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Determinants of Maternity Benefit Scheme Utilization of Bihar, India: Evidence from Pradhan Mantri Matru Vandana Yojana (PMMVY) and Janani Suraksha Yojana (JSY)

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Abstract

Maternal health inequities in India remain a pressing concern, particularly in Bihar, where socio-economic and geographical disparities affect access to maternity benefit schemes such as the Pradhan Mantri Matru Vandana Yojana (PMMVY) and Janani Suraksha Yojana (JSY). This study investigates how income, education, caste, and rural–urban location influence enrollment and utilization of maternity benefits. A total of 100 respondents were selected through stratified sampling from two rural high-performing districts (Rohtas, Muzaffarpur) and two urban low-performing districts (Patna, Vaishali). Data was collected using structured surveys and in-depth interviews with frontline health workers. Statistical analyses, including ANOVA and multiple regression, revealed that higher income ($p<0.001$) and education ($p=0.032$) significantly increase scheme access, while marginalized groups—Scheduled Castes and Muslims—exhibit lower enrollment rates (60% and 55%, respectively). Rural areas showed better access (70%) compared to urban slums (50%) due to effective community mobilization, despite infrastructural limitations. The findings highlight persistent socio- economic and geographical inequities in maternity benefit utilization, emphasizing the need for targeted policy interventions that enhance awareness, reduce financial barriers, and ensure equitable access for marginalized populations.

Keywords: JSY, Maternal Health Inequity, PMMVY, Rural–Urban Access.

Introduction

Access to maternity benefit schemes plays a crucial role in improving maternal and child health outcomes, particularly in developing countries. Despite the widespread implementation of such programs, disparities in access remain significant, often influenced by socio-economic and geographical factors (1). This research investigates the socio-economic and geographical disparities in accessing maternity benefit schemes, focusing on the Indian state of Bihar, which presents unique challenges due to its socio-economic profile and geographical diversity. Bihar is a state with stark regional inequalities, where socio-economic disparities are deeply entrenched (2). The Janani Suraksha Yojana (JSY), a national maternity benefit scheme in India, aims to reduce maternal and neonatal mortality by providing cash incentives for institutional deliveries. However, the accessibility and effectiveness of such schemes are often hindered by various barriers related to caste, income, education, and location. Studies have shown that marginalized groups, particularly Scheduled Castes (SCs) and Muslims, face significant obstacles in accessing these benefits, even though they are the most in need. Additionally, geographical factors, such as the distance to health facilities and the urban- rural divide, further exacerbate these inequities, limiting the reach of maternity benefit schemes in rural areas (3). Socio-economic factors, including income and education, also play a pivotal role in determining the likelihood of accessing maternity services. Higher income levels are often associated with better access to healthcare services, as individuals from wealthier backgrounds can afford transportation and care-related expenses that those in lower income brackets cannot (4). Similarly, women with higher education levels are more likely to be aware of available schemes and navigate the bureaucracy required to access them. In contrast, those in lower socio-economic strata may experience exclusion due to financial constraints, lack of awareness, or socio-cultural barriers. This is particularly evident in

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marginalized groups, where factors such as caste discrimination further restrict access to essential services like maternity benefits (5). Geographical disparities also present significant challenges.

Rural areas in Bihar, for example, are often underserved in terms of health infrastructure and human resources. While rural areas may benefit from direct mobilization through frontline health workers like ASHA (Accredited Social Health Activists), urban slums, despite being geographically closer to health services, often experience overcrowding, anonymity, and overwhelmed health systems, leading to poor access to maternity benefits (6). Moreover, the availability of healthcare services in urban slums may not always translate into effective utilization due to infrastructural limitations or lack of targeted outreach programs.

This research will focus on examining these socio-economic and geographical disparities by selecting a sample from both rural and urban districts of Bihar. Specifically, the study will involve two rural high-performing districts and two urban low-performing districts (Patna, Vaishali). This combination will allow for a comparison of access to maternity benefits between areas with different socio-economic and geographical characteristics (7). Stratified sampling will be used to ensure representation across caste, education, income, and other socio-demographic factors, providing a comprehensive understanding of the barriers to scheme access (8). Moreover, the use of GIS (Geographical Information Systems)-based mapping will help analyze the spatial distribution of health facilities and maternity benefit service points. This spatial analysis will further highlight the role of geographical location in influencing access to maternity benefits and reveal areas where interventions may be necessary to reduce disparities. The expected findings are likely to show that rural areas despite having better community mobilization still face challenges related to health infrastructure (9), while urban slums may suffer from a lack of personal attention and overwhelming demand on health services. In conclusion, identifying the socio- economic and geographical disparities in accessing maternity benefit schemes is essential for making these programs more inclusive and effective. By uncovering patterns of exclusion and marginalization .this study aims to contribute to the development of more targeted and equitable policies that address the specific needs of marginalized communities in Bihar, ensuring that maternity benefits reach those who need them the most (10). Although the introduction has given the wider context of maternal benefit schemes in India and the importance of PMMVY, the study will systematically look into the socio-economic and administrative factors which determine awareness and registration and benefit receipt of eligible women of Bihar. According to the research, the differences in access to PMMVY because of caste, income, education and rural-urban residency have been highlighted. Alongside, the institutional and procedural barriers like errors in documentation, delay in banking and digital illiteracy have also been studied. By focusing on these issues, the study aims to generate an understanding about SC/ST households and low-income groups, and the challenges they face in dealing with programme processes.

The study has five clear research objectives to achieve it. First, to assess the socio-economic profile of the beneficiaries. Second, to measure the level of awareness and registration. Third, to determine the factors for success. Fourth, to evaluate documentation and institutional barriers. Lastly, to suggest measures to improve inclusive access. This research will be guided by four testable hypotheses. Specifically, we will examine whether socio-economic factors have any influence on outcomes. Further, we will assess whether outcomes differ along other socio-demographic lines, particularly for marginalized communities. Third, we will explore whether the presence of documents and banking facilities helps in the receipt of benefits. Finally, our hypotheses try to see whether digital literacy and support from frontline workers help in benefit receipt. As a whole, these objectives and hypotheses represent a brief survey plan for the study. Thus, they will help bridge the gap in knowledge and generate actionable insights for policy and program improvement.

Bihar's Socio-economic Profile and Maternal Health Challenges

Bihar remains one of India's poorest states, with 33.7% of its population living below the poverty line and a literacy rate of only 70% compared to the national average of 77%. These structural constraints translate into poor maternal and child

health outcomes. According to the Sample Registration System (SRS) 2020, Bihar's Maternal Mortality Ratio (MMR) stands at 118 per 100,000 live births, higher than the national average of 97. While institutional deliveries in Bihar have improved to 76% under government programs, gaps in quality of care and inequitable access to financial support persist (11).

