ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

Maternal Serum Magnesium Status and Preterm Birth: A Comparative Cross-Sectional Study in Northwestern Nigeria

Abubakar Mayana Usman[1*]; Bello Alhaji Mohammed[1]; Umar Abdullahi[2]; Rabiu Funtua Anas[3]; Anas Yakubu Ibrahim[4]; Mansur Muhammad Birnin Kebbi[5]; Muhammad Aliyu Abbas[6]

[1]Department of Obstetrics and Gynaecology, Federal Medical Center, Gusau, Zamfara State, Nigeria
[2]Department of Internal Medicine, Federal Medical Center / Federal University Gusau, Zamfara State, Nigeria
[3]Department of Obstetrics and Gynaecology, Federal Teaching Hospital, Katsina, Katsina State, Nigeria
[4]Department of Psychiatry, Federal Teaching Hospital, Birnin Kebbi, Kebbi State, Nigeria
[5]Deparment of Chemical Pathology, Federal Teaching Hospital, Birnin Kebbi, Kebbi State, Nigeria
[6]Deparment of Chemical Pathology, Usmanu Danfodiyo University Teaching Hospital, Sokoto

Corresponding Author: Abubakar Mayana Usman[1*]

Publication Date: 2026/07/31

Abstract:

- ***Background:***

Maternal magnesium deficiency has been implicated in the pathogenesis of spontaneous preterm birth through its effects on myometrial contractility, placental function, and inflammatory pathways. However, evidence from northwestern Nigeria remains limited. This study compared maternal serum magnesium concentrations between women with preterm and term deliveries and evaluated the association and diagnostic performance of serum magnesium for identifying preterm birth.

- ***Methods:***

A hospital-based comparative cross-sectional study was conducted among 120 pregnant women (60 preterm and 60 term deliveries) at Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. Maternal serum magnesium concentrations were measured using the xylidyl blue colorimetric method. Group differences were compared using the independent-samples *t*-test and chi-square test. Receiver operating characteristic (ROC) curve analysis was performed to assess the predictive performance of serum magnesium for preterm birth.

- ***Results:***

Women with preterm birth had significantly lower mean serum magnesium concentrations than those with term birth (0.59 ± 0.21 vs. 0.83 ± 0.21 mmol/L). Hypomagnesaemia (<0.65 mmol/L) was more common among women with preterm birth (76.7%) than among those with term birth (20.0%) ($p < 0.001$). Maternal hypomagnesaemia was associated with a higher risk of preterm birth (RR = 3.83, 95% CI: 2.27–6.48) and increased odds of preterm birth (OR = 13.14, 95% CI: 5.50–31.39). ROC analysis demonstrated good discriminatory ability (AUC = 0.784, 95% CI: 0.702–0.867), with an optimal serum magnesium cut-off of <0.64 mmol/L, yielding 80.0% sensitivity and 77.0% specificity.

- ***Conclusions:***

Maternal hypomagnesaemia was strongly associated with preterm birth. Serum magnesium showed good diagnostic performance and may serve as a useful adjunctive biomarker for identifying women at increased risk of preterm birth. Prospective multicentre studies are needed to validate these findings.

Keywords: *Preterm Birth; Serum Magnesium; Hypomagnesaemia; Pregnancy; Biomarker; Nigeria.*

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

How to Cite: Abubakar Mayana Usman; Bello Alhaji Mohammed; Umar Abdullahi; Rabiu Funtua Anas; Anas Yakubu Ibrahim; Mansur Muhammad Birnin Kebbi; Muhammad Aliyu Abbas (2026) Maternal Serum Magnesium Status and Preterm Birth: A Comparative Cross-Sectional Study in Northwestern Nigeria. *International Journal of Innovative Science and Research Technology*, 11(7), 2195-2205. https://doi.org/10.38124/ijisrt/26jul854

I. INTRODUCTION

Preterm birth, defined by the World Health Organization (WHO) as delivery before 37 completed weeks of gestation, remains one of the leading causes of neonatal morbidity and mortality worldwide (World Health Organization [WHO], 2023). Approximately 13–15 million babies are born prematurely each year, representing nearly one in every ten live births globally (Blencowe et al., 2023). Although advances in obstetric and neonatal care have improved survival, complications of prematurity remain the leading direct cause of neonatal deaths and account for a substantial proportion of mortality among children younger than five years (Liu et al., 2016). Infants born preterm are at increased risk of respiratory distress syndrome, intraventricular haemorrhage, necrotising enterocolitis, chronic lung disease, cerebral palsy, neurodevelopmental impairment, visual and hearing deficits, and long-term metabolic disorders (WHO, 2023). Beyond these clinical consequences, preterm birth imposes considerable psychological, social, and financial burdens on affected families and healthcare systems, particularly in low- and middle-income countries (LMICs), where access to specialised neonatal care is often limited (Adu-Bonsaffoh et al., 2020).

