40-44	16.9	3.4	11.1	0.5	0.3	0.2	79.2	88.0	0.7	55.5	72.0	0.9	
	45-49	17.6	4.4	10.0	0.7	0.5	0.4	90.8	113.0	0.9	61.9	92.0	1.0	
	15-19	NS	-	-	-	-	-	-	-	-	-	-	-	
	20-24	22.2	5.9	12.0	0.9	1.3	0.9	53.7	43.0	0.1	40.4	34.0	0.2	
	25-29	20.4	5.6	10.6	0.9	0.6	0.5	93.9	75.0	0.1	62.4	61.0	0.4	
	30-34	18.1	3.8	11.5	0.6	0.3	0.3	120.9	88.0	0.0	75.7	72.0	0.4	
Faizabad	35-39	17.7	3.6	11.5	0.6	0.3	0.3	75.5	83.0	0.7	54.5	68.0	0.9	
	40-44	17.7	4.1	10.7	0.6	0.4	0.3	89.8	98.0	0.7	62.0	80.0	0.9	
	45-49	18.4	4.8	10.1	0.7	0.5	0.4	91.0	93.0	0.5	72.2	76.0	0.6	

COALE'S NUPTIALITY MODEL, UTTAR PRADESH, INDIA (NFHS-4)
Adjusted Fitted (.) and Pooled(*) proportions Marrying Cohort (45-49)



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