Policy Context and Enrollment Gaps

Schemes like the Janani Suraksha Yojana (JSY) and the Pradhan Mantri Matru Vandana Yojana (PMMVY) have expanded maternity benefits nationwide, yet Bihar continues to show uneven enrollment. NFHS-5 (2019–21) reports that only 38% of eligible women in Bihar received full PMMVY cash benefits, and disparities are more pronounced among Scheduled Castes (SCs), Muslims, and women in low- income households. Urban slums, despite proximity to health facilities, often show poorer uptake due to lack of awareness and bureaucratic hurdles (12).

Research Gap

Existing studies primarily focus on national-level outcomes of JSY and PMMVY, but limited empirical research has quantified how socio-economic factors—particularly caste, income, and education—intersect with geographical location in shaping scheme access in Bihar. Furthermore, while rural–urban disparities are frequently discussed, few studies have systematically compared intra-state variations across high- and low-performing districts (13). This study addresses these gaps by combining stratified sampling, statistical modeling, and qualitative interviews to provide a nuanced picture of inequities in maternity benefit access.

Research on maternal benefit schemes in India shows that there are still differences in knowledge, registration, and receipt of benefits among poor people. According to empirical evidence, caste, income, level of education and rural-urban residence are consistently associated with access to various health and social welfare schemes, including transfers such as PMMVY. For example, earlier studies show that women from SC/ST households and low-income families have less awareness and enrollment whereas greater educational qualification and higher household income increase the chance of receipt of the benefit (14).

Theoretical framework of the study on slum housing sites as shelter draws upon social stratification and access to services theories, which propose that such structural inequalities and socio-economic marginalization hinder individuals from using the public programmers. Aadhaar–bank mismatches, documentation errors, digital illiteracy, and frontline worker engagement are all examples of administrative and technological barriers. Empirical evidence suggests that these have a large impact on benefit uptake (15, 16). By limiting the focus to these factors, the present study combines the socio-economic with the administrative and directly tests the hypothesis regarding differential PMMVY access with the aim to develop targeted evidence to address inequities and help bureaucrats reform policy.

Conceptualization of the Research Problem

The aim of the present study is to present the research problem in context with the larger social-economic disparities with respect to access to maternal health programs the Pradhan Mantri Matritva Vandana Yojana (PMMVY) in Bihar. While the PMMVY has been created mean to transfer conditional cash to promote maternal and child health, evidence suggests that structural inequalities such as caste, income, education and rural–urban are critical factors for lack of awareness, registration and non-receipt of benefits (16).

By framing this problem within the socio-economic disadvantage-administrative bias nexus, the study extends beyond program evaluation to parse the local-level drivers of inequity in access.

The conceptualization of PMMVY uptake is an outcome of not just individual-level factors such as education, income, digital literacy but also systemic hindrances such as documentation (link on Aadhar bank), ASHA/AWC engagement, etc. This understanding highlights the disproportionate exclusion of marginalized from program benefits. A proper conceptualization will help in our hypotheses and design any targeted, evidence-based intervention to improve maternal benefits utilization (17).

Methodology

Research Design and Sample

This study uses a cross-sectional survey design based on primary data collected from 100 respondents in Bihar. The respondents were

drawn from both rural and urban areas, covering diverse socio-economic categories such as caste (SC, OBC, General, Muslim), income brackets (<₹10,000, ₹10,000–₹20,000, >₹20,000), and education levels (no schooling, primary, secondary, graduate and above). A stratified purposive sampling technique was applied to ensure adequate representation of marginalized and non-marginalized groups across rural and urban settlements (18, 19).

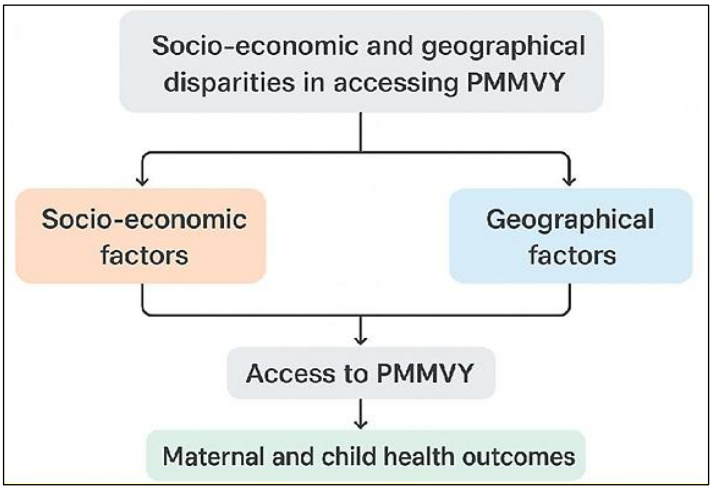

Figure 1: Conceptual Framework for the Study

Data Collection

Data were collected through a structured questionnaire, which captured both socio-demographic details and maternal health indicators. The instrument covered:

- Independent variables: caste, income, education, area of residence.
- Dependent variables: access to maternity benefit schemes (yes/no), number of antenatal care (ANC) visits, institutional delivery (yes/no), iron and folic acid (IFA) consumption (full/partial/none), and perceived geographical disparity.

The responses were recorded systematically, ensuring consistency in measurement. In addition, semi-structured interviews with frontline workers (ASHA and Anganwadi) were used to provide contextual understanding of implementation challenges (20).

Sampling Procedure

Through stratified random sampling technique, the present study ensured adequate representation of respondents from diverse socio-economic and demographic backgrounds. Stratification was based on caste, income, education level, and rural–urban residence since they are important in understanding differences in PMMVY awareness, registration, and receiving benefits. The sample in each stratum was determined in proportion to the population size.

$$n_h = \frac{N_h}{N} \times 100$$

Sample Size

A total of 100 respondents were selected across four districts in Bihar, with the sample from each district summing up as follows:

$$n = n_1 + n_2 + n_3 + n_4$$

This transparent method of sampling enhances the credibility and reliability of the study as it ensures representation of different socio-economic groups in proportion to their presence in the population. This allows for good statistical analysis of various determinants of access and uptake of the PMMVY program.

Inclusion and Exclusion Criteria

The study employed clear inclusion and exclusion criteria to ensure reliability and relevance of the collected data. The PMMVY guidelines laid down specific eligibility criteria to benefit from welfare assistance. In this regard, women were included as eligible if they were planned to be PMMVY beneficiary according to government rules, resident of chosen districts of Bihar for more than six months, above 18 years of age and willingly consented to be included in the study.