Sub-Saharan Africa bears a disproportionate share of the global burden of preterm birth, with some of the highest rates reported worldwide (Blencowe et al., 2023). In Nigeria, preterm birth remains a major contributor to neonatal mortality and adverse pregnancy outcomes despite ongoing improvements in maternal healthcare services (Mas'ud et al., 2020). The persistently high burden reflects multiple interacting factors, including maternal infections, hypertensive disorders of pregnancy, multiple gestation, poor maternal nutrition, limited access to quality antenatal care, and socioeconomic inequalities (Adu-Bonsaffoh et al., 2020; Haram et al., 2013). Consequently, identifying potentially modifiable maternal risk factors remains a priority for reducing the incidence of preterm birth and improving neonatal survival in resource-limited settings.

Although the aetiology of spontaneous preterm birth is multifactorial, accumulating evidence suggests that maternal nutritional status plays an important role in maintaining normal pregnancy and regulating the timing of labour (Zhang et al., 2021). Micronutrient deficiencies have been implicated in abnormal placental development, oxidative stress, inflammatory activation, endothelial dysfunction, and altered myometrial contractility, all of which may contribute to premature cervical ripening and uterine contractions (Lotfalizadeh et al., 2018; Zhang et al., 2021). Among these micronutrients, magnesium has attracted considerable research interest because of its essential physiological functions during pregnancy and its potential role in preventing adverse obstetric outcomes.

Magnesium is the fourth most abundant mineral and the second most abundant intracellular cation in the human body. It serves as an essential cofactor in more than 300 enzymatic reactions involved in adenosine triphosphate (ATP) metabolism, protein synthesis, nucleic acid synthesis, neuromuscular transmission, maintenance of membrane stability, and regulation of electrolyte homeostasis (Zhang et al., 2021). During pregnancy, magnesium plays a crucial role in placental development, fetal growth, vascular tone, and maintenance of uterine quiescence (Djagbletey et al., 2018). Maternal magnesium requirements increase progressively throughout gestation because of plasma volume expansion, increased renal excretion, haemodilution, and active placental transfer of magnesium to the growing fetus, particularly during the third trimester (Djagbletey et al., 2018; Enaruna et al., 2013). Consequently, pregnant women may become increasingly susceptible to magnesium deficiency, especially in settings where dietary intake is inadequate.

Experimental and clinical evidence suggests several biological mechanisms linking maternal hypomagnesaemia with spontaneous preterm birth. Magnesium acts as a physiological calcium antagonist by regulating intracellular calcium transport within smooth muscle cells (Anand et al., 2019). Reduced magnesium concentrations increase calcium influx into myometrial cells, resulting in enhanced actin–myosin interaction, increased uterine contractility, cervical ripening, and the initiation of labour (Syed et al., 2023). In addition, magnesium inhibits adenylate cyclase activity, stabilises cell membranes, modulates inflammatory responses, improves uteroplacental perfusion, and suppresses the release of excitatory neurotransmitters involved in uterine contractions (Mahmoud et al., 2016; Uludağ et al., 2014). These biological properties provide a strong mechanistic basis for the hypothesis that maternal magnesium deficiency may increase the risk of spontaneous preterm birth.

The importance of magnesium in pregnancy is further underscored by its well-established therapeutic applications in obstetric practice. Magnesium sulfate remains the standard treatment for the prevention and control of eclamptic seizures and is recommended for fetal neuroprotection in women at risk of imminent early preterm birth (WHO, 2023). Although its effectiveness as a tocolytic agent remains controversial, the widespread clinical use of magnesium sulfate highlights the central role of magnesium in maintaining uterine relaxation and preserving pregnancy (Elliott, 2013; Zhang et al., 2021). These observations have prompted increasing interest in determining whether maternal magnesium status itself influences the risk of preterm birth and whether early identification of hypomagnesaemia could contribute to preventive antenatal strategies.

