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Infertility In India: A Comprehensive Narrative Review Of Epidemiological, Psychosocial, And Genetic Risk Factors (2010–2024)

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Abstract: Background:

Infertility, the inability to achieve conception after 12 months of regular unprotected intercourse, is a growing reproductive health concern in India. Despite being recognized as a public health issue with major psychosocial consequences, infertility remains under-researched and stigmatized. Global prevalence is estimated at 8–12%, yet Indian data vary regionally due to differences in healthcare access, social norms, and biological determinants.

Objective:

This narrative review synthesizes epidemiological, clinical, psychosocial, and molecular research on infertility in India from 2010–2024, highlighting prevalence patterns, regional variations, and key risk factors influencing reproductive outcomes.

Methods:

A narrative synthesis was conducted using eight major studies published between 2010 and 2024, encompassing community surveys, hospital-based cross-sectional analyses, and a genetic case–control investigation. Comparative interpretation focused on sociodemographic, reproductive, psychological, and genetic domains influencing primary and secondary infertility.

Results:

The prevalence of infertility in Indian populations ranged between 6% and 13%, consistent with WHO global estimates. Primary infertility predominated in younger, rural populations, while secondary infertility was more common among women with prior reproductive or infectious histories. Key determinants included age at marriage, menstrual irregularities, RTI/STI history, PCOD, socioeconomic status, and psychological stress. Genetic studies identified novel associations between VEGF promoter polymorphisms (−2578C/A, −2549I/D, −460T/C) and infertility risk in North-West Indians. Psychosocial research revealed infertility-specific stress in up to 80% of affected women.

Conclusion:

Infertility in India is multifactorial, reflecting complex interactions among biological, social, and genetic variables. Regional disparities persist, underscoring the need for holistic interventions integrating reproductive health services, mental health care, and molecular diagnostics.

Keywords: Infertility, Primary infertility, India, Psychosocial stress, VEGF, HIF1A, PCOD, RTI/STI, Socioeconomic determinants.

1. Introduction: Infertility is a major and growing public health concern worldwide, affecting nearly one in six couples of reproductive age according to the World Health Organization (WHO, 2023). It contributes significantly to the global burden of reproductive ill-health, with rising incidence linked to delayed childbearing, urbanization, and lifestyle changes. Recent global data show a consistent increase in infertility-related disability-adjusted life years (DALYs), especially among women aged 25–39 years (Liu et al., 2025)1.

In India, infertility carries deep personal, psychological, and sociocultural consequences. Social expectations of fertility, coupled with gender-based blame, lead to stigmatization and marital instability—particularly in rural and low-income populations (Pandey, 2021)10. Despite advances in reproductive medicine, including the growing availability of assisted reproductive technologies (ART) such as in vitro fertilization (IVF) and intracytoplasmic sperm injection (ICSI), access remains concentrated in metropolitan centers (Ramaraju & Muvvala, 2023)2. Economic barriers, lack of awareness, and fragmented healthcare infrastructure prevent equitable access to fertility care, resulting in an urban–rural treatment divide (Tholeti et al., 2024)8.

Emerging Indian and international research has also identified molecular and genetic pathways influencing infertility. A 2025 analysis highlighted key chromosomal and molecular genetic abnormalities that disrupt gametogenesis and implantation, demonstrating how these mechanisms affect both male and female infertility outcomes (Ioannou & Tempest, 2025)4. Indian studies further identified cytogenetic profiles in couples with recurrent implantation failure following IVF, emphasizing the role of chromosomal aberrations in reproductive failure (Pjevic, 2025)5.

In the Indian context, infertility prevalence has shown an upward trend, reflecting behavioral, demographic, and biological determinants. An analysis of reproductive dynamics highlighted that decreasing crude birth rates are associated with increasing infertility incidence, underlining a demographic transition in India's fertility landscape (Santosh & Roy, 2025)3. Furthermore, advances in pharmacogenomics and reproductive genetics are shaping the personalization of ART treatment for Indian women, helping to optimize hormonal responses and oocyte quality (Oberoi, 2025; Zakir, 2024)7,9.

Despite these advancements, data fragmentation and inconsistent diagnostic criteria persist across Indian infertility studies, limiting the ability to accurately estimate prevalence and assess intervention outcomes. The purpose of this narrative review is to synthesize key Indian studies conducted between 2010 and 2025, encompassing epidemiological, clinical, and molecular perspectives on infertility. By integrating community-based, clinic-based, and genetic data, this review aims to offer a comprehensive understanding of infertility within the Indian context—bridging biomedical findings with social and policy dimensions.

