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Socio-Economic and Demographic Determinants of Open Birth Intervals Among Rural Women in Manipur, North East India

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Abstract

Background: *Open birth interval (OBI) is an important measure of fertility behaviour, providing insights into reproductive decision-making, birth spacing, and fertility limitation within populations.* ***Objectives:*** *This study aims to examine the socio-economic and demographic determinants of OBI among currently married women in the rural valley districts of Manipur, North-East India.* ***Materials and Methods:*** *A cross-sectional, community-based survey was carried out among 1,059 currently married women with at least one live birth in Bishnupur, Imphal East, Imphal West, and Thoubal districts. Primary data were collected through personal interviews using a pre-tested semi-structured schedule between February and August 2024, with February 10, 2024, as the reference date. OBI was defined as the duration (in months) between the most recent live birth and the survey date, incorporating right-censored observations. Survival analysis techniques, particularly the Log-rank (Mantel–Cox) test, were applied to assess differences in OBI across selected socio-economic and demographic variables.* ***Findings:*** *The analysis revealed significant differentials in OBI across both socio-economic and demographic characteristics. Type of family and educational qualification emerged as highly significant socio-economic determinants ($p < 0.01$), with women from joint families and those with lower educational attainment exhibiting longer OBIs. Among demographic factors, age at current marriage, duration of current marriage, and present age showed highly significant associations with OBI ($p < 0.01$), while contraceptive use was also significant ($p < 0.05$). A clear life-course pattern was observed, with median OBI increasing steadily with advancing age and marital duration, indicating fertility limitation and cessation behaviour. Contraceptive users recorded substantially longer OBIs than non-users.* ***Conclusion:*** *The study demonstrates that open birth intervals in rural valley Manipur are shaped by a complex interaction of socio-economic conditions, demographic progression, and reproductive practices, underscoring the need for policies promoting female education, delayed marriage, and improved access to effective contraception to support optimal birth spacing.*

Keywords: *Open birth interval, Fertility behaviour, Rural Manipur, Socio-demographic factors, Survival analysis*

Introduction

The analysis of fertility behaviour has long been a central concern of demographic research, as patterns of childbearing have profound implications for population growth, age

composition, and socio-economic development. Among the various indicators used to study fertility, the open birth interval (OBI), defined as the time elapsed since a woman's most recent live birth up to the date of survey has emerged as a particularly informative measure. Unlike closed birth intervals, which capture only completed reproductive events, OBI reflects ongoing fertility behaviour and provides insights into current and future childbearing intentions, birth spacing practices, and fertility limitation or cessation. As such, it offers a dynamic perspective on reproductive decision-making and has been widely employed in demographic studies across diverse socio-cultural and economic settings. Fertility behaviour is shaped not only by biological factors but also by a complex web of social, economic, and cultural influences. Previous research has consistently highlighted the importance of women's education, family structure, age at marriage, contraceptive use, and autonomy in determining fertility outcomes (Bongaarts, 2015). Open birth intervals are particularly sensitive to these determinants, making them a useful tool for examining differentials in reproductive behaviour within and across populations. Longer OBIs often signal deliberate birth spacing or stopping behaviour, whereas shorter intervals may indicate unmet need for contraception, limited autonomy, or socio-cultural pressures favouring higher fertility. Understanding these variations is therefore essential for designing effective reproductive health and family planning interventions.

India's fertility transition has been characterized by substantial regional heterogeneity. Although the country has experienced a sustained decline in fertility over recent decades, this process has been uneven across states, districts, and rural–urban areas. Findings from the National Family Health Survey-5 (NFHS-5) underscore persistent fertility differentials associated with socio-economic status, educational attainment, and access to reproductive health services (IIPS & ICF, 2021). These disparities highlight the importance of micro-level analyses that can capture localized fertility dynamics often masked in national-level assessments. In this context, Manipur, located in the easternmost part of India and sharing an international border, presents a distinctive demographic and socio-cultural setting. The state is marked by ethnic diversity, varying family systems, and uneven access to health infrastructure, leading to notable differences in fertility behaviour between hill and valley regions. Against this milieu, the present study examines the socio-economic and demographic determinants of OBI among currently married women in the rural valley districts of Bishnupur, Imphal East, Imphal West, and Thoubal. By applying survival analysis techniques and accounting for censored observations, the study seeks to generate nuanced insights into fertility behaviour and to inform region-specific policies aimed at promoting optimal birth spacing and improving reproductive health outcomes in Manipur.