Several observational studies have demonstrated an inverse relationship between maternal serum magnesium concentration and the risk of preterm birth, suggesting that

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

hypomagnesaemia may be an important modifiable risk factor during pregnancy. In a comprehensive systematic review and meta-analysis of observational and interventional studies, Zhang et al. (2021) reported that lower maternal magnesium concentrations were consistently associated with increased rates of preterm birth across diverse populations. The authors proposed that inadequate maternal magnesium status contributes to increased myometrial excitability and inflammatory activation, thereby predisposing women to spontaneous preterm labour. These findings have renewed interest in the role of maternal magnesium status as a potentially modifiable determinant of adverse pregnancy outcomes.

Evidence from hospital-based observational studies further supports this association. In Nigeria, Okunade et al. (2014) reported significantly lower serum magnesium concentrations among women presenting with spontaneous preterm labour than among women who delivered at term. Women with hypomagnesaemia (serum magnesium <1.6 mg/dL) were approximately 1.8 times more likely to experience preterm labour than women with normal serum magnesium concentrations. Similar findings have been reported in Bangladesh, where Shahid et al. (2018) observed significantly lower maternal serum magnesium levels among women with preterm labour and demonstrated that hypomagnesaemia was associated with more than a three-fold increased risk of premature delivery. Comparable associations have also been described in studies conducted in India (Anand et al., 2019), Egypt (Mahmoud et al., 2016), Iran (Khani et al., 2017), and Ghana (Djagbletey et al., 2018), suggesting that the relationship between maternal magnesium deficiency and preterm birth may be consistent across different populations despite variations in study design and participant characteristics.

Despite these encouraging findings, the available evidence remains inconclusive. Several studies have differed considerably in their definitions of hypomagnesaemia, timing of blood sample collection, laboratory methods used for serum magnesium estimation, gestational age at recruitment, and inclusion of women with medical or obstetric complications. These methodological differences have contributed to inconsistent estimates of effect size and have limited direct comparison between studies (Zhang et al., 2021). Furthermore, serum magnesium represents less than 1% of total body magnesium stores and may not fully reflect intracellular magnesium status, introducing additional uncertainty when interpreting findings from observational studies (Djagbletey et al., 2018).

Evidence regarding magnesium supplementation during pregnancy has also remained inconsistent. Although some randomized controlled trials have suggested that antenatal magnesium supplementation may reduce uterine irritability and lower the incidence of preterm birth, others have reported little or no significant clinical benefit (Lotfalizadeh et al., 2018; Uludağ et al., 2014). Consequently, recent systematic reviews have concluded that current evidence is insufficient to recommend routine magnesium supplementation solely for the prevention of spontaneous preterm birth outside established clinical indications (Zhang et al., 2021). This uncertainty highlights the need for additional well-designed observational studies capable of identifying women at increased risk of hypomagnesaemia and clarifying its relationship with preterm delivery in different populations.

Evidence from sub-Saharan Africa remains particularly limited despite the disproportionately high burden of preterm birth in the region. Most published African studies have originated from Ghana and southwestern Nigeria, with very few data available from northwestern Nigeria, where maternal nutritional practices, dietary intake, environmental conditions, and socioeconomic characteristics differ considerably from other regions of the country (Adu-Bonsaffoh et al., 2020; Djagbletey et al., 2018; Okunade et al., 2014). Because maternal micronutrient status is strongly influenced by geographical, cultural, and dietary factors, findings from one population may not necessarily be generalisable to another. This underscores the importance of generating region-specific evidence to guide clinical decision-making and nutritional interventions.

Furthermore, previous Nigerian studies have primarily focused on establishing the association between hypomagnesaemia and preterm labour, with limited attention to determining clinically relevant serum magnesium concentrations that may predict preterm delivery. Identifying population-specific magnesium thresholds could facilitate early risk stratification during antenatal care and improve opportunities for targeted nutritional counselling and preventive interventions. Such evidence may also contribute to the development of locally appropriate clinical guidelines for the management of women at increased risk of preterm birth.

Against this background, the present study compared maternal serum magnesium concentrations between women with preterm and term deliveries at Usmanu Danfodiyo University Teaching Hospital, Sokoto, and examined the association between maternal serum magnesium status and preterm birth. By generating evidence from northwestern Nigeria, this study seeks to strengthen the existing body of literature on maternal micronutrient status and preterm birth and provide data that may inform antenatal nutritional assessment, early identification of women at increased risk of preterm delivery, and future multicentre studies in similar low-resource settings.