2. Epidemiological Overview

2.1 National and Regional Patterns

Across India, reported infertility prevalence fluctuates between 6% and 13%, depending on regional and methodological variations.

- Patra & Unisa (2015) analyzed the District Level Household and Facility Survey (DLHS-3) data, estimating 6.6% prevalence of primary infertility and 2.1% secondary infertility, with district-level peaks reaching 15% in certain regions13.
- Adamson et al. (2010) in Mysore, Karnataka found a 12.6% prevalence, among young married women aged 15–30 years12.
- Banerjee et al. (2023), in a rural north-west Indian cohort, reported 7.25% primary infertility, consistent with WHO's lower-middle-income estimates14.
- Sharma et al. (2024), studying peri-urban Ahmedabad, reported a total burden of 7.4%, split almost equally between primary (3.5%) and secondary (3.9%) infertility15.
- Chaubey et al. (2018), studying couples attending Sir Sunderlal Hospital in Varanasi, observed that 51.7% of infertile women had primary infertility, while 48.3% had secondary infertility, highlighting a near-equal distribution in clinical samples16.

Regional comparison reveals higher prevalence in Southern and Western India (Mysore, Ahmedabad) and modestly lower rates in Eastern and Northern India (Varanasi, Jaipur). Urbanization, delayed marriage, and lifestyle changes may explain elevated rates in urban centers, while untreated infections contribute more in rural settings.

3. Sociodemographic and Lifestyle Correlates

3.1 Age and Marriage Patterns

Age at marriage and conception emerged as consistent predictors of infertility across studies.

- In Banerjee et al. (2023), both age ($p < 0.01$) and age at marriage ($p < 0.01$) were significantly correlated with infertility risk14.
- Chaubey et al. (2018) found that younger women (15–26 years) predominantly experienced primary infertility (72%), while older women (27–38 years) showed higher rates of secondary infertility (65.6%, $p = 0.016$)16.

Delayed marriage (>30 years) and prolonged intervals between marriage and first conception increase the probability of anovulatory disorders and reproductive aging.

3.2 Education and Socioeconomic Status

Education and income produce complex, sometimes paradoxical relationships with infertility.

• In rural populations (Patra & Unisa, 2015; Banerjee et al., 2023), lower education and poverty corresponded with greater infertility due to untreated RTIs/STIs and limited healthcare utilization13-14.

• In contrast, Chakraborty & Chatterjee (2021) found higher education and better income were linked to greater infertility risk in urban north India, attributed to delayed childbearing, work stress, and lifestyle changes.

Thus, infertility reflects a social gradient reversal—poor women face biological causes and inadequate treatment, while affluent women confront lifestyle-induced infertility.

3.3 Occupation, Lifestyle, and Addiction

Occupational workload and substance use emerged as moderate predictors. Banerjee et al. (2023) identified addiction (alcohol, tobacco) as significantly related to infertility ($p < 0.03$)14. Prolonged standing, shift work, and exposure to heat or chemicals, common in industrial labor, can influence reproductive hormones.

Lifestyle patterns such as sedentary behavior, stress, and poor diet are increasingly important in urban infertility etiology.

4. Physiological and Reproductive Health Factors

4.1 Menstrual Irregularities

Menstrual cycle regularity is a critical indicator of ovulatory health.

• Chaubey et al. (2018) demonstrated a strong association between irregular cycles and secondary infertility ($p = 0.009$)16.

• Banerjee et al. (2023) found menstrual pattern significantly related to infertility ($p < 0.01$), alongside menarcheal age ($p < 0.03$)14.

Irregular or scanty menstruation reflects hormonal imbalance and anovulation, common in PCOD and thyroid dysfunction.

4.2 Body Mass Index (BMI)

Weight abnormalities—both underweight and obesity—affect ovulation, implantation, and hormonal milieu.

• In Banerjee et al. (2023), BMI showed a strong correlation ($p < 0.001$) with infertility14.

• However, Chaubey et al. (2018) found BMI differences were not statistically significant, possibly due to small sample size (n=60)16.

Collectively, these findings suggest BMI acts synergistically with other metabolic and endocrine variables.