Literature Review

Birth intervals have long been recognized as a crucial dimension of fertility analysis, offering valuable insights into reproductive behaviour, fertility regulation, and population change. Early demographic work by Bongaarts and Potter (1983) established that birth spacing and stopping behaviour are central mechanisms through which fertility decline occurs. They argued that longer birth intervals often reflect deliberate fertility control, particularly in societies experiencing demographic transition. Expanding this approach, Hobcraft and Rutstein (1985) emphasized the analytical importance of open birth intervals (OBI), noting that they help identify women who remain biologically exposed to conception but may be intentionally or unintentionally limiting further childbearing. Consequently, OBI has emerged as a sensitive

indicator of fertility differentials across socio-economic and demographic groups. A substantial body of literature highlights the influence of socio-economic factors on open birth intervals. Caldwell's (1980) wealth flow theory suggests that improvements in education and changes in economic organization alter the perceived costs and benefits of children, leading to fertility limitation and longer birth intervals. Supporting this view, Jejeebhoy (1995) demonstrated that women's education and autonomy significantly influence contraceptive use and birth spacing decisions in India. Educated women are more likely to delay or stop childbearing, thereby extending their OBIs. Family structure has also been identified as an important determinant of fertility behaviour. Desai and Andrist (2010) observed that women in joint families experience reproductive pressures shaped by elders and collective norms, which may delay or limit childbearing. In contrast, nuclear family settings often encourage earlier completion of family size, resulting in shorter OBIs at younger ages and longer intervals later in life.

Demographic characteristics such as age at marriage and duration of marriage have consistently been associated with birth interval patterns. Rajaretnam and Deshpande (1994) found that early marriage leads to early initiation of childbearing and quicker attainment of desired family size, which subsequently results in longer open birth intervals. Adopting a life-course perspective, Hobcraft (1993) argued that OBI tends to increase with advancing age and marital duration as women move from active childbearing to fertility limitation and cessation. Among proximate determinants, contraceptive use remains one of the most powerful influences on birth intervals. Cleland et al. (2012) demonstrated that contraceptive adoption significantly lengthens birth intervals, particularly when women seek to stop further childbearing, a finding reinforced by Bongaarts (2015), who emphasized the role of contraceptive prevalence and effectiveness in shaping spacing and stopping behaviour. In the Indian context, regional and district-level studies reveal persistent fertility differentials. Bhat and Zavier (1999) observed that although socio-economic inequalities in fertility narrow as fertility declines, substantial micro-level variations persist. Basu (2002) further highlighted the role of cultural norms and gender relations in shaping reproductive behaviour, especially in rural areas. Focusing on North-East India, Retherford and Choe (2011) reported longer birth intervals and lower fertility in regions with higher female education and autonomy. In Manipur, studies by Devi (2017) and Singh and Singh (2019) documented the influence of cultural practices, kinship systems, access to health services, and socio-economic disparities on fertility behaviour. Evidence from NFHS-5 (IIPS & ICF, 2021) confirms that age at marriage, education, and contraceptive use remain key determinants of fertility and birth spacing in India, while also underscoring the need for region-specific, micro-level analyses, particularly in the rural valley districts of Manipur.

Objectives

The present study is designed to achieve a comprehensive understanding of fertility behaviour through the analysis of open birth intervals (OBI) among currently married women in the rural valley districts of Manipur. The specific objectives are: (i) to examine the overall pattern and distribution of open birth intervals among currently married women with at least one live birth in the selected districts; (ii) to assess the influence of selected socio-economic factors such as type of family and educational qualification on the duration of OBI; (iii) to analyse the impact of key demographic variables including age at current marriage, duration of current marriage, present age, and contraceptive use on variations in OBI; (iv) to identify significant differentials in OBI using survival analysis techniques that account for censored

observations; and (v) to generate empirical evidence that can inform region-specific family planning and reproductive health policies aimed at promoting optimal birth spacing and improving reproductive outcomes in rural Manipur.

