Research Article

Annual Demographic Behaviour of Rural Population Covered Under Demographic Surveillance at Palwa Sector, Ujjain District (2023)

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Background: Demographic surveillance provides essential insights into fertility, mortality, migration, and maternal and child health indicators, particularly in rural populations where localized data are often limited. National demographic estimates may mask important micro-level variations, highlighting the need for block-level surveillance to support decentralized planning and targeted public health interventions.

Aim and Objectives: To analyse and compare demographic characteristics and birth-related events across three rural blocks, Tarana, Mahidpur, and Ghatiya of Ujjain district, using routine demographic surveillance data for the year 2023. The objectives included comparison of live births, childbirth characteristics, mortality patterns, and migration trends, along with evaluation of block-wise demographic indicators.

Methodology: This retrospective cross-sectional record-based study was conducted using demographic surveillance data from 60 adopted rural villages under the field practice area of the Tertiary Medical College of Madhya Pradesh. Universal sampling was applied, and all recorded live births, deaths, immigration, and emigration events between 1 January and 30 December 2023 were included. Data were extracted using a structured format, analysed using SPSS software, and summarized using descriptive and inferential statistics, including chi-square tests for block-wise comparisons.

Results: The study covered a population of 99,067 and recorded 1,439 live births and 405 deaths, resulting in a crude birth rate of 14.5 per 1000 and a crude death rate of 4.09 per 1000. Ghatiya showed the lowest mortality, highest natural increase, and highest net migration rate, indicating stronger population growth dynamics. Institutional deliveries were predominant across all blocks, and normal vaginal delivery was the most common mode. Female migration constituted the majority of migration events. However, sex ratios at birth were low across all blocks, indicating gender imbalance.

Conclusion: The study highlights significant inter-block demographic variations and demonstrates the utility of routine demographic surveillance in identifying localized population trends. Regular surveillance can support evidence-based planning, strengthen maternal and child health programs, and enable targeted public health interventions at block and district levels.

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Introduction

Demographic surveillance provides a critical foundation for understanding population dynamics and guiding public health planning, particularly in rural and resource-limited settings. Indicators such as fertility, mortality, sex ratio, and migration patterns reflect the health and socio-economic conditions of communities and are essential for monitoring progress toward national health goals.[1] In India, macro-level estimates generated through large-scale systems such as the Sample Registration System (SRS reported a crude birth rate of 18.4 per 1,000 population and a crude death rate of 6.4 per 1,000 in 2023, alongside improvements in child survival indicators and sex ratio at birth.[2] While these national estimates are valuable, they often conceal substantial sub-regional variation, underscoring the importance of localized demographic assessments capable of informing decentralized planning.[3]

Over recent decades, government initiatives aimed at strengthening maternal and child health have contributed to significant shifts in childbirth practices and service utilisation. Programs implemented under the National Health Mission, including the Janani Suraksha

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Yojana and Janani Shishu Suraksha Karyakram, have improved access to antenatal care, institutional delivery services, and newborn care across India.[4] Evidence from observational studies has demonstrated marked increases in institutional deliveries following implementation of these schemes, particularly among rural and socio-economically disadvantaged populations. National survey findings, including those from NFHS-5, further indicate improvements in maternal health service utilisation in states such as Madhya Pradesh, reflecting progress in outreach, transport linkages, and community health worker engagement.[5]

Despite these advances, disparities persist in maternal and child health outcomes across states and rural regions. Madhya Pradesh continues to experience relatively higher maternal and infant mortality compared with national averages, reflecting ongoing gaps in access to quality obstetric care, infrastructure, and skilled workforce availability in rural populations. Accessibility barriers, socio-cultural factors, and migration patterns, especially marriage-related female migration, further influence healthcare continuity and population composition. Importantly, most available data are aggregated at state or district levels, limiting the ability to identify micro-level variations that may influence program effectiveness and health outcomes.[4]

Routine demographic surveillance conducted through academic field practice areas provides a valuable mechanism to generate granular, community-level evidence. Continuous documentation of births, deaths, and migration at the household level allows detailed monitoring of population change and service utilisation patterns at micro-administrative scales. However, such routinely collected records remain under-analysed, and comparative block-wise assessments are seldom undertaken.[6] Consequently, variations in childbirth practices, cesarean section rates, sex ratio at birth, birth weight distribution, seasonal trends in vital events, and migration dynamics remain insufficiently explored. The absence of such disaggregated analysis restricts decentralized planning and limits the development of targeted, context-specific interventions aimed at improving maternal and child health outcomes.[7]