II. METHODS

- *Study Design and Setting*

This hospital-based comparative cross-sectional study was conducted over a five-month period in the labour ward complex of Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, northwestern Nigeria. The study compared maternal serum magnesium concentrations between women with preterm labour and those with term labour.

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➢ *Study Population*

The study enrolled pregnant women aged 16–45 years with singleton pregnancies who presented in labour at UDUTH. Participants were allocated into two groups based on gestational age at delivery. The preterm group comprised women who delivered between 28 and less than 37 completed weeks of gestation, whereas the control group consisted of women who delivered at 37–42 completed weeks of gestation.

Women with a previous history of preterm birth, multiple pregnancy, severe systemic disease, HIV infection, polyhydramnios, smoking, alcohol consumption, illicit drug use, or significant intercurrent illness were excluded. Women who declined participation were also excluded.

➢ *Sample Size Determination and Sampling Technique*

The sample size was determined using the formula for comparing two independent means, as described by Araoye (2014) and Taofeek (2019)**.** The calculation was based on the difference in mean maternal serum magnesium concentrations reported among women with preterm labour and those with term labour by Bhat and Waheed (2012)**.** Assuming a two-sided significance level of 5%, a statistical power of 80%, and the reported mean serum magnesium concentrations with their corresponding standard deviations, the minimum required sample size was estimated to be 11 participants per group**.** After adjusting for a 10% non-response rate, the minimum sample size increased to 12 participants per group**.**

To enhance the precision of the estimates and increase the statistical power of the study, all eligible women recruited during the study period who met the inclusion criteria were enrolled. Consequently, a total of 120 participants**,** comprising 60 women with preterm labour and 60 women with term labour, were included in the study, substantially exceeding the minimum calculated sample size.

Participants were selected using a systematic random sampling technique over the five-month study period. Eligible women presenting in labour at the study site were recruited after providing written informed consent. For each study group, the first participant was selected by simple random sampling using balloting, after which every *k*th eligible woman was recruited according to the predetermined sampling interval until the required sample size was attained.

➢ *Data Collection*

Following written informed consent, participants were interviewed using a structured interviewer-administered questionnaire to obtain sociodemographic characteristics, obstetric history, and relevant clinical information. To ensure confidentiality, unique study identification numbers were assigned to all participants instead of personal identifiers.

➢ *Blood Sample Collection and Laboratory Analysis*

Five millilitres of venous blood were collected from each participant under strict aseptic conditions before delivery. Blood samples were allowed to clot at room temperature for 30–60 minutes and centrifuged at 4,000 rpm for 10 minutes to obtain serum. Serum samples were stored at −20°C until laboratory analysis.

Serum magnesium concentration was determined using the xylidyl blue colorimetric method (AGAPPE Diagnostics GmbH, Switzerland). In an alkaline medium, magnesium reacts with xylidyl blue to form a coloured complex, the intensity of which is directly proportional to the magnesium concentration in the sample. Absorbance was measured at a wavelength of 547 nm using a Beckman Coulter DU-720 UV/VIS spectrophotometer (Beckman Coulter Inc., USA). Serum magnesium concentration was calculated according to the manufacturer's instructions using the absorbance of the sample relative to the standard.

➢ *Quality Assurance*

Internal quality control procedures were performed throughout the study using commercially available quality-control sera (Qualicheck Normal and Pathological; AGAPPE Diagnostics GmbH, Switzerland). Quality-control samples were analysed with each batch of specimens to ensure analytical accuracy and precision before reporting study results.

➢ *Outcome Measure*

The primary outcome was maternal serum magnesium concentration among women with preterm and term deliveries. The association between maternal serum magnesium level and preterm birth was also evaluated.

➢ *Statistical Analysis*

Data were analysed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality and are presented as mean ± standard deviation (SD), while categorical variables are presented as frequencies and percentages. Differences in mean serum magnesium concentrations between study groups were compared using the independent-samples *t*-test. Associations between categorical variables were assessed using the chi-square test. Multivariable logistic regression analysis was performed to identify independent predictors of preterm birth after adjusting for potential confounding variables. Statistical significance was set at $p < 0.05$.

➢ *Ethical Considerations*

Ethical approval for the study was obtained from the Health Research Ethics Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, (UDUTH/HREC/2023/1292/V2). The study was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before enrolment, and confidentiality of participants' information was maintained throughout the study.