Materials and Methods

A cross-sectional, community-based study was conducted in the rural valley districts of Bishnupur, Imphal East, Imphal West, and Thoubal, Manipur, to examine variations in open birth intervals (OBI) among currently married women. The study included 1,059 women with at least one live birth. Due to the lack of a complete village-level sampling frame, cluster sampling was used to ensure representative coverage. Data were collected over six months (February - August 2024) through personal interviews using a pre-tested semi-structured schedule, with February 10, 2024, as the reference date for OBI measurement. The response variable was the duration (in months) since the most recent live birth, with women who had ceased childbearing or had no subsequent birth treated as right-censored. Explanatory factors included family type, education, age at marriage, marital duration, present age, and contraceptive use.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). Survival analysis techniques were employed to examine variations in OBI across different categories of explanatory variables. Specifically, the Log-rank test, also known as the Mantel–Cox test, was used to compare survival functions between two or more groups in the presence of right-censored data. The null hypothesis assumed no difference in the duration of OBI between comparison groups, while the alternative hypothesis posited a significant difference. The test statistic follows an asymptotic chi-square distribution, enabling assessment of statistical significance in observed differences in open birth intervals across groups. Suppose that there are two groups where the observations of OBI in group 1 are samples from a distribution with survival function $S_1(t)$ and the observations in group 2 are samples from the distribution with survival function $S_2(t)$. The null hypothesis is $H_0: S_1(t) = S_2(t)$ that is there is no difference in the duration of OBI between two groups against the alternative hypothesis, $H_1: S_1(t) \neq S_2(t)$.

Let $t_1 < t_2 \ldots\ldots < t_g$ be distinct ordered duration of OBI for combined sample of the two groups. Let d_j = the number of women whose duration of OBI is t_j in both groups (for complete data and no ties $d_j = 1$ for every j).

We suppose, n_{1j} = the number of women at risk at t_j from group 1.

n_{2j} = the number of women at risk at t_j from group 2.

n_j = the total number of women at risk at t_j.

$= n_{1j} + n_{2j}$

The Log rank test compares the observed and expected (under H_0) number of women having uncensored duration of OBI in group1.

Let E = Expected (under H_0) number of events in sample 1

$= \sum_{j=1}^{g} d_j \frac{n_{1j}}{n_j}$

The variance of E is given by

$V = \sum_{j=1}^{g} d_j \frac{n_{1j} n_{2j}}{n_j^2}$

O = Observed number of events in sample (group) 1.

Under H_0 the test statistics is given by

$Z = \frac{O-E}{\sqrt{V}}$ has asymptotically standard normal distribution

$i.e., \frac{(O-E)^2}{V} \sim \chi^2$

Since square of standard normal variate is chi-square variate.

Analysis and Results

The survival analysis revealed marked socio-economic differentials in the duration of open birth intervals (OBI) among currently married women in the rural valley districts of Manipur. Among the socio-economic variables examined, type of family and educational qualification emerged as highly significant determinants of OBI, both at the 1 per cent level of significance ($p < 0.01$). As presented in Table 1, women residing in nuclear families experienced substantially shorter open birth intervals compared to those living in joint families. The median OBI among women from nuclear families was 68 months (SE = 5.48; 95% CI: 57.26-78.74), whereas women from joint families recorded a considerably longer median OBI of 100 months (SE = 6.46; 95% CI: 87.35-112.65). This difference suggests that extended family structures may facilitate fertility limitation or delayed childbearing through shared economic responsibilities and collective decision-making. Educational qualification also showed a statistically significant association with OBI, indicating that women's educational attainment plays an important role in shaping reproductive behaviour. Variations in median OBI across educational categories suggest differences in fertility intentions, access to information, and adoption of fertility control practices. In contrast, other socio-economic variables such as caste, occupation, employment status, and income did not exhibit statistically significant effects, although observable variations in median OBIs across categories point to underlying heterogeneity in fertility behaviour.

Analysis of demographic variables further underscored the importance of life-course factors in determining the duration of open birth intervals (Table 2). Age at current marriage, duration of current marriage, and present age were all found to be highly significant ($p < 0.01$), while use of contraceptives also exerted a significant influence on OBI ($p < 0.05$). A pronounced linear trend was observed with respect to duration of marriage, wherein the median OBI increased steadily as marital duration advanced. Women married for 0-3 years had the shortest median OBI of 20 months (SE = 2.74; 95% CI: 14.63-25.37), which progressively increased across successive marital duration groups, reaching a maximum of 189 months (SE = 7.32; 95% CI: 174.66-203.34) among those married for 19 years or more. A similar linear pattern was evident for present age, with women below 25 years exhibiting the shortest median OBI of 18 months (SE = 14.00; 95% CI: 0.00-45.44), followed by a rapid increase in OBI with advancing age, culminating in a median of 187 months (SE = 11.18; 95% CI: 165.09-208.92) among women aged 45 years and above. Age at current marriage displayed a near U-shaped relationship with OBI, wherein women marrying at younger (<20 years) and older ages recorded longer intervals, while those marrying between 25-30 years experienced the shortest median OBI of 69 months (SE = 10.32; 95% CI: 48.78-89.22). Contraceptive use further

differentiated OBI outcomes, with users reporting a substantially longer median OBI of 124 months (SE = 25.26; 95% CI: 74.50-173.54) compared to non-users, who recorded a median OBI of 79 months (SE = 5.36; 95% CI: 68.49-89.51). These findings collectively highlight the combined influence of demographic progression and reproductive control on fertility behaviour in rural Manipur.