In this context, the present study was undertaken to analyse the annual demographic behaviour of rural populations covered under demographic surveillance in the Palwa sector of Ujjain district. By examining block-wise variations in births, mortality, childbirth characteristics, and migration patterns, the study aims to generate localized evidence that can inform health planning, support resource prioritisation, and contribute to understanding demographic transitions within rural central India.

Materials and Methods

This retrospective cross-sectional record-based study was conducted using routinely collected demographic surveillance data from 60 adopted rural villages under the field practice area of a tertiary care medical college in Central India for the year 2023. These villages were distributed across three rural blocks of Ujjain district-Tarana, Mahidpur, and Ghatiya-with each block comprising 20 villages. The study aimed to analyse and compare demographic characteristics and birth-related events across the three blocks. The primary objectives were to assess and compare the total number of live

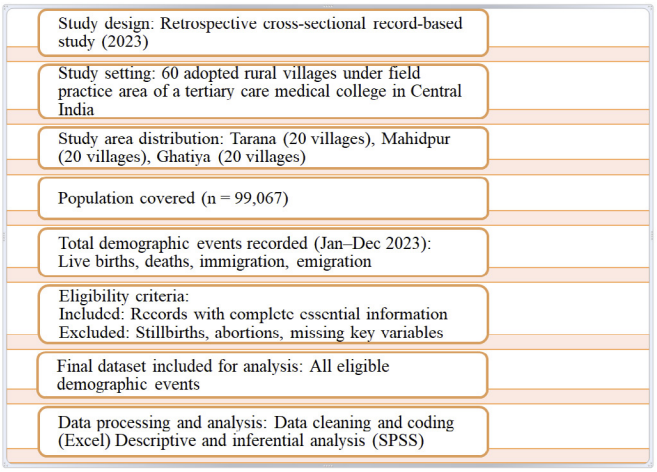

Fig 1: Flowchart of Study Setting, Sampling, and Data Inclusion Process

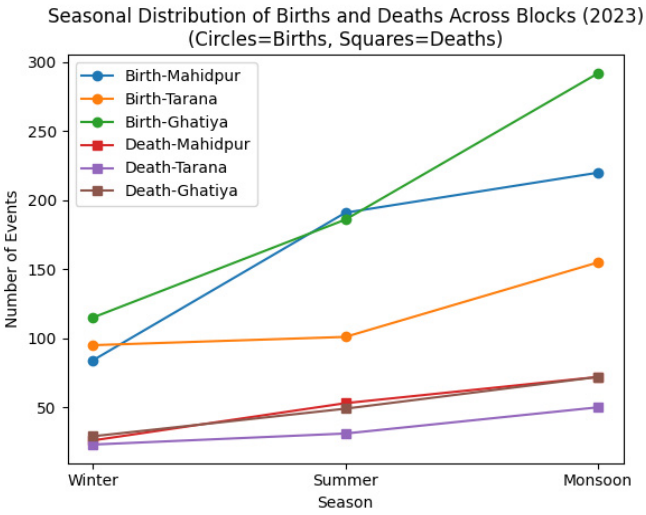

Fig 2: Seasonal distribution of births and deaths across blocks

Table 1: Population dynamics and vital events: Comparison of birth and death indicators across blocks (2023

Block	*Population*	*Live births (n*	*Birth rate (per 1000*	*Deaths (n*	*Death rate (per 1000*
Mahidpur	33,225	495	14.9	151	4.54
Tarana	25,870	351	13.6	104	4.02
Ghatiya	39,972	593	14.8	150	3.75
Total	99,067	1,439	14.5	405	4.09

Table 2: Mortality comparison by sex across blocks

Block	*Male deaths*	*Female deaths*	*Total*	*Chi-square value*	*p-value*
Mahidpur	86 (56.95%	65 (43.05%	151	1.228	0.541
Tarana	57 (54.81%	47 (45.19%	104		
Ghatiya	76 (50.67%	74 (49.33%	150		