III. RESULTS

➢ *Baseline Sociodemographic Characteristics of the Study Participants*

A total of 120 pregnant women were enrolled in this comparative cross-sectional study conducted between

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November 2023 and March 2024, comprising 60 women with preterm labour and 60 women with term labour**.** The mean age of participants was comparable between the preterm and term groups (26.68 ± 4.80 vs. 25.93 ± 5.76 years, respectively).

The majority of participants in both groups were of Hausa/Fulani ethnicity (76.7% vs. 85.0%), practiced Islam (81.7% vs. 91.7%), were married**,** and had attained tertiary education (43.3% vs. 41.7%). Most participants had received antenatal care (booked) (78.3% vs. 73.3%). Multiparity was more common among women with preterm labour (58.3%), whereas primiparity predominated in the term labour group (51.7%).

There were no statistically significant differences between the two groups with respect to age, occupation, ethnicity, religion, educational attainment, booking status, parity, or social class (all $p > .05$). However, body mass index (BMI) differed significantly between the groups ($\chi^2 = 32.79$, $p < .001$), with overweight women being more prevalent in the term labour group, while normal BMI was more common among women with preterm labour (Table 1).

Table 1 Baseline Sociodemographic Characteristics of the Study Participants

Characteristic	Preterm labour (n = 60)	Term labour (n = 60)	χ^2	*P*
Age (years)				0.332
15–25	27 (45.0)	12 (20.0)		
26–35	30 (50.0)	14 (23.3)		
36–45	3 (5.0)	34 (56.7)		
Mean ± SD	26.68 ± 4.80	25.93 ± 5.76		
Occupation				0.172
Housewife	24 (40.0)	31 (51.7)		
Civil servant	12 (20.0)	11 (18.3)		
Businesswoman	24 (40.0)	18 (30.0)		
Religion				0.268
Islam	49 (81.7)	55 (91.7)		
Christianity	11 (18.3)	5 (8.3)		
Ethnicity				0.955
Hausa/Fulani	46 (76.7)	51 (85.0)		
Igbo	5 (8.3)	4 (6.7)		
Yoruba	5 (8.3)	4 (6.7)		
Others	4 (6.7)	1 (1.7)		
Educational level				0.949
Primary/Non-formal	20 (33.3)	15 (25.0)		
Secondary	14 (23.3)	20 (33.3)		
Tertiary	26 (43.3)	25 (41.7)		
Booking status				0.705
Booked	47 (78.3)	44 (73.3)		
Unbooked	13 (21.7)	16 (26.7)		
Parity				0.275
Primipara	25 (41.7)	31 (51.7)		
Multipara	35 (58.3)	29 (48.3)		
Social class				0.162
Upper	12 (20.0)	11 (18.3)		
Middle	24 (40.0)	18 (30.0)		
Lower	24 (40.0)	31 (51.7)		
BMI (kg/m²)				< .001
Normal	38 (63.3)	8 (13.3)		
Overweight	12 (20.0)	46 (76.7)		
Obese	10 (16.7)	6 (10.0)		
Mean ± SD	24.95 ± 5.20	24.26 ± 4.26		

➢ *Serum Magnesium Status of the Study Participants*

The distribution of maternal serum magnesium concentrations is presented in Table 2**.** The prevalence of hypomagnesaemia (serum magnesium <0.65 mmol/L) was significantly higher among women with preterm labour than among those with term labour. Overall, 46 (76.7%) women in the preterm group had low serum magnesium concentrations compared with 12 (20.0%) women in the term group. Conversely, normal serum magnesium concentrations (≥0.65 mmol/L) were observed in 48 (80.0%) women with term labour compared with 14 (23.3%) women with preterm labour.

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The mean serum magnesium concentration was lower among women with preterm labour than among those with term labour (0.59 ± 0.21 mmol/L **vs.** 0.83 ± 0.21 mmol/L, respectively). The overall mean serum magnesium concentration for the study population was 0.71 ± 0.24 mmol/L (Table 2).