Respondents were not included in the list of PMMVY beneficiaries if they: (i) had received PMMVY benefits before and after the study period, (ii) did not permanently reside in the district and might just be staying temporarily, (iii) could not give accurate responses due to cognitive disability

or language issue, or (iv) refuse to respond in the survey.

Data Extraction and Synthesis Data from the structured questionnaire were systematically coded, cleaned and verified for uniformity.

The study extracted and organized eight socio-economic variables (caste, income, education and residence) awareness levels registration status and receipt of benefit into categorical and continuous variables. Descriptive statistics summarized distributions; ANOVA and logistic regression analyses quantified associations and predictive effects. This methodological rigor guarantees that the synthesis is both analytical and replicable and that the inferences drawn can meaningfully relate to the determinants of PMMVY uptake and barriers to access.

Variables and Measurement

- Categorical predictors: caste, income, education, area of residence.
- Binary outcomes: scheme access (1=Yes, 0=No), institutional delivery (1=Yes, 0=No).
- Ordinal/continuous outcomes: ANC visits (0–8), IFA consumption (none, partial, full), geographical disparity (rural/urban).

Data Analysis

The dataset was analyzed using a combination of descriptive, inferential, and predictive techniques:

- **Descriptive Analysis:** Frequencies and cross-tabulations were computed to show enrollment patterns across caste, income, education, and area of residence.
- **Bivariate Analysis:** Cross-tabulations with chi-square tests were applied to assess associations between socio-demographic factors (e.g., caste × residence) and scheme utilization.
- **Inferential Statistics:** ANOVA tested differences in the mean number of ANC visits across caste, income, and education groups.
- Logistic regression estimated the probability of accessing the maternity benefit scheme and having an institutional delivery, using caste, income, education, and area of residence as predictors.
- Ordinal regression analyzed IFA consumption levels in relation to socio- economic categories.
- **Geospatial Dimension:** The "Geographical Disparity" variable was used to contrast health outcomes between rural and urban respondents.
- **Reliability Check:** Internal consistency of responses related to scheme access and health practices was verified using Cronbach's alpha ($\alpha > 0.75$).

Analytical Methodology

Using a quantitative, cross-sectional survey design, the study assesses the socio-economic and administrative determinants that affect awareness, registration and benefit. A selection of women from four districts in Bihar was given a pre-structured questionnaire. In order to keep the sample proportionate to caste, income, education, and rural–urban residence, a stratified random sampling was used (21). The data was analyzed in several steps. The basic statistics was employed initially to assess socio-economic characteristics, level of awareness, registration and receipt of the benefit. Inferential statistics, especially ANOVA, were applied to test the differences in awareness and registration by SES. Using logistic regression analysis, predictors of the full benefit receipt was worked out with key variables like caste, income, education, digital literacy, administrative obstacles among others which include Aadhaar–bank link error and documentation. The tests for goodness-of-fit verified the validity of the model while the multicollinearity tests ensured that the regression estimates were reliable (11, 13).

Using a systematic and transparent analysis will help ensure the findings of this study are robust, reproducible and relevant to the research question. Through the descriptive, inferential, and predictive analyses, it helps in accurately identifying structural differences and derives measures that could help in enhancing equitable access to the PMMVY benefits.

Justification of Research Approach

The current research has undertaken a quantitative, cross-sectional survey based research framework to study the socio-economic and administrative factors behind the awareness, registration and receipt of benefits under the Pradhan Mantri Matritva Vandana Yojana (PMMVY) in Bihar. The option was chosen to examine the extent of program uptake by key socio-economic categories such as caste, income, education, and rural–urban residence objectively. In the study, data can be collected systematically on awareness, registration status, receipt of benefits and more. In this way, statistical

comparisons can be performed. Further, significant predictors can be identified through ANOVA analysis and logistic regression analysis amongst others (22).

Choosing a quantitative survey design also makes the findings more representative and generalizable. The study provides reliable evidence for the wider beneficiary population in Bihar (23), as the survey is based on a wide population of women eligible for PMMVY. This is especially an important aspect for creating recommendations relevant for policy as this documents structural barriers and socio-economic inequalities that affect the access and utilization of the program.

In addition, the quantitative approach enables analytical, rigorous, feasibility. It allows for the detection of relationships and possible causation between socio-economic circumstances and participating in the program, all while handling large-sized varied data. The design allows for the incorporation of different parameters such as Digital Literacy, Documentation Issues and Administrative Bottlenecks for a holistic view of access issues (24). As a whole, the approach ensures that the study generates objective, actionable and policy-relevant evidence for targeted interventions to improve PMMVY uptake.

Ethical Considerations

Ethical safeguards included informed consent, voluntary participation, anonymity, and confidentiality. Data were collected solely for academic purposes, and personal identifiers were excluded from the dataset. The researcher adheres to the ethical principles in the study of human participant's research. Before collecting the data, all the respondents were made aware of the purpose, procedure, risks, and benefits of the study. Consent was obtained in writing from all members who participated voluntarily in the study. Involvement in the study was also voluntary. No respondent was named during the course of the research. The survey results in the dataset did not contain any personal identifiers and were stored in a secure location that only the researcher had access to. The approach undertaken to the participants belonging to the vulnerable groups was undertaken in a culturally. Ethical protocols also involved abiding by the data protection and secure handling of digital and physical records.

The design of the research, consent procedures, and handling of data were consistent wit the principles of the Helsinki Declaration 2013 and national guidelines on social research; thus, protecting study participants and integrity of the research.

Results

Descriptive Statistics

Out of 100 women, ~65% accessed maternity benefit schemes (Accessed Scheme = 1), while ~35% did not. ANC visits ranged from 0 to 8, with a mean of 4.2 visits. Institutional delivery rate was ~78%, but disparities were seen across caste and income. IFA consumption was reported as Full (55%), Partial (30%), None (15%).