Table 3: Migration patterns: Gender-wise distribution of migration

Block	*Immigration male N (%*	*Immigration female n (%*	*Immigration total*	*Emigration male n (%*	*Emigration female n (%*	*Emigration total*
Mahidpur	38 (16.1	198 (83.9	236	1 (1.5	67 (98.5	68
Tarana	16 (9.8	148 (90.2	164	0 (0.0	33 (100.0	33
Ghatiya	57 (15.4	312 (84.6	369	1 (1.3	74 (98.7	75
Total	111 (14.4	658 (85.6	769	2 (1.1	174 (98.9	176
$\chi^2 = 0.47$, p = 0.789				$\chi^2 = 3.74$, p = 0.154		

births recorded in each block and to evaluate childbirth characteristics, including place of delivery (institutional or home, type of delivery (normal or cesarean, sex of the newborn, and birth weight distribution. The secondary objectives were to analyse and compare monthly trends in births and mortality patterns and to describe migration patterns, including immigration and emigration, across the three blocks.

The study included all demographic events recorded between 1 January 2023 and 30 December 2023. Data were obtained from routine demographic surveillance conducted by trained health workers and voluntary workers under the framework of National Medical Commission guidelines, the Family Adoption Program (FAP,[8,9] and the Community Adoption Program implemented by postgraduate students. All surveillance activities were supervised by the Department of Community Medicine of the same institution. The surveillance system systematically records household-level demographic events, including live births, deaths, immigration, and emigration.

Universal sampling was adopted, and all recorded live births, deaths, immigration, and emigration events with complete essential information were included in the study. Records of stillbirths and abortions, as well as records with missing critical information such as date of event, sex, place of delivery, or block and village identification, were excluded from the analysis. Relevant data were extracted using a structured data extraction format and entered into Microsoft Excel, where data cleaning was performed to remove duplicate entries and incomplete records. Variables were appropriately coded, and statistical analysis was carried out using SPSS software. Descriptive statistics, including frequencies, percentages, and means, were used to summarize the data, while inferential statistical analysis included chi-square tests to assess block-wise differences and trend analysis to evaluate monthly variations. Comparative tables and graphical representations were generated for block-wise comparison and interpretation. The primary outcome measures included block-wise comparison of crude birth rates, crude death rates, natural increase rates, institutional delivery rates, type of delivery (normal and cesarean, sex ratio at birth, distribution of birth weight (low birth weight and normal birth weight, sex-wise mortality distribution, and migration patterns,

Table 4: Comparison of childbirth characteristics and sex ratio across blocks (2023

Category	*Characteristic*	*Mahidpur*	*Tarana*	*Ghatiya*	*χ^2 Value*	*p-value*
Sex ratio at birth	Male Births (n	287	190	359	—	—
	Female Births (n	208	161	234	—	—
	Sex Ratio (F/1000 M	724.7	847.4	651.8	—	—
Place of delivery	Govt Hospital wn (%	384 (77.6	316 (90.0	456 (76.9	27.49	<0.001
Type of delivery	Normal n (%	468 (94.5	333 (94.9	551 (92.9	1.95	0.378
	Cesarean n (%	27 (5.5	18 (5.1	42 (7.1		
Sex of newborn	Male n (%	287 (58.0	190 (54.1	359 (60.5	3.72	0.155
	Female n (%	208 (42.0	161 (45.9	234 (39.5		
Birth weight	LBW n (%	5 (1.0	9 (2.6	8 (1.3	3.51	0.173
	Normal BW n (%	490 (99.0	342 (97.4	585 (98.7		

Table 5: Comparative block performance: Population growth indicators and migration dynamics across blocks (2023

Block	*Crude birth rate*	*Crude death rate*	*Natural increase rate*	*Immigration rate*	*Emigration rate*	*Net migration rate*
Mahidpur	14.9	4.54	10.36	7.10	2.05	5.05
Tarana	13.6	4.02	9.58	6.34	1.28	5.06
Ghatiya	14.8	3.75	11.05	9.23	1.88	7.35

Table 6: Comparative demographic indicators- India, Madhya Pradesh, and Study Blocks (2023

