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Risk factors for maternal anaemia and low birth weight in pregnant women living in rural India: a prospective cohort study

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ABSTRACT

Objective: The aim of this prospective study was to estimate the prevalence and risk factors for maternal anaemia and low birth weight (LBW) in pregnant women living in Maharashtra state, India.
Study design: This is a prospective study.
Methods: Women between 3 and 5 months of pregnancy were recruited from 34 villages based in Maharashtra state. Baseline data collection, anthropometric measurements and blood investigations were performed. Participants were followed-up to record birth weight.
Results: In total, 303 women were eligible, and 287 (95%) provided data. 77% were anaemic, defined as haemoglobin less than 11.0 g/dl at the time of recruitment, with a mean corpuscular volume of 80.5 fl/cell (standard deviation: 7.22, range: 53.4–93.8). The increased risk of anaemia was seen in women with consanguineous marriages (odds ratio [OR]: 2.41, 95% confidence interval [CI]: 1.16–5.01, $P = 0.01$) after adjustment for potential confounding factors. Postdelivery data from full-term singleton live births demonstrated a 7% prevalence of LBW. Consanguineous marriage was a major risk factor for LBW (OR: 4.10, 95% CI: 1.25–13.41, $P = 0.02$). The presence of maternal anaemia during 3–5 months of pregnancy was associated with lower risk of LBW (unadjusted OR: 0.34, 95% CI: 0.13–0.92, $P = 0.03$).
Conclusion: About 30% of our study participants were in a consanguineous marriage, which was identified as a potentially avoidable risk factor for both anaemia and LBW.

Abbreviations: ANC, Antenatal care; BMI, Body mass index; BP, Blood pressure; CBC, Complete blood count; g/dl, Grams per decilitre; Haemoglobin, Hb; HMF, Halo Medical Foundation; IFA, Iron folic acid; LBW, Low birth weight; MAS, Maharashtra Anaemia Study; MCV, Mean corpuscular volume; MUAC, Mid-upper arm circumference; NFHS, National Family Health Survey; RBS, Random blood sugar; VHW, Village health worker.

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Introduction

Anaemia is a very common condition, which leads to a decrease in red blood cells and circulating haemoglobin (Hb) in the blood, resulting in lower oxygen carrying capacity.[1] This is widely observed among pregnant women in developing countries such as India.[1] Anaemia leads to general fatigue, weakness and shortness of breath.[1]

The National Family Health Survey of India (NFHS 3) reported that 56% of women (between 15 and 49 years of age) were anaemic with a greater prevalence in rural areas.[2] The high prevalence of anaemia in a rural Indian setting is exacerbated by limited medical infrastructure to diagnose and treat anaemia.[3,4] Poor medical care during pregnancy may affect obstetric outcomes such as birth weight.[2] If the weight at birth is less than 2.5 Kg then it is labelled as low birth weight (LBW), which may hamper neonatal health outcomes.[2] The NFHS 3 suggested that the LBW prevalence is about 22% in the country with higher occurrence in rural areas compared to urban regions.[2] Higher prevalence was seen in younger women (<20 years) at the time of delivery, and the prevalence decreased with an increase in education and wealth.[2]

There is limited information on risk factors for either anaemia during pregnancy or LBW from rural areas of India. A community-based cohort study to identify the determinants of LBW was conducted in rural areas of Maharashtra state in 1994.[5] In this study, an increased risk of LBW was associated with; (i) low maternal Hb (less than 9.0 g/dl); (ii) third trimestral bleeding; and (iii) low maternal body mass index (BMI). However, the prevalence and risk factors associated with maternal anaemia were not assessed in this study. To our knowledge, no cohort studies on this important public health issue have been conducted in rural areas of the country.

The aim of this study was to estimate the prevalence of anaemia and investigate the associated risk factors during the early stages of pregnancy in pregnant women from rural areas of Maharashtra state of India. The study also examined exposures associated with LBW in the rural population. This research is a part of the project known as 'Maharashtra Anaemia Study' (MAS).

Methods

Study population

The MAS is a joint collaboration between the Halo Medical Foundation (HMF) India and the University of Nottingham, United Kingdom (UK).[6] The research area included 34 villages (approximately 65,000 population) from Tuljapur and Lohara blocks of Osmanabad district. The Osmanabad district has a population of 1.6 million individuals; 85% reside in rural areas, with a low mean annual income (600 GBP per capita) and limited healthcare infrastructure.[7] The majority of pregnant women receive obstetric care in this community from government healthcare providers such as nurses.

A pilot process to test the study recruitment and data collection methods was conducted from January 2014 to March 2014. The study equipment was tested on the 1st working day of each month to generate an equipment performance report. The HMF's hospital in Andur provided the laboratory investigation support for this study.[8]

The study was approved by the Institutional Ethics Committee of Government Medical College Aurangabad, Maharashtra, India (reference number: Pharma/IEC/GMA/196/2014) and the University of Nottingham (UK) Medical School Ethics Committee (reference number: E10102013).

Recruitment and data collection

The data were collected at three stages: (a) predelivery data collection from pregnant women participants; (b) village-level data collection; and (c) postdelivery data collection.

Predelivery data collection

Pregnant women were identified through monthly household surveys of women in the reproductive age group (15–49 years), conducted by HMF's village-based healthcare workers. All self-reported pregnancies identified between April 1, 2014 and December 31, 2014 were eligible. No formal sample size calculation was conducted, as the project was designed as a feasibility study to inform future research priorities. The eligible study participants were approached and provided with a summary of the proposed study. Those who decided to enter the study provided a written consent before entry to the study.

The questionnaire was administered in the local language by a trained data assistant or the primary investigator (PI) himself across the project tenure. The individual questionnaire had sections on sociodemographic characteristics, medical/obstetric history, iron supplements, vaccinations, dietary preferences, 7-day diet recalls, family assets, antenatal care (ANC) access and self-reported birth outcomes, in accordance with the standard operating procedures.[9] The blood sample was collected by a trained member of the study team. Anthropometric measurements, including height and mid-upper arm circumference (MUAC) of the dominant hand, were recorded using measuring tapes. Weight was ascertained using a digital weighing machine (OMRON Healthcare, India). The blood pressure (BP) was measured in the right arm in a sitting position using an automated digital BP monitor following manufacturer's recommendations (OMRON Healthcare, India). Venous blood withdrawal was performed in a supine position by a qualified and trained laboratory technician. The complete blood count was measured using Sysmex XP-100 automated analyser (Sysmex Corporation, Japan), and the random blood sugar (RBS) was calculated using semi-automated device Erba Chem Touch (Erba Mannheim, Germany) at HMF hospital. All data collection and investigation were performed in the presence of the PI. Additional information on data collection, blood withdrawal, transport, investigation and quality controls is published elsewhere.[10]

Anaemia was defined based on an Hb level of less than 11.0 g/dl, and additionally, further categorisation is performed using Hb levels as follows: severe anaemia (Hb <7.0 g/dl), moderate anaemia (Hb: 7.0–9.9 g/dl) and mild anaemia (Hb: 10.0–10.9 g/dl).[11] The LBW was defined as baby weight less than 2.5 Kg at birth.[12] Diabetes was defined as RBS $\geq$200 mg/dl.[13] Any pathological changes in white blood cells, platelets