4.3 Reproductive Tract Infections (RTI/STI)

Untreated RTIs/STIs remain leading preventable causes of infertility in India.

• Adamson et al. (2010) found HSV-2 seropositivity tripled infertility odds (aOR 3.41, 95% CI 1.86–6.26)12.

• Patra & Unisa (2015) reported high infertility prevalence in women with self-reported RTI symptoms (vaginal discharge, pelvic pain)13.

• Absence of Neisseria gonorrhoeae or Trichomonas vaginalis in Adamson's cohort suggests that viral infections and chronic pelvic inflammatory disease are more relevant to infertility than acute bacterial STIs12.

4.4 Gynecological and Endocrine Disorders

Polycystic Ovarian Disease (PCOD), endometriosis, and uterine abnormalities (fibroids, septate uterus) are major contributors.

• Sharma et al. (2024) observed a high prevalence of PCOD and menstrual disorders among infertile women in Ahmedabad15.

• Patel et al. (2016) found that 29% of women with primary infertility had female-factor causes, including PCOD (14%) and endometriosis (4%).

• These disorders often coexist with metabolic and inflammatory dysfunction, emphasizing the need for multidisciplinary diagnosis.

5. Psychosocial and Mental Health Dimensions

The psychosocial toll of infertility in India cannot be overstated. Cultural emphasis on motherhood amplifies distress, guilt, and social isolation for affected women.

5.1 Prevalence of Psychological Stress

Patel et al. (2016) documented infertility-specific stress in 80% of women diagnosed with primary infertility. Stress levels were significantly associated with duration of marriage, coping difficulties, and psychiatric comorbidity.

Similarly, Chakraborty & Chatterjee (2021) noted high emotional strain among urban women, correlating with occupational and familial pressures.

5.2 Predictors of Stress

In Patel et al.'s logistic regression, significant predictors included:

- Duration of infertility and treatment cycles (IUI, OI)
- Gynecological surgery history
- Premenstrual dysphoria severity
- Coping inefficiency

Only coping difficulties and infertility type remained significant in multivariate models, highlighting the centrality of psychological adaptation mechanisms.

5.3 Social Consequences

Indian sociocultural norms often attribute infertility blame to women, leading to stigma, domestic violence, and social exclusion. Studies consistently report delayed mental health help-seeking only 10% of Patel's participants had prior psychological consultation.

Thus, infertility is not only a clinical disorder but a psychosocial crisis, necessitating integrated counseling and community awareness.

6. Genetic and Molecular Perspectives

Recent molecular studies are uncovering genetic predispositions that may explain unexplained infertility cases.

6.1 VEGF and HIF1A Polymorphisms

Sambyal et al. (2023) investigated six polymorphisms in VEGF and HIF1A genes among 193 infertile patients and 213 controls in Punjab.

Findings:

- VEGF-2549II, VEGF-2578AA, and VEGF-460CC genotypes significantly increased infertility risk (p = 0.02–0.04).
- HIF1A variants (g.C1772T, g.G1790A, g.C111A) showed no significant difference.

The results suggest that impaired angiogenesis and endometrial hypoxia, regulated by VEGF and HIF1A pathways, might disrupt folliculogenesis or implantation.

6.2 Implications

This pioneering study is among the first to establish angiogenesis-related genetic risk in Indian infertility. It highlights:

- The role of vascularization in oocyte maturation and endometrial receptivity.
- The need for genotype-phenotype correlation studies across India's diverse populations.
- Potential for integrating genetic screening in recurrent or unexplained infertility cases.

7. Comparative Synthesis Across Studies

Study & Region	Sample Size / Setting	Prevalence	Main Risk Factors Identified	Unique Findings
Adamson et al., 2010 (Mysore, South India)	n = 897	12.6% primary infertility	HSV-2 infection, younger age, shorter sexual duration	First evidence of viral association
Patra & Unisa, 2015 (India-wide, DLHS-3)	548582 currently married women (20-49 years), (excluding UTs, the sample is 532100).	6.7% primary, 2.1% secondary	RTI/STI, education, poverty	District-level heterogeneity
Banerjee et al., 2023 (NW India, rural)	n = 400	7.25%	Age, BMI, addiction, menarche, menstrual pattern	Emphasized modifiable lifestyle risks
Sharma et al., 2024 (Ahmedabad)	n = 2,014	7.4% (total)	PCOD, asthma, menstrual disorders	Urban peri-urban differences
Chaubey et al., 2018 (Varanasi)	n = 65	51.7% primary 48.3%) had secondary infertility.	Age, menstrual irregularity	Pilot identification of

				menstrual impact
Chakraborty & Chatterjee, 2021 (North India)	n = 500	9%	Age, education, SES	Socioeconomic reversal trend
Patel et al., 2016 (Manipal)	n = 300	—	Coping difficulty, infertility type	80% stress prevalence
Sambyal et al., 2023 (Punjab)	n = 406 (193+213)	—	VEGF polymorphisms	First genetic association study

This comparative table underscores heterogeneity in determinants yet coherence in the overall pattern: infertility in India is shaped by interacting social, clinical, and biological mechanisms.

8. Integrated Discussion

8.1 Multifactorial and Context-Specific Etiology

The reviewed evidence supports a multifactorial model: sociocultural, behavioral, medical, and genetic variables converge to shape fertility outcomes. Rural women primarily suffer infection-related infertility, while urban women increasingly face endocrine and lifestyle disorders.

8.2 Rural-Urban and Socioeconomic Disparities

Disparities reflect healthcare access and cultural norms. In rural north India, women delay seeking care due to stigma or fatalism (Chaubey et al., 2018)16. Urban women have better access but delay conception. Public health planning must thus differentiate preventive strategies (infection control) for rural areas and lifestyle modification for urban populations.

8.3 Psychological Resilience and Support Systems

Infertility-specific stress is nearly universal, yet psychological services remain scarce. Integrating counseling into ART and gynecology clinics, as Patel et al. (2016) recommend, can improve treatment adherence and emotional well-being. Addressing cultural blame and marital strain through awareness campaigns remains essential.

8.4 Genetic Frontier and Personalized Medicine

The VEGF/HIF1A findings (Sambyal et al., 2023) signal India's entry into molecular infertility research. Future work should explore:

- Gene–environment interactions (e.g., obesity × angiogenesis genes).
- Epigenetic modifications due to stress or endocrine disruptors.
- Population-specific polymorphism panels for precision diagnostics.

8.5 Limitations of Current Evidence

Most studies are cross-sectional with modest sample sizes and limited male inclusion. Definitions of infertility and diagnostic protocols vary widely. Longitudinal, multicenter research integrating clinical, psychological, and genomic data is urgently needed.

9. Public Health and Policy Implications

The findings of this review underscore the urgent need for a comprehensive, equity-driven public health response to infertility in India. A national infertility surveillance framework should be developed by incorporating fertility-related modules into large-scale demographic health surveys such as NFHS and DLHS to facilitate systematic monitoring of prevalence, risk factors, and treatment access. Preventive reproductive health programs must be strengthened, particularly at the primary health care level, with emphasis on regular RTI/STI screening, menstrual hygiene education, and awareness about early diagnosis and treatment-seeking behaviors. In addition, dedicated infertility counseling units within tertiary hospitals and ART clinics are essential to provide psychological and marital support, as infertility carries deep emotional and social consequences, especially for women in patriarchal societies. Policies ensuring affordable access to infertility diagnostics and assisted reproductive technologies (ART) for low-income couples are crucial to reducing the treatment gap and preventing socioeconomic inequity in reproductive health outcomes. To advance scientific understanding, investment in research infrastructure—including regional biobanks, molecular laboratories, and data-sharing networks focusing on reproductive genetics—is necessary for early identification of hereditary and environmental causes of infertility. Finally, a gender-inclusive approach must be adopted to challenge social stigma and ensure equal assessment of both partners, thereby reframing infertility from a "woman's problem" to a shared reproductive health issue. Collectively, these integrated policy measures can promote early detection, reduce stigma, and ensure equitable access to fertility care across India's diverse social and geographic contexts.

CONCLUSION

Infertility in India represents a dynamic convergence of medical, social, and genetic factors. Between 2010 and 2024, Indian research has progressed from basic prevalence surveys to advanced molecular investigations, yet key challenges persist — inadequate awareness, delayed treatment, and limited psychosocial support.

The collective findings underscore that infertility is not merely a private tragedy but a public health issue demanding multisectoral response. Integrating reproductive health services, mental health care, and emerging genomic technologies could substantially reduce India's infertility burden and promote reproductive justice.

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