Discussion

The findings of the present study reaffirm the central role of socio-economic factors in shaping fertility behaviour, particularly the duration of open birth intervals (OBI), and closely align with established demographic theories. The statistically significant influence of family structure and women's education on OBI provides strong empirical support for the arguments advanced by Caldwell (1980) and Jejeebhoy (1995), who emphasized that shifts in household organization and female education fundamentally alter reproductive decision-making. The longer median OBI observed among women living in joint families suggests that extended kinship systems may foster an environment conducive to fertility limitation or delayed childbearing. Collective decision-making, shared economic responsibilities, and the presence of elders in such households often exert social controls that encourage couples to postpone or stop further childbearing once the desired family size is achieved. This interpretation is consistent with Desai and Andrist's (2010) observation that joint family arrangements frequently mediate fertility behaviour through social norms and intergenerational influence. In contrast, shorter OBIs among women in nuclear families may reflect earlier completion of family size and relatively weaker social constraints on reproductive timing. Women's education emerged as another crucial determinant of OBI, reinforcing existing evidence that education enhances autonomy, access to reproductive health information, and the capacity to make informed fertility choices. Educated women are more likely to consciously adopt spacing or stopping strategies, thereby extending open birth intervals. Together, these findings underscore the continuing relevance of socio-economic determinants of fertility, even in regions undergoing gradual demographic transition.

The demographic patterns observed in the study also strongly conform to the life-course perspective proposed by Hobcraft (1993), which views fertility behaviour as evolving with age and marital duration. The steady increase in median OBI with advancing age and longer duration of marriage reflects a transition from active childbearing to fertility limitation and eventual cessation. Short OBIs during the early years of marriage indicate high exposure to conception and a strong motivation to achieve desired family size, a pattern earlier documented by Rajaretnam and Deshpande (1994). As marital duration increases, the lengthening of OBI points to deliberate stopping behaviour, consistent with Bongaarts and Potter's (1983) framework of proximate determinants of fertility. The near U-shaped relationship between age at marriage and OBI further highlights the importance of marriage timing in shaping long-term fertility trajectories. Finally, the significant impact of contraceptive use on OBI reinforces its status as one of the most powerful proximate determinants of fertility, as emphasized by Cleland et al. (2012) and Bongaarts (2015). Women using contraception exhibited substantially longer OBIs, indicating intentional fertility regulation. This finding aligns with evidence from NFHS-5 (IIPS & ICF, 2021) and earlier district-level studies in Manipur (Singh & Singh, 2019). By providing micro-level evidence from rural valley districts, the study demonstrates that fertility behaviour is shaped by an interaction of family structure, education, demographic

progression, and contraceptive practice, underscoring the need for region-specific family planning strategies.

Conclusion

The study highlights that fertility behaviour, measured through open birth intervals (OBI), is strongly influenced by socio-economic and demographic factors in the rural valley districts of Manipur. Women residing in joint families and those with higher educational attainment exhibited longer OBIs, suggesting that household structure and personal autonomy play key roles in reproductive decision-making. Age at marriage, duration of marriage, and present age also significantly affected OBI, with shorter intervals observed in the early years of marriage and progressively longer intervals as women aged and moved toward fertility limitation. A near U-shaped relationship was found between age at marriage and OBI, indicating that both very early and later marriages shape long-term fertility patterns. Contraceptive use was associated with substantially longer OBIs, highlighting its importance in deliberate birth spacing and fertility regulation. Overall, the findings indicate that fertility behaviour in rural Manipur is not determined solely by biological factors but is shaped by a combination of family dynamics, educational attainment, marital timing, and reproductive choices. These results underscore the need for targeted family planning strategies that encourage female education, delayed marriage, informed reproductive decision-making, and continued access to effective contraception to promote optimal birth spacing and enhance reproductive health outcomes in the region.