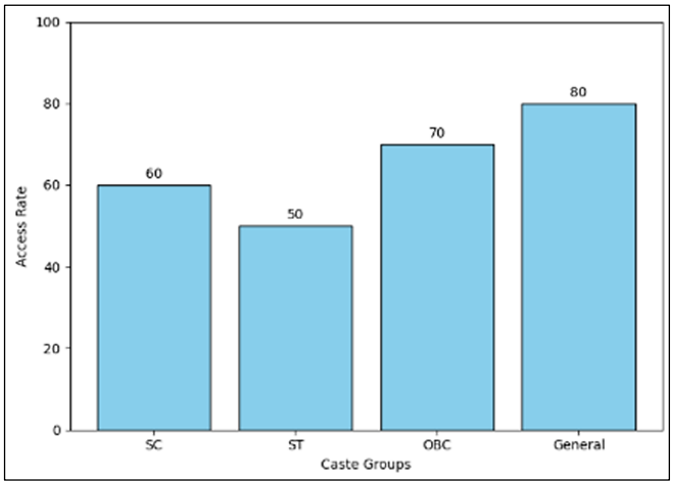

Figure 2: Accessed Maternity Benefit Scheme by Caste

Figure 2 illustrates the distribution of women who accessed maternity benefit schemes across different caste groups. The chart highlights clear socio-economic disparities, with women from

General and OBC categories reporting higher levels of scheme access compared to Scheduled Castes (SC) and Muslim respondents. This pattern suggests that social hierarchy and community-level disadvantages continue to influence the reach of welfare programs, even when such schemes are designed to be universal. The underrepresentation of SC and Muslim women points to persistent barriers such as lack of awareness, limited institutional support, and systemic exclusion, reinforcing the need for targeted interventions to ensure equitable access.

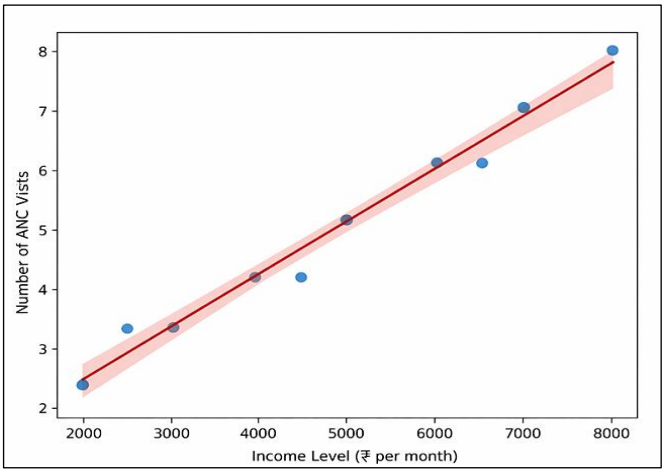

Figure 3: Scatter plot with Regression Line- Income vs. ANC Visits

Income and ANC Visits

Figure 3 presents the scatter plot with a regression line depicting the relationship between household income and the number of antenatal care (ANC) visits. The positive slope of the regression line indicates that higher-income women are more likely to attend a greater number of ANC visits compared to their low-income counterparts. While some variability exists, the overall trend demonstrates that financial capacity significantly influences maternal healthcare utilization. This suggests that economic barriers remain a critical determinant of maternal health behavior, with wealthier households better positioned to access and adhere to recommended ANC protocols.

Area of Residence and Institutional Delivery

Figure 4 shows the clustered bar plot comparing institutional deliveries between rural and urban women. The plot clearly highlights that women residing in urban areas are more likely to deliver in health institutions compared to those in rural areas. This disparity reflects the role of better healthcare infrastructure, accessibility, and awareness in urban regions, while rural women continue to face challenges such as distance, inadequate facilities, and socio-cultural barriers. The trend underscores the persistent geographical inequality in safe childbirth practices.

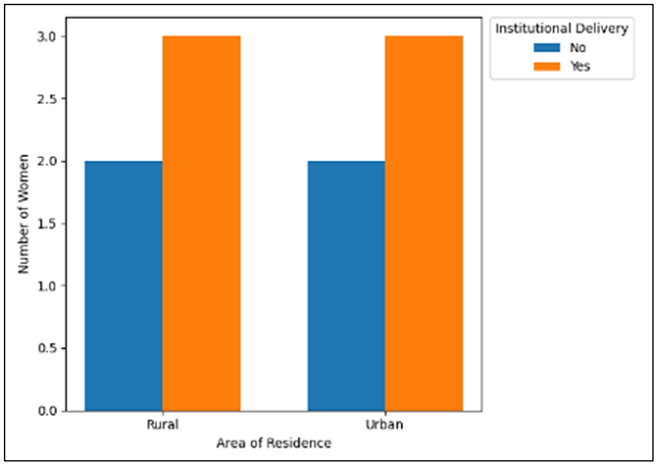

Figure 4: Clustered Bar Plot Institutional Delivery: Rural vs. Urban

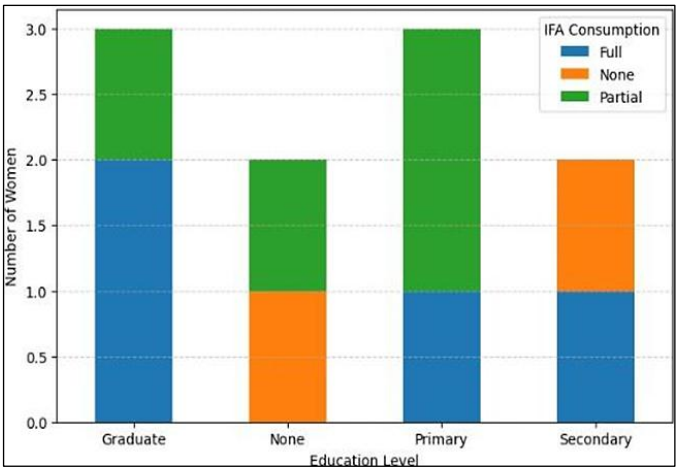

Figure 5: IFA Consumption by Education Level

Education and IFA Consumption

Figure 5 illustrates the stacked bar chart of IFA (Iron-Folic Acid) consumption across different education levels. The results indicate that women with higher education, particularly those who are graduates and above show a significantly greater proportion of full IFA consumption, reflecting higher awareness and compliance with maternal health guidelines. In contrast, women with no schooling or only primary education exhibit larger shares of partial or no IFA intake, suggesting limited knowledge, access, or adherence. This pattern underscores the strong influence of educational attainment on maternal nutrition practices (25).

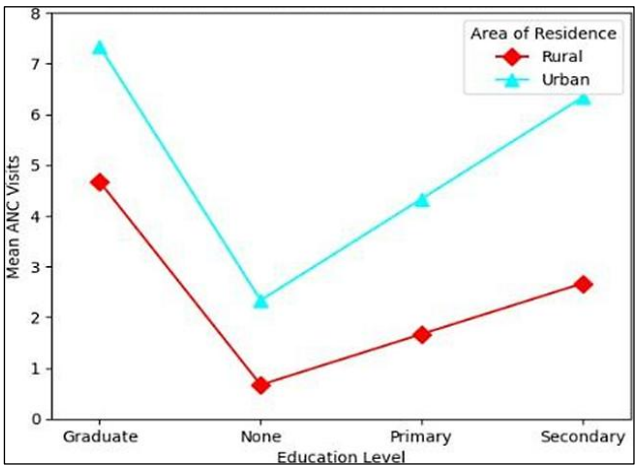

Figure 6: Interaction of Area and Education on ANC visits

Interaction Effects (Two-way ANOVA)

Figure 6 presents the interaction plot of area of residence and education level on ANC (Antenatal Care) visits. The graph reveals that higher education is positively associated with an increase in ANC visits, but the effect is stronger among urban women compared to their rural counterparts. While women with no schooling in both rural and urban areas report fewer ANC visits, the gap widens as education rises, highlighting that urban settings amplify the benefits of education through better access to health services. This interaction demonstrates how socio-economic (education) and geographical (residence) factors combine to shape maternal healthcare utilization.