Table 2 Maternal Serum Magnesium Status of the Study Participants

Serum magnesium (mmol/L)	**Preterm labour (n = 60), *n* (%)**	**Term labour (n = 60), *n* (%)**	**Total (N = 120), *n* (%)**
Low (<0.65)	46 (76.7)	12 (20.0)	58 (48.3)
Normal (≥0.65)	14 (23.3)	48 (80.0)	62 (51.7)
Total	60 (100.0)	60 (100.0)	120 (100.0)
Mean ± SD (mmol/L)	0.59 ± 0.21	0.83 ± 0.21	0.71 ± 0.24
Range (min–max), mmol/L	0.23–1.02	0.34–1.03	0.23–1.03

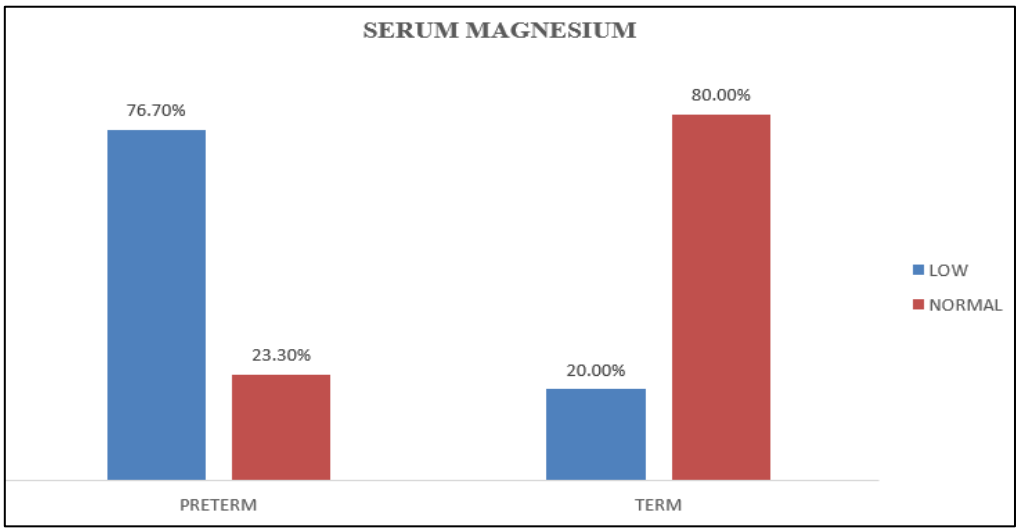

Fig 1 Distribution of Maternal Serum Magnesium Status Among Women with Preterm and Term Labour.

The distribution of maternal serum magnesium status according to study group is illustrated in Figure 2**.** Hypomagnesaemia (serum magnesium <0.65 mmol/L) was considerably more prevalent among women with preterm labour, whereas normal serum magnesium concentrations (≥0.65 mmol/L) predominated among women with term labour.

- *Association Between Maternal Serum Magnesium Status and Selected Maternal and Neonatal Characteristics*

The association between maternal serum magnesium status and selected maternal and neonatal characteristics is presented in Table 3. Maternal serum magnesium status was significantly associated with gestational age ($\chi^2 = 38.58$, $df = 1$, $p < .001$) and birth weight (Fisher's exact test, $p = .018$). Women with hypomagnesaemia were significantly more likely to experience preterm labour and deliver low-birth-weight infants than women with normal serum magnesium concentrations.

No significant associations were observed between maternal serum magnesium status and booking status ($\chi^2 < 0.001$, $p = 1.000$), parity ($\chi^2 = 0.001$, $p = 1.000$), body mass index (Fisher's exact test, $p = .265$), or fetal outcome (Fisher's exact test, $p = .681$).

Table 3 Association Between Maternal Serum Magnesium Status and Selected Maternal and Neonatal Characteristics

Variable	**Low serum magnesium (<0.65 mmol/L) n (%)**	**Normal serum magnesium (≥0.65 mmol/L) n (%)**	**Test statistic**	***df***	***p***
Gestational age			$\chi^2 = 38.58$	1	< .001
Preterm labour	46 (76.7)	14 (23.3)			
Term labour	12 (20.0)	48 (80.0)			
Booking status			$\chi^2 < 0.001$	1	1.000
Booked	30 (48.4)	32 (51.6)			
Unbooked	28 (48.3)	30 (51.7)			
Parity			$\chi^2 = 0.001$	1	1.000
Primipara	27 (48.2)	29 (51.8)			
Multipara	31 (48.4)	33 (51.6)			
Body mass index (kg/m²)			Fisher's exact test	—	.265
Underweight	1 (100.0)	0 (0.0)			
Normal weight	35 (47.3)	39 (52.7)			

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Overweight/Obese†	22 (46.8)	25 (53.2)			
Fetal outcome			Fisher's exact test	—	.681
Live birth	57 (49.1)	59 (50.9)			
Stillbirth	1 (33.3)	2 (66.7)			
Birth weight			Fisher's exact test	—	.018
Low birth weight (<2.5 kg)	30 (51.4)	28 (48.6)			
Normal birth weight (2.5–3.5 kg)	28 (10.0)	32 (90.0)			

Note. Values are presented as *n* (%). Fisher's exact test was used where expected cell counts were <5.