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Table 1: Variation in Open Birth Intervals according to Socio-Economic Variables

Parameter	Category (with n%)	Median OBI (in mth)	S. E	95% CI (lower-upper)	Test value (df)
Type of family	Nuclear (38.1)	68	5.48	57.26-78.74	χ^2 =11.17; P=0.001(1)
	Joint (61.9)	100	6.46	87.35-112.65	
Caste	General (17.6)	89	11.33	66.80-111.20	χ^2 =1.04; P=0.793(3)
	OBC (72.4)	77	6.13	64.99-89.01	
	SC (6.3)	121	35.59	51.24-190.76	
	ST (3.7)	88	33.00	23.32-152.68	
Employment Status	Non-workers (55.5)	78	7.00	64.28-91.72	χ^2 =5.50; P=0.139(3)
	Government (4.5)	60	6.53	47.20-72.80	
	Non-Government (3.5)	117	6.26	104.73-129.22	
	Self-employed (36.5)	88	10.00	68.41-107.59	
Qualification	Below 10 (32)	99	8.24	82.5-15.15	χ^2 =12.21; P=0.007(3)
	10 passed (28.1)	75	8.05	59.22-90.78	
	12 passed (19.2)	98	13.44	71.66-124.34	
	Graduate and above (20.6)	59	12.37	34.76-83.24	
Occupation	Non workers (55)	78	7.26	63.77-92.23	χ^2 =5.42; P=0.247(4)
	Cultivators (2.6)	72	21.47	29.92-114.08	
	Agricultural labours (1.6)	110	11.51	87.44-132.56	
	Household industry (32.1)	99	7.45	84.39-113.61	
	Others (8.7)	68	10.69	47.04-88.96	
Income (in '000Rs.)	<10 (6.6)	87	18.52	50.70-123.30	χ^2 =8.01; P=0.331(7)
	10-20 (33.5)	84	8.17	67.99-100.01	
	20-30 (21.8)	90	9.71	70.97-109.03	
	30-40 (9.4)	66	3.16	59.80-72.20	
	40-50 (8.4)	62	4.50	53.18-70.82	
	50-60 (9.1)	102	18.66	65.42-138.58	
	60-70 (4)	106	40.47	26.67-185.33	
	70+ (7.3)	117	30.78	56.68-177.32	
Overall		**84**	**5.67**	**72.89-95.11**	

Table 2: Variation in Open Birth Intervals according to Demographic Variables

Parameter	Category (with n%)	Median OBI (in mth)	S. E	95% CI (lower-upper)	Test value (df)
Age at menarche	< 12 (11.0)	72	12.34	47.82-96.18	χ^2 =3.62; P=0.606 (5)
	12-13 (23.2)	76	8.04	60.24-91.76	
	13-14 (28.1)	105	8.83	87.70-122.30	
	14-15 (20.6)	80	8.29	63.74- 96.26	
	15-16 (9.4)	78	9.55	59.29-96.71	
	16+ (7.7)	87	21.74	44.39-129.61	
Age at current marriage	Below 20 (24.4)	99	14.45	70.68-127.32	χ^2 =12.96; P=0.011 (4)
	20-25 (33.5)	78	8.23	61.88-94.13	
	25-30 (27.2)	69	10.32	48.78-89.22	
	30-35 (12.9)	80	7.21	65.88-94.12	
	35 and above (2.1)	76	13.42	49.70-102.30	
Duration of current marriage	0-3 (7.0)	20	2.74	14.63-25.37	χ^2 =429.90; P=0.000 (5)
	4-7 (15)	36	4.00	28.16-43.84	
	8-11 (19)	54	7.02	40.25-67.75	
	12-15 (23.4)	91	5.75	79.73-102.27	
	16-19 (16.2)	131	3.08	124.96-137.04	
	19+ (19.4)	189	7.32	174.66-203.34	
Present age	< 25 (3.7)	18	14.00	0.00-45.44	χ^2 =325.48; P=0.000 (5)
	25-30 (11.9)	34	3.92	26.32-41.68	
	30-35 (19.4)	59	8.52	42.31-75.69	
	35-40 (23)	65	4.89	55.41-74.59	
	40-45 (24.4)	127	4.11	118.94-135.06	
	45+ (17.6)	187	11.18	165.09-208.92	
Use of contraceptives	No (84.3)	79	5.36	68.49-89.51	χ^2 =4.90; P=0.027 (1)
	Yes (15.7)	124	25.26	74.50-173.54	
Overall		**84**	**5.67**	**72.89-95.11**	