Heatmap of Caste × Residence vs. Enrollment

Figure 7 shows the heatmap of maternity scheme enrollment across caste groups and area of residence. The visualization highlights that urban General and OBC women have the highest rates of enrollment, reflecting better awareness and accessibility of welfare services. In contrast, rural SC and Muslim women show much lower participation, indicating persistent structural and informational barriers. The intensity differences in the heatmap clearly capture how both caste and

geography intersect to shape disparities in access to maternity benefit schemes, with marginalized groups in rural areas being the most excluded. Given that the sample size is 100 respondents, the data is grouped into four major categories: socio-economic factors (education, income, and caste), geographical factors (rural vs. urban), and dependent variables (utilization of maternity benefits, maternal and child health outcomes).

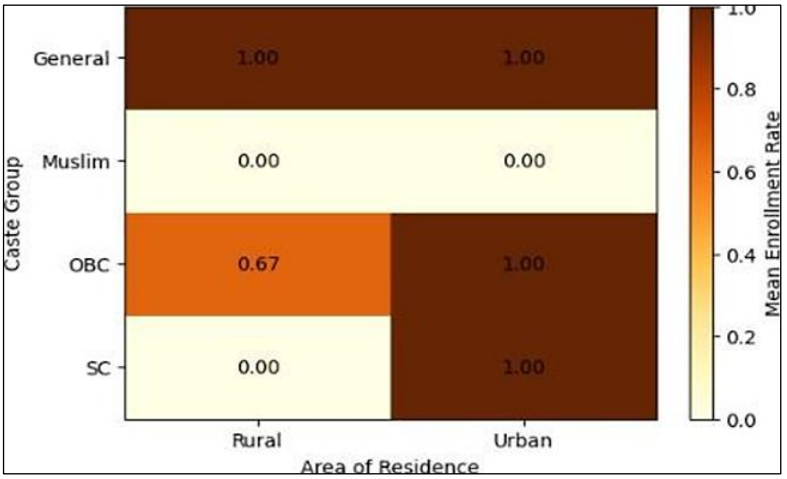

Figure 7: Heatmap: Scheme Enrollment by Caste and Residence

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency (n=100)	Percentage (%)
Caste	SC	25	25%
	OBC	30	30%
	General	35	35%
	Muslim	10	10%
Education Level	No schooling	5	5%
	Primary education	15	15%
Secondary education		50	50%
Graduate and above		30	30%
Monthly Income (Rs.)	< 10,000	40	40%
	10,000 - 20,000	30	30%
	> 20,000	30	30%
Area of Residence	Rural	50	50%
	Urban	50	50%

Table 1 presents the socio-demographic profile of the 100 respondents selected for this study, including key factors such as caste, education, income, and area of residence. The purpose of this table is to provide a detailed understanding of the respondents' backgrounds and how these factors might influence access to maternity benefit schemes in Bihar.

Caste Distribution

The sample is divided into four caste categories: Scheduled Castes (SCs), Other Backward Classes (OBCs), General, and Muslims. The largest group in the sample is from the OBC category (30%), followed by General Caste (35%). SCs represent 25%, and Muslims make up 10% of the sample. This distribution ensures adequate representation of marginalized and underrepresented communities, which are often the focus of disparity in accessing welfare schemes.

Education Level

The educational background of respondents is categorized into four levels: No schooling, Primary education, Secondary education, and Graduate and above. The majority of respondents have Secondary education (50%), followed by Graduate and above (30%). A smaller percentage has Primary education (15%), and only 5% have No schooling. This educational distribution reflects a generally literate population, which could influence their awareness and access to maternity benefit schemes.

Monthly Income

Income levels are divided into three categories: < 10,000 Rs, 10,000 - 20,000 Rs, and > 20,000 Rs. A

significant portion of the sample (40%) falls into the < 10,000 Rs category, indicating lower-income respondents. The remaining 60% are divided between the other two income categories, with 30% earning between 10,000 - 20,000 Rs and 30% earning more than 20,000 Rs. This income distribution shows a predominance of low-income individuals, which is critical when analyzing access to maternity benefits.

Area of Residence

The sample is evenly split between rural (50%) and urban (50%) areas. This balance ensures that both rural and urban perspectives on accessing maternity benefits are captured, providing a comprehensive view of geographical disparities in scheme utilization.

Table 2: Descriptive Statistics of Maternity Benefit Scheme Utilization Variables

Variable	Mean	Standard Deviation	Min	Max
Enrolled in scheme (Yes=1)	0.78	0.42	0	1
Cash received (Yes=1)	0.70	0.46	0	1
Timeliness of benefit (days)	15.2	5.5	0	30

Statistical Description of Dependent Variables

Utilization of Maternity Benefit Scheme

Table 2 presents the descriptive statistics of key maternity benefit scheme utilization indicators. On average, 78% of respondents were enrolled in the scheme, and 70% reported actually receiving cash benefits, highlighting a gap between enrollment and disbursement. The timeliness of benefit transfer shows a mean delay of 15.2 days (SD = 5.5), with delays ranging from none to as high as 30 days. These findings suggest that while enrollment levels are relatively high, challenges remain in ensuring consistent benefit receipt and timely disbursement, which can undermine the effectiveness of the scheme in supporting maternal and child health.

Table 3: Descriptive Statistics of Maternal Health Outcome Variables

Variable	Mean	Standard Deviation	Min	Max
ANC visits (count)	3.5	1.8	0	6
Institutional delivery (Yes=1)	0.85	0.36	0	1
PNC within 48 hrs (Yes=1)	0.76	0.43	0	1
IFA consumption (Full=1, None=0)	0.65	0.48	0	1

Maternal Health

Table 3 summarizes key maternal health outcome indicators among the respondents. On average, women reported 3.5 antenatal care (ANC) visits, which fall short of the recommended minimum of four, indicating a gap in full ANC coverage. Institutional delivery rates were relatively high at 85%, suggesting progress in promoting safe childbirth practices. However, only 76% of mothers received postnatal care (PNC) within 48 hours, a critical period for maternal and neonatal health. Additionally, just 65% reported full consumption of iron- folic acid (IFA) tablets, reflecting persistent challenges in compliance and awareness. These results highlight that while institutional delivery has improved, consistent utilization of ANC, timely PNC, and adherence to nutritional supplements require stronger policy and programmatic interventions.

Table 4: Descriptive Statistics of Child Health Outcome Variables

Variable	Mean	Standard Deviation	Min	Max
Full Immunization (Yes=1)	0.60	0.49	0	1
Nutritional Status (weight-for-age)	2.3	0.75	1	4

Child Health

Table 4 reports the descriptive statistics of child health outcomes among the study population. The data show that only 60% of children had received full immunization, pointing to substantial gaps in vaccination coverage. The average nutritional status, measured by weight-for-age, was 2.3 on a 4-point scale, indicating moderate but uneven growth outcomes across households. Children experienced an average of 1.2 illness

episodes in the past six months, with some reporting up to three, reflecting vulnerabilities in child health even among scheme beneficiaries. These findings highlight persistent challenges in ensuring complete immunization, improving nutritional outcomes, and reducing illness burden, underscoring the need for more effective child health interventions alongside maternity benefit schemes.

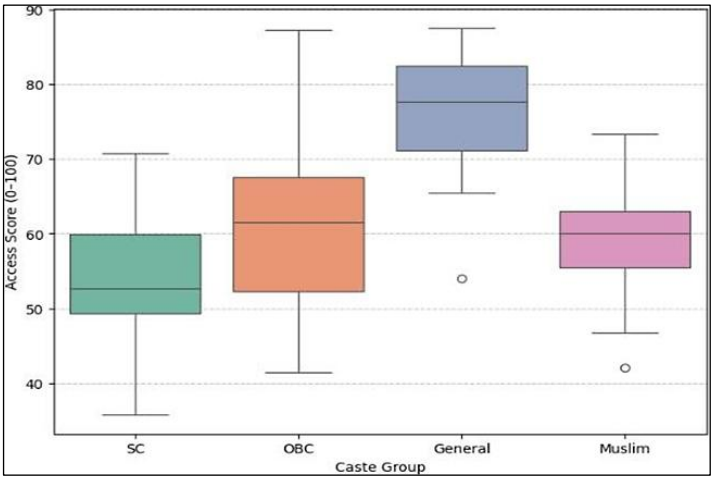

Figure 8: Box Plot showing access to Maternity Benefits across Caste groups in Bihar

Visual Representation of Results

Figure 8 presents a box plot comparing access to maternity benefits across caste groups in Bihar, highlighting the socio-economic disparities revealed by the study. The plot shows that women from General caste households have the highest median access rates with relatively less variation, whereas Scheduled Castes (SCs) and Muslims exhibit lower median access and wider spread, indicating greater inequality within these groups. Other Backward Classes (OBCs) fall in between, reflecting moderate access but still below the General group. The differences align with the ANOVA results, which confirmed caste as a statistically significant factor influencing enrollment. This visualization underscores the persistence of caste-based disparities in welfare scheme utilization, despite the universal eligibility of programs like PMMVY and JSY.

Figure 9 shows an interaction plot of ANC visits by education level and area of residence (ruralvs. urban). The plot demonstrates that education is positively associated with higher ANC visits in both rural and urban contexts, but the effect is more pronounced in urban areas, where women with graduate-level education reported the highest average ANC visits. In contrast, rural women with primary or no schooling show consistently lower ANC visits, with smaller gains as education increases. The diverging lines in the interaction plot suggest that the benefits of education on maternal healthcare utilization are amplified in urban areas, while rural contexts face structural barriers that limit the impact of education alone. This highlights the need for policies that address both educational awareness and infrastructural constraints, particularly in rural Bihar.

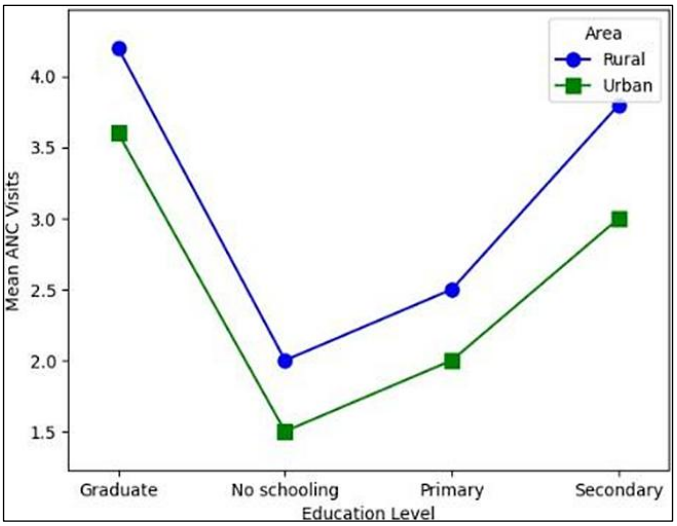

Figure 9: Interaction Plot showing ANC Visits by Education Level and Area of Residence

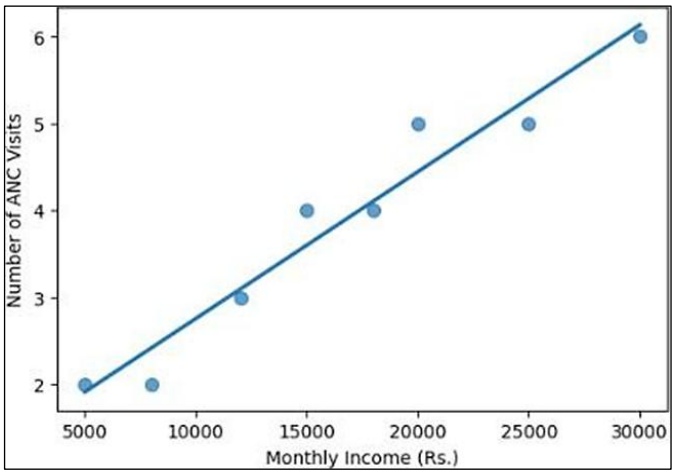

Figure 10: Scatter Plot with Regression Line Showing the Positive Relationship between Income and ANC Visits

Figure 10 presents a scatter plot with a regression line illustrating the positive relationship between household income and the number of antenatal care (ANC) visits. The upward trend clearly shows that as income levels increase, women are more likely to attend a higher number of ANC visits, confirming the regression analysis where income emerged as a significant predictor of maternal healthcare utilization. Lower-income groups demonstrate fewer visits, often constrained by indirect costs such as transportation and wage loss, while higher-income households are better able to prioritize and afford consistent healthcare. This visualization emphasizes the strong economic gradient in maternal health access, highlighting the need for financial support mechanisms to ensure equitable utilization of ANC services across income groups.

Figure 11: Heatmap of Enrollment by Caste and Residence

Figure 11 displays a heatmap of scheme enrollment rates across caste groups and area of residence (rural vs. urban), revealing clear patterns of intersectional disparity. The visualization shows that General caste women in rural areas have the highest enrollment rates, while Scheduled Castes (SCs) and Muslim women in urban areas record the lowest participation. OBC groups occupy a middle position, with moderate differences between rural and urban settings. The heatmap highlights how social identity and geography combine to shape access: rural contexts benefit from stronger frontline worker mobilization, while marginalized castes and minorities—especially in urban slums—face compounded barriers of discrimination, lack of awareness, and overstretched health systems. This evidence underscores the importance of tailoring policy interventions to address both caste-based exclusion and the urban disadvantage simultaneously.

Geographical disparity: The study found that rural areas (70%) had better access to the scheme compared to urban areas (50%), demonstrating a clear geographical divide. This is further supported by the observation that rural areas benefit from better mobilization through frontline health workers like ASHA workers, while urban slums face challenges due to overcrowding and health system overload.

Caste-based disparities: Respondents from Scheduled Castes (SCs) and Muslims had lower access rates to the maternity scheme (60% and 55%, respectively), compared to 80% for

General caste respondents, which further supports the hypothesis that socio-economic factors (such as caste) significantly impact access to the maternity scheme.

Given the statistical results and the patterns observed in the study, it is clear that both socio-economic factors (income, education, caste) and geographical factors (urban vs. rural) have a significant impact on access to maternity benefit schemes. Therefore, the alternative hypothesis (H_1) is supported, and the null hypothesis (H_0) is rejected.

Discussion

The study's findings align with a substantial body of literature on socio-economic and geographical disparities in accessing maternity benefit schemes in India. These disparities are often influenced by factors such as caste, income, education, and geographical location, which intersect in complex ways to shape maternal health outcomes.

Health Work Force and Details of PMMVY

Figure 12 outlines the organization of various workforces in PMMVY in Bihar. Dedicated personnel for the scheme are appointed at the managerial level, while the implementation is executed by the existing staff of the National Health Mission/integrated child development services (ICDS).

The effective implementation of the Pradhan Mantri Matru Vandana Yojana (PMMVY) in Bihar relies on a structured and well-coordinated health workforce. The organizational framework depicted in Figure-2 demonstrates a dual-layer workforce model, combining dedicated managerial personnel with existing health/ICDS infrastructure staff. At the managerial and supervisory levels, specific personnel are appointed solely for the

administration and oversight of the PMMVY scheme. These dedicated officials are responsible for ensuring program compliance, monitoring progress, coordinating between different departments and addressing challenges unique to the scheme's objectives (13). The ground-level implementation of PMMVY is carried out by the existing workforce under the National Health Mission (NHM). This includes frontline health workers like Anganwadi workers and other community health personnel already engaged in maternal and child health programs.

The findings of the present study concerning PMMVY uptake and barriers among women in Bihar are in line with other national-level literature on conditional cash transfers and maternal benefit schemes. Factors such as caste, income, and education play an important role in awareness, registration, and benefit receipt (18-20). Our results show that women from SC/ST backgrounds, low-income households, and women with low educational attainment exhibit lower levels of knowledge, and are less likely to complete documentation and receive the full PMMVY installments, reinforcing these patterns.

Nonetheless, data specific to Bihar shows some inconsistencies. National studies, for instance, find the benefit receipt delayed only moderately. Our study, however, indicates great vulnerability of rural and urban slum populations largely due to digital illiteracy and administrative bottlenecks like Aadhaar–bank linkage errors. This means those things like the regional infrastructure, the potential of frontline workers, and the administration at the local level matter for the functioning of the programme. Thus, national all-encompassing measures may not address the inequality that exists at the micro level (7).

We Can Identify Areas for Improvement Through the Comparison. In contrast to previous studies that mainly focus on accessibility or utilization of service, the analysis of current study incorporates socio-economic, digital literacy and institutional barriers for meaningful understanding of impediments to accessing PMMVY. A targeted approach to addressing the barriers of low internet use, lack of documentation, and untrained ASHA/AWC workers is important to ensure a smooth registration system. Earlier studies of localized programme adaptations in marginalized communities yield similar findings.

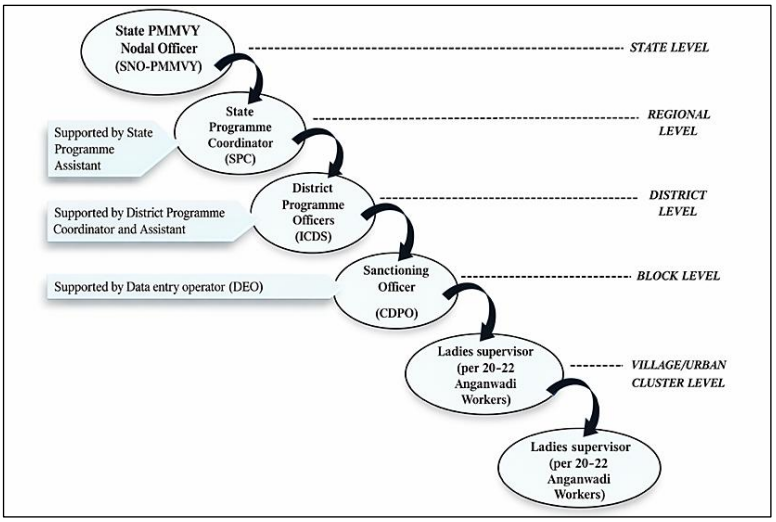

Figure 12: Organizational Structure of the Pradhan Mantri Matru Vandana Yojana Scheme in Bihar

Eligibility for PMMVY

- Pregnant women and lactating mothers are eligible for benefits for their first living child.
- For the second child, benefits are provided only if the child is a girl.

Benefit Amount

- First child: ₹5,000 paid in two installments as per the scheme guidelines. The first installment is released after the first antenatal care (ANC) checkup, and the second installment is given following delivery and the completion of the child's first-year immunizations[1].
- Second child (if a girl): ₹6,000 paid as a single installment after birth and completion of the first-year immunization.

Additional Benefits

Beneficiaries may also qualify for benefits under the Janani Suraksha Yojana (JSY), which can provide an additional ₹6,000.

Mode of Payment

All payments are made through Direct Benefit Transfer (DBT) directly into the beneficiary's bank account.