➢ *Association Between Maternal Serum Magnesium Status and Preterm Birth*

Maternal serum magnesium status was significantly associated with preterm birth ($\chi^2 = 36.34$, $df = 1$, $p < .001$). Women with low serum magnesium concentrations were 3.83 times more likely to experience preterm birth than women with normal serum magnesium concentrations (RR = 3.83, 95% CI: 2.27–6.48). Furthermore, hypomagnesaemia was associated with a more than 13-fold increase in the odds of preterm birth (OR = 13.14, 95% CI: 5.50–31.39).

Table 4 Association Between Maternal Serum Magnesium Status and Preterm Birth

Gestational age	Low serum magnesium (<0.65 mmol/L), *n*	Normal serum magnesium (≥0.65 mmol/L), *n*	Total
Preterm birth	46	14	60
Term birth	12	48	60
Total	58	62	120

Statistical measure	Estimate
χ^2 ($df = 1$)	36.34
P	< .001
Relative risk (RR)	3.83 (95% CI: 2.27–6.48)
Odds ratio (OR)	13.14 (95% CI: 5.50–31.39)

Note. CI = confidence interval; OR = odds ratio; RR = relative risk.

➢ *Diagnostic Performance of Maternal Serum Magnesium for Identifying Preterm Birth*

The diagnostic performance of maternal serum magnesium concentration for identifying preterm birth was evaluated using receiver operating characteristic (ROC) curve analysis (Figure 3). Maternal serum magnesium demonstrated good discriminatory ability, with an area under the ROC curve (AUC) of 0.784 (95% CI: 0.702–0.867, $p < .001$), indicating good accuracy in distinguishing women with preterm birth from those with term birth.

The optimal serum magnesium cut-off value was <0.64 mmol/L, which yielded a sensitivity of 80.0% and a specificity of 77.0%. At this threshold, the positive predictive value (PPV) was 78.9%**,** while the negative predictive value (NPV) was 76.2% (Table 5).

Overall, these findings indicate that maternal hypomagnesaemia was strongly associated with preterm birth and that serum magnesium demonstrated good diagnostic performance in identifying women at increased risk of preterm birth. These results suggest that maternal serum magnesium may serve as a useful adjunctive biomarker for the early identification of women at risk of preterm birth, although further prospective multicentre studies are required to validate its clinical utility.

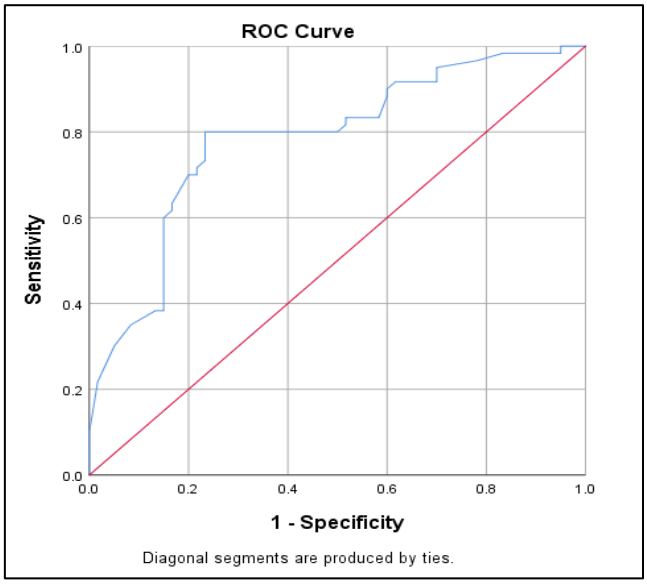

Fig 2 Receiver Operating Characteristic (ROC) Curve of Maternal Serum Magnesium for Identifying Preterm Birth

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

Table 5 Diagnostic Performance of Maternal Serum Magnesium for Identifying Preterm Birth

Parameter	Estimