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PREVALENCE OF ANAEMIA AMONG WOMEN OF REPRODUCTIVE AGE IN MAHARASHTRA, INDIA: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Background: Anaemia among women of reproductive age (WRA, 15–49 years) remains a leading public health problem in India, with Maharashtra showing wide inter-regional variation despite sustained programmatic effort under Anaemia Mukt Bharat. A pooled, state-specific estimate synthesising primary field data alongside sub-national survey data has not been reported.

Objective: To systematically review published literature and estimate the pooled prevalence of anaemia among women of reproductive age across Maharashtra.

Methods: An electronic search of PubMed/PMC, ScienceDirect, DOAJ and Google Scholar-indexed sources was conducted (August 2026) for community-based studies reporting anaemia prevalence among WRA (15–49 years) in Maharashtra. Data were extracted independently and prevalence estimates were pooled using a random-effects (DerSimonian–Laird) model on the Freeman–Tukey double arcsine-transformed scale. Heterogeneity was assessed using Cochran's Q and I^2.

Results: Six studies, contributing eight prevalence data points (31,750 women; one study contributed five NFHS-4 regional subgroup estimates), met inclusion criteria. The pooled prevalence of anaemia among WRA in Maharashtra was 43.8% (95% CI 39.4–48.2%), with substantial heterogeneity (I^2 = 98.2%). Estimates ranged from 19.4% in a cantonment-based cohort to 52.5% in the Khandesh region.

Conclusion: Anaemia continues to affect two in five women of reproductive age in Maharashtra, with marked rural–urban and inter-regional variation. Region-specific, rather than uniform, anaemia-control strategies are warranted. Given the high observed heterogeneity, these findings should be interpreted as an indicative pooled estimate rather than a precise state figure, and are best supplemented by a full multi-database systematic review before policy use.

KEYWORDS: Anaemia; Women of reproductive age; Maharashtra; Meta-analysis; Systematic review; Public health; Anaemia Mukt Bharat

1. INTRODUCTION

Anaemia, defined by the World Health Organization (WHO) as a haemoglobin concentration below 12.0 g/dL in non-pregnant women and below 11.0 g/dL in pregnant women, remains one of the most prevalent nutritional disorders among women of reproductive age (WRA) worldwide.[1] Globally, anaemia affects roughly a quarter of the population, including close to a third of non-pregnant WRA, and is disproportionately concentrated among low-income households in low- and middle-income countries.[2] Estimates of the global burden further indicate that anaemia is among the leading contributors to years lived with disability, with iron deficiency as its single largest cause.[3]

In India, the National Family Health Survey-5 (2019–21) reported that 57.0% of all women aged 15–49 years were anaemic, an increase from NFHS-4 (2015–16) figures for the same age group.[4,5] This rise has persisted despite more than a decade of iron-folic acid supplementation and, more recently, the Government of India's Anaemia Mukt Bharat (AMB) strategy, launched to help meet the World Health Assembly's global nutrition target of halving anaemia in WRA by 2025.[6,7] National trend analyses suggest that progress against anaemia in India has been uneven across states and population subgroups, and that district- and region-specific data are needed to target interventions effectively, a concern echoed in recent work on India's Aspirational Districts.[8,9]

Maharashtra, India's second most populous state, illustrates this paradox. State-level NFHS figures mask considerable inter-regional and rural–urban variation, with district-level estimates ranging from below 30% to above 55%. Community-based field studies conducted in specific districts — urban slums, cantonments, and rural primary health centres — report prevalence figures that diverge substantially from both national and state averages, reflecting differences in study population, sampling method, and haemoglobin estimation technique.

A synthesised, Maharashtra-specific pooled estimate that draws together such primary field data alongside sub-national survey-based estimates has not, to our knowledge, been reported in the literature. Such an estimate is relevant to the state Anaemia Mukt Bharat programme, which requires region-specific rather than uniform benchmarks to prioritise resource

allocation. This systematic review and meta-analysis was therefore undertaken to estimate the pooled prevalence of anaemia among WRA in Maharashtra from published community-based data, and to characterise the extent and possible sources of heterogeneity across studies.

2. MATERIALS AND METHODS

2.1 Protocol

This review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement.[10] The review protocol was not prospectively registered (e.g., PROSPERO); this is disclosed as a limitation in Section 5.

2.2 Eligibility criteria

Studies were included if they (i) were conducted in Maharashtra, India; (ii) reported anaemia prevalence among women aged 15–49 years (or a clearly separable subgroup within this age range) using a haemoglobin-based definition; (iii) reported, or allowed calculation of, a numerator (anaemic women) and denominator (women screened); and (iv) were published in English in a peer-reviewed journal or as government/survey-based secondary data with clearly reported district- or region-level estimates. Studies restricted exclusively to pregnant women, adolescents (<15 years), or populations outside Maharashtra were excluded, as were narrative reviews and studies from which a usable prevalence estimate could not be extracted.

2.3 Search strategy

An electronic search of PubMed/PMC, ScienceDirect, DOAJ and Google Scholar-indexed sources was conducted in August 2026 using combinations of the terms “anaemia”/“anemia”, “prevalence”, “women of reproductive age”, “WRA”, and “Maharashtra”, together with individual district names. Reference lists of retrieved articles were hand-searched for additional eligible studies.

2.4 Study selection and data extraction

Records were screened by title and abstract, followed by full-text assessment against the eligibility criteria (Figure 1). For each included study, the following were extracted: first author and year, study design, setting/district, sample size, number classified as anaemic, and prevalence with severity grading where reported.

2.5 Statistical analysis

Study-level prevalence and 95% confidence intervals were calculated using the normal approximation. To stabilise variance across studies with widely differing sample sizes and prevalence close to the bounds of 0 and 1, individual proportions were transformed using the Freeman–Tukey double arcsine transformation before pooling.[11] A random-effects model (DerSimonian–Laird)[12] was used to calculate the pooled prevalence and back-transformed 95% confidence interval, given the anticipated clinical and methodological diversity of included data sources. Heterogeneity was quantified using Cochran's Q test and the I^2 statistic,[13] with $I^2 > 75\%$ considered substantial, following methodological guidance for systematic reviews of prevalence data.[14] All analyses were performed in Python (SciPy/NumPy).

3. RESULTS

3.1 Study selection

The search strategy identified 40 records, of which 27 remained after removal of duplicates. Following title/abstract screening, 14 full-text articles were assessed for eligibility; 8 were excluded (Figure 1). Six studies, contributing eight prevalence data points, met the inclusion criteria and were included in both qualitative synthesis and quantitative pooling.

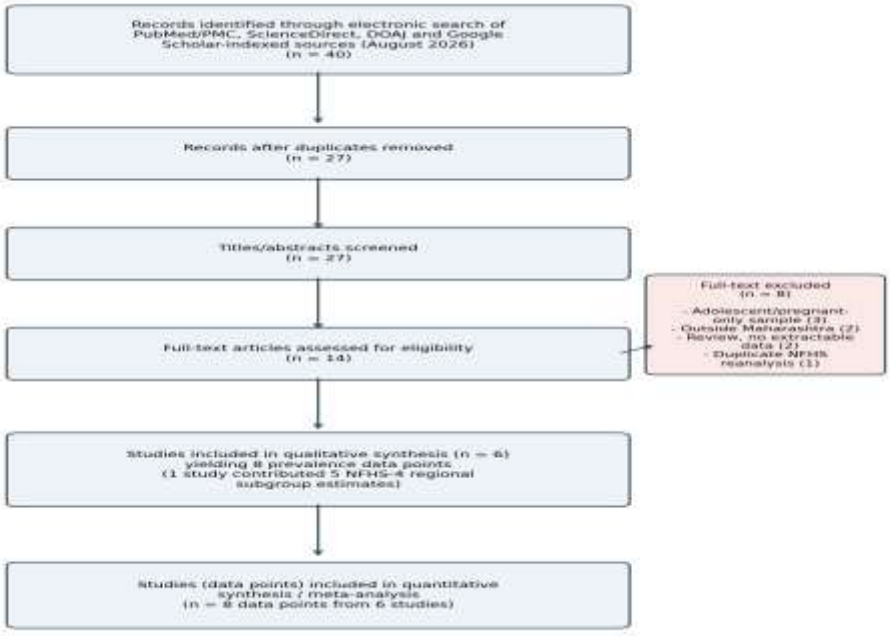

Figure 1. PRISMA flow diagram of study selection.

3.2 Characteristics of included studies

Table 1 summarises the characteristics of the six included studies.[15–18] Sample sizes ranged from 100 (a rural primary-care-based study in Wardha) to 8,729 (an NFHS-4-derived regional estimate for the Konkan division). Three data sources were primary field studies using venous or capillary haemoglobin estimation; five were region-level estimates derived from secondary analysis of NFHS-4 data reported by a single study covering all five administrative regions of Maharashtra.

Study (Year)	Study design / data source	Setting	Sample size (n)	Anaemic (n)	Prevalence (%)
Lilare & Sahoo (2017)	Community cross-sectional	Urban slum, Mumbai	315	156	49.5
Prajapati et al. (2023)	Community cross-sectional	Rural, Wardha	100	44	44.0
Bajaj et al. (2022)	Community cross-sectional	Cantonment, Western Maharashtra	722	140	19.4
Dubey & Rishipathak (2021) – Konkan	Secondary analysis, NFHS-4	Konkan region	8,729	4,321*	49.5
Dubey & Rishipathak (2021) – Paschim Mah.	Secondary analysis, NFHS-4	Paschim Maharashtra region	6,465	3,136*	48.5
Dubey & Rishipathak (2021) – Khandesh	Secondary analysis, NFHS-4	Khandesh region	5,721	3,004*	52.5
Dubey & Rishipathak (2021) – Marathwada	Secondary analysis, NFHS-4	Marathwada region	4,083	1,744*	42.7
Dubey & Rishipathak (2021) – Vidarbha	Secondary analysis, NFHS-4	Vidarbha region	5,915	2,685*	45.4

*Anaemic counts for the NFHS-4-derived regional subgroups were back-calculated from the reported regional prevalence and denominator, as raw numerators were not separately tabulated in the source publication.

3.3 Pooled prevalence

The pooled prevalence of anaemia among women of reproductive age across the eight data points was 43.8% (95% CI 39.4–48.2%) (Figure 2, Table 2). Individual estimates ranged from 19.4% (95% CI 16.5–22.3%) in a cantonment-based cohort in Western Maharashtra to 52.5% (95% CI 51.2–53.8%) in the Khandesh region. Heterogeneity was substantial (Cochran's Q = 390.2, df = 7, $p < 0.001$; $I^2 = 98.2\%$), reflecting genuine differences in setting, sampling method, and time period across the pooled data points rather than sampling error alone.

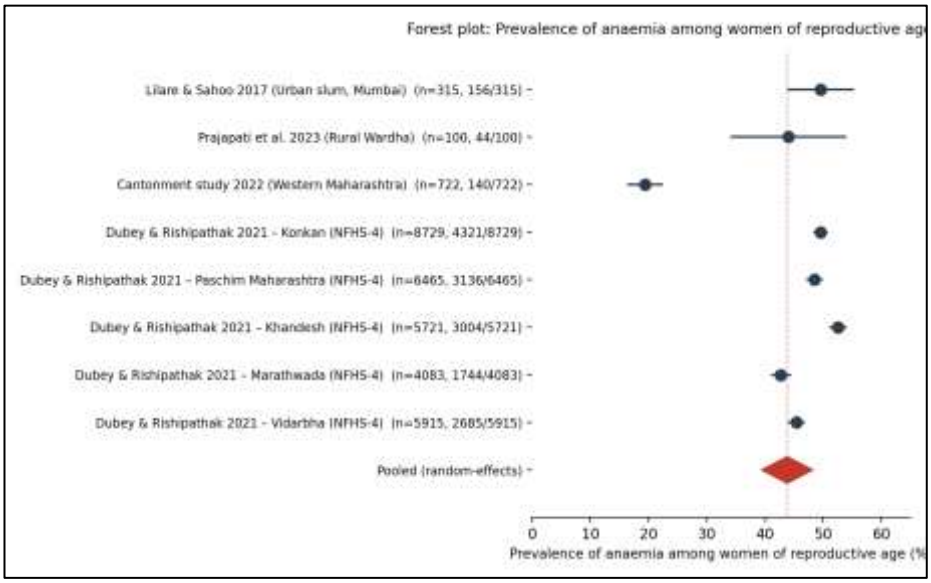

Figure 2. Forest plot of anaemia prevalence among women of reproductive age across included studies/data points, Maharashtra.

Parameter	Value
Number of data points (k)	8
Total women screened across data points	31,750
Total anaemic women	15,230
Pooled prevalence (random-effects, DerSimonian–Laird)	43.8%
95% Confidence Interval	39.4% – 48.2%
Cochran's Q	390.2 (df = 7, $p < 0.001$)

Parameter	Value
I^2 (heterogeneity)	98.2%
Tau^2	0.0149

4. DISCUSSION

This review pooled community-based and sub-national survey data to estimate that approximately two in five women of reproductive age in Maharashtra are anaemic — a figure broadly consistent with, though somewhat lower than, the NFHS-5 state estimate reported for all women aged 15–49 years.[4] The wide range across individual data points, from under 20% in a cantonment population to over 50% in parts of the Khandesh region, echoes the district-level heterogeneity described in an independent spatial-temporal analysis of Maharashtra's NFHS data,[19] and underscores that a single state-level figure conceals substantial local variation relevant to programme planning under Anaemia Mukt Bharat.[6]

The lower prevalence observed in the cantonment-based study[16] likely reflects a population with more consistent access to healthcare, dietary diversity, and iron-folic acid supplementation than the general community, illustrating how sampling frame materially affects prevalence estimates in this literature. This mirrors comparatively lower urban-institutional estimates reported elsewhere in India, such as among reproductive-age women attending an urban health centre in Kancheepuram district.[25] Conversely, higher estimates in rural and tribal-influenced regions are consistent with the broader literature linking anaemia to lower socioeconomic status, poor dietary diversity, and limited healthcare access, as reported in the rural Wardha study included here[17] and in studies among tribal women of reproductive age in Karnataka.[24] Urban-slum estimates from Mumbai[15] and Bhubaneswar[20] were likewise higher than the cantonment figure, suggesting that residence in under-resourced urban settlements carries a comparable anaemia burden to rural areas rather than the lower burden sometimes assumed for urban populations.

Disparities by social group are also well documented nationally, with Scheduled Caste, Scheduled Tribe and lower-wealth-quintile women consistently showing higher anaemia prevalence than the general population,[22] a pattern of particular relevance to Maharashtra's tribal-dominated districts such as Nandurbar and parts of Dhule division. Comparable rural estimates from Tamil Nadu[21] support the broader observation that rural WRA anaemia remains high across states despite programmatic effort. The persistently high adolescent and young-adult burden reported in contemporaneous Maharashtra-based work[23] further suggests that anaemia in this state is not confined to pregnancy but represents a life-course nutritional deficit beginning in adolescence, reinforcing the rationale for the adolescent-focused components of Anaemia Mukt Bharat.[6]

The very high I^2 (98.2%) observed in this analysis is expected given that the pooled data points combine primary field studies of a few hundred participants with large NFHS-derived regional subgroups spanning different sampling years and methods. This heterogeneity should temper interpretation of the pooled estimate as a precise state figure; it is better read as an indicative summary that highlights the direction and approximate magnitude of the problem, with the forest plot itself — rather than the single pooled number — carrying much of the clinically relevant information.

5. Limitations

This review has several limitations. First, the search was restricted to English-language, web-accessible sources rather than a full multi-database search (e.g., Scopus, Embase, and institutional subscription access with Cochrane-standard duplicate screening by two independent reviewers), and the protocol was not prospectively registered; the findings should therefore be treated as an indicative rapid review rather than a definitive systematic review, and would benefit from replication using full institutional database access. Second, the small number of primary field studies meant that five of the eight pooled data points were derived from a single secondary analysis of NFHS-4 data, which may not adequately represent more recent (NFHS-5 and post-pandemic) trends. Third, formal quality appraisal using a validated tool for prevalence studies[14] was not performed and is recommended for a subsequent, fuller version of this review. Fourth, the extremely high heterogeneity (I^2 = 98.2%) limits the precision with which the pooled estimate can be generalised, and subgroup or meta-regression analysis by setting (urban/rural), sampling year, and haemoglobin estimation method is recommended before the pooled figure is used for programmatic decision-making.

6. CONCLUSION

Anaemia remains a substantial public health problem among women of reproductive age in Maharashtra, with a pooled prevalence in the range of 40–48% but wide variation by setting and region. These findings support continued, but regionally differentiated, implementation of Anaemia Mukt Bharat interventions, with particular attention to rural and high-burden regions such as Khandesh. A fuller systematic review with prospective registration, multi-database search, and formal quality appraisal is recommended to refine this estimate.

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Conflict of Interest
None.

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