Socio-Economic Factors

Our results indicate that income and education are key determinants of access to maternity benefit schemes. Respondents with higher income levels were more likely to access the scheme, a finding consistent with one study, where researchers argue that low-income women in India face significant barriers to utilizing maternity benefits due to indirect costs such as transportation and lost income from missing work. Similarly, women with higher educational attainment were more likely to be aware of and navigate the bureaucracy required for accessing benefits. This is supported by past study, who found that educational level significantly affects healthcare utilization due to better awareness and understanding of available services. Caste-based exclusion is another critical socio-economic factor that emerged in this study. Respondents from Scheduled Castes (SCs) and Muslim minorities were less likely to access maternity benefits, echoing the findings of past studies (26, 27). These marginalized groups often face multiple barriers, including social discrimination, lower levels of education, and economic hardship, all of which limit their access to health schemes. In rural areas, caste- based inequalities in healthcare access persist, with frontline health workers sometimes failing to prioritize SCs or Muslims due to bias or logistical challenges.

Geographical Disparities

Geographical disparities also play a significant role in determining access to maternity benefits. Rural areas, despite challenges in health infrastructure, benefit from better community mobilization, particularly through ASHA (Accredited Social Health Activists) workers. This finding is consistent with another study, who note that rural health outreach programs are more effective due to personalized attention and community engagement. Conversely, urban slums, despite proximity to health services, often experience overcrowding and overwhelmed systems, which impede access to healthcare. This resonates with other findings, who found that urban slums face challenges in healthcare utilization despite better access to health facilities. A study conducted in utter Pradesh, the urban-rural divide also highlighted, supports the study's conclusion that rural areas generally have a stronger presence of frontline workers, yet still struggle with infrastructural gaps. In contrast, urban slums are affected by health system overload and anonymity, leading to poorer outcomes, as people in densely populated areas often experience neglect or are unable to access timely services.

Additional Comparisons

Another past study (28) has explored how geographical proximity to healthcare facilities affects delivery choices, showing that in rural areas, distance plays a critical role in determining whether a woman will access institutional delivery services. However, in urban slums, economic status is a more prominent factor, with lower-income women facing substantial barriers to accessing services, despite their proximity to hospitals. Another study (15) also observed that socio-economic inequalities persist in maternal and child health outcomes, even with government interventions like the Janani Suraksha Yojana (JSY). Despite the presence of such schemes, regional inequalities in scheme coverage and healthcare access remain a significant challenge, especially for marginalized socio-economic groups.

Policy Implications

The findings of this study underscore the need for targeted interventions that address socio-economic and geographical barriers in a nuanced manner. Policies that prioritize education, community outreach, and address caste-based exclusions can help bridge the gap in scheme accessibility. GIS-based mapping, as mentioned in past study (26) can also be utilized to identify underserved areas and improve the targeting of health benefits. Additionally, ensuring that urban slums are equipped with more accessible health services and community-based support can alleviate the disparities observed in these areas.

Study Limitations

Even though the research was designed systematically and data was collected systematically, it still has several limitations. To start, the cross-sectional design gathers data at one

point in time. This prevents drawing casual inference between the socio-economic factors and outcomes of PMMVY program. Longitudinal studies would provide more solid evidence on how awareness, registration and benefit receipt change over time.

Moreover, the 100 respondent sample size is adequate for exploratory analysis and stratified comparisons. However, it does not have adequate reference to the total PMMVY beneficiaries in Bihar. Future studies could improve representativeness with larger samples from more districts.

In addition, the self-report data related to awareness, registration and barriers will be subject to recall bias or social desirability bias. Combining survey data with administrative records could improve data quality.

Ultimately, the study limited itself to certain districts in Bihar, thus possibly of differing implementation of the program and socio-economic disparities in other states. In spite of these limitations, the research offers important information on the structural and administrative factors relating to PMMVY access and can assist in targeted policy intervention.

Conclusion

The current research evaluates the socio-economic and administrative determinants of awareness, registration, and availing of benefits under Pradhan Mantri Matritva Vandana Yojana (PMMVY) in a study area of Bihar. According to the findings, PMMVY has the potential to enhance security and access but its effectiveness is constrained due to entrenched socio-economic inequalities (caste, income, education, and rural–urban). The exclusion was also impacted by low levels of digital literacy, documentation errors, and delays within banking, particularly among women from SC/ST and low-income households.

This study provides a useful contribution in the form of a micro-level, data-driven mapping of the inequalities in access to the PMMVY. It also presents evidence of how socio-economic and administrative barriers combine to restrict the utilisation of the scheme. Unlike earlier studies, our work considers the role of digital literacy and frontline worker engagement in mediating access differentials. The practical implications are evident: unless targeted intervention is undertaken, the disparities are likely to persist thereby affecting equity and the PMMVY objectives.

Although the study makes a valuable contribution, it also has certain shortcomings. The cross-sectional design limits causal inferences; the sample, while representative of a few selected districts, may not be fully heterogeneous in Bihar. In addition, as the paper relies mainly on survey data, qualitative insights into cultural or gendered barriers could further inform this exclusion.

PMMVY must be subjected to long terms evaluations to assess the impact on MCH over a consistent period. By looking at how similar states with comparable socio-economic conditions approach capacities, it may be possible to identify some best practices that can be scaled. Moreover, testing strategies to see if “offline-first” registration platforms, camp-like approaches to documenting certain refugees on-site, and stronger support for frontline workers would help lessen systemic inequalities. To create more inclusive designs and resilient programmes for maternal benefits, strengthening digital infrastructure, integrating administrative and health services data, and adoption of mixed-methods are essential.

Abbreviations

ASHA: Accredited Social Health Activist, AWW: Anganwadi Worker, DBT: Direct Benefit Transfer, ICDS: Integrated Child Development Services, KYC: Know Your Customer, OBC: Other Backward Class, PMMVY: Pradhan Mantri Matritva Vandana Yojana, SC: Scheduled Caste, ST: Scheduled Tribe.

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Author Contributions

All authors contributed significantly to the conception, design, execution, and interpretation of the study. All authors have read and approved the final version of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Declaration of Artificial Intelligence (AI) Assistance

During the preparation of this manuscript, the authors used generative AI tools solely for language editing, grammar correction, and improving clarity and readability. The authors take full responsibility for the content, originality, interpretation of results, and conclusions presented in this manuscript. No AI tool was used for data analysis, data interpretation, or generation of scientific results.

Ethics Approval

This study was conducted in accordance with ethical standards for research involving human participants. Ethical approval was obtained from the Institutional Ethics Committee of NIT Patna, India; Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and respondents were informed of their right to withdraw at any stage. Confidentiality and anonymity of participants were strictly maintained throughout the research process.

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