Indicator	*India (SRS 2023[10]**	*Madhya Pradesh [11]**	*Mahidpur*	*Tarana*	*Ghatiya*
Crude birth rate	18.4	~22.5	14.9	13.6	14.8
Crude death rate	6.4	~6–7	4.54	4.02	3.75
Natural increase rate	~12.0	~15.7	10.36	9.58	11.05
Sex ratio at birth (F/1000 M	~917	~930–950†	724.7	847.4	651.8

including immigration, emigration, and net migration rates. In addition, key demographic indicators such as crude birth rate, crude death rate, natural increase rate, and sex ratio at birth were compared with available state and national estimates to provide a broader demographic context. These indicators were used to assess inter-block demographic variations and to identify block-specific differences in population dynamics and maternal and child health characteristics.

Results

The present study analysed demographic surveillance data from 60 adopted villages, covering a total population of 99,067. Table 1 shows that A total of 1,439 live births and 405 deaths were recorded, corresponding to a crude birth rate of 14.5 per 1000 and a crude death rate of 4.09 per 1000. Among the blocks, Mahidpur reported the highest crude birth rate (14.9 per 1000 and death rate (4.54 per 1000, while Tarana had the lowest birth rate (13.6 per 1000. Ghatiya demonstrated the lowest mortality (3.75 per 1000 and the highest natural increase rate (11.05 per 1000. Sex-wise mortality showed a predominance of male deaths in Mahidpur (56.9% and Tarana (54.8%, whereas Ghatiya demonstrated a nearly equal distribution. Births increased steadily from winter to monsoon across all blocks, while deaths remained consistently lower (Fig. 2). However, the difference was not statistically significant (χ^2=1.228, p = 0.541) (Table-2). Migration analysis (Table-3) showed a predominance of female migration, accounting for 85.6% of immigrants and 98.9% of emigrants. Ghatiya recorded the highest net migration rate (7.35 per 1000, followed by Tarana (5.06 per 1000 and Mahidpur (5.05 per 1000. Table 4 presents childbirth characteristics and sex ratios across the blocks. Male births exceeded female

births in all blocks, resulting in a low sex ratio at birth, particularly in Ghatiya block, where only 651.8 females were born per 1,000 males. Institutional deliveries were predominant, especially in government facilities (76–90%, with a statistically significant difference between blocks (χ^2=27.49, p <0.001. Normal vaginal delivery was the most common mode (92.9–94.9%, while cesarean section rates remained low (5.1–7.1%. Low birth weight prevalence was minimal (1.0–2.6% across all blocks. Comparative analysis (Table 5) showed that the natural increase was highest in Ghatiya block (11.05 per 1,000), followed by Mahidpur block (10.36 per 1,000) and Tarana block (9.58 per 1,000). Crude birth and death rates across all blocks were lower than the national estimates (18.4 and 6.4 per 1,000, respectively). However, the sex ratio at birth was substantially lower than both national and state estimates, as shown in Table 6.

Discussion

The present demographic surveillance–based analysis provides insight into population dynamics across rural blocks of Ujjain district and highlights the value of routinely collected community-level data for understanding localized demographic behaviour. The study demonstrated comparatively lower fertility and mortality indicators than national benchmarks alongside high institutional delivery utilisation, low cesarean section prevalence, predominantly normal birth weight distribution, female-dominant migration, and markedly skewed sex ratios at birth. These findings underscore intra-district heterogeneity and reinforce the importance of micro-level demographic monitoring for decentralized planning. The crude birth rates observed in Mahidpur, Tarana, and Ghatiya were lower than national estimates reported by the Sample Registration System, which documented a crude birth rate of 18.4 per 1,000 population in 2023, reflecting an overall decline in fertility levels across India as part of an ongoing demographic transition.[12]

Reduced fertility in the present population may relate to increased access to family planning services, delayed age at marriage, rising education levels, and behavioural shifts toward smaller family norms that have been reported nationally as contributors to fertility decline.[13] Similarly, crude death rates across the study blocks were lower than the national estimate of 6.4 per 1,000 population, suggesting relatively favourable survival conditions possibly linked to improved healthcare outreach and immunization coverage under national health programs, although the possibility of under-registration inherent in record-based surveillance must be considered when interpreting such findings. The resulting natural increase rates below national patterns indicate comparatively slower population growth and may represent localized progression toward demographic stabilization consistent with broader national trends in declining fertility and mortality.[14]

Comparison with state and national data further contextualizes these findings. Mahidpur, Tarana, and Ghatiya recorded substantially lower crude birth rates than the national average of 18.4 per 1,000 population and lower crude death rates than national benchmarks, indicating comparatively reduced fertility and mortality levels in these blocks. Natural increase rates were also lower, reflecting slower population growth through natural increase relative to broader demographic patterns. In contrast, sex ratios at birth in the study population were considerably lower than national benchmarks, where India's sex ratio at birth has been estimated at approximately 917 females per 1,000 males. Persistent imbalance in sex ratio has been attributed in prior research to factors such as son preference and fertility squeeze, which contribute to sex-selective practices and gender disparities in birth outcomes. The markedly lower ratios observed in the present study, therefore, warrant attention and may reflect socio-cultural influences, reporting variability, or small-area demographic fluctuation.[14, 15]

High institutional delivery utilisation across blocks aligns with national improvements in access to maternal healthcare services and reflects progress in facility-based childbirth coverage documented in population-level studies. However, cesarean section rates in the present study remained lower than national estimates of approximately 14% overall and about 10% in public facilities, suggesting possible differences in case-mix, referral patterns, or access to surgical obstetric care. Interpretation of low cesarean prevalence should therefore consider both clinical and health system determinants. The low proportion of low birth weight recorded in surveillance data contrasts with findings from national survey analyses documenting substantial adverse neonatal outcomes even among low-risk pregnancies, highlighting potential measurement or documentation variability in routine records.[16,17]

Migration patterns observed in the study demonstrated female predominance and positive net migration across blocks, consistent with national

patterns in which marriage-related movement constitutes the primary driver of female migration and shapes population structure and service utilisation. Such demographic mobility is increasingly recognized as a key determinant influencing healthcare access and population composition. Socio-economic and gender-related disparities further influence mobility and social participation patterns among women, reflecting broader structural inequalities documented in national research.[18]

Taken together, the coexistence of lower fertility and mortality with persistent gender imbalance and positive migration suggests a demographic profile characteristic of intermediate stages of transition influenced by local socio-economic development and health service access. The study's strengths lie in its population-based surveillance coverage and universal event inclusion, providing granular evidence not available from aggregated datasets. However, reliance on secondary records introduces limitations, including potential under-registration, absence of socioeconomic adjustment, and cross-sectional analytical constraints. Nevertheless, the findings demonstrate that systematic analysis of surveillance data can reveal important micro-level variations and support targeted public health interventions, resource allocation, and gender equity initiatives within rural populations.[19]

Conclusion

The present study provides a comprehensive assessment of demographic dynamics across Mahidpur, Tarana, and Ghatiya blocks using population-based surveillance data and highlights moderate population growth with clear variations in fertility, mortality, migration, and birth characteristics across the blocks. Ghatiya demonstrated the most favorable demographic performance, characterized by lower mortality, higher natural population increase, and stronger positive migration trends, indicating relatively better population stability. Mahidpur showed comparatively higher fertility but less favorable mortality and migration indicators, while Tarana demonstrated moderate demographic performance across most parameters. Institutional deliveries were widely utilized across all blocks, and normal vaginal delivery was the predominant mode, reflecting good access to maternal healthcare services. Migration patterns were predominantly female-driven, influencing population structure and growth dynamics. However, the consistently low sex ratio at birth across all blocks highlights a concerning gender imbalance that requires focused public health attention. The block-wise ranking further confirmed Ghatiya as the best-performing block overall, while Mahidpur showed scope for improvement in survival and migration indicators.

The findings emphasize the importance of establishing regular demographic surveillance at block and district levels as an integral component of the public health system, with coordinated support from state and national authorities. Continuous monitoring of demographic indicators can facilitate early identification of adverse trends, support evidence-based planning, improve resource allocation, and strengthen maternal and child health programs. Such surveillance systems can also help evaluate the effectiveness of ongoing interventions and enable targeted, region-specific public health strategies, thereby contributing to improved population health management and balanced demographic development.

Ethical Approval

The ethical approval has been given by the Institutional Ethics Committee of R.D. Gardi Medical College, Ujjain, with reference no. 01/2025

Conflict of Interest

None.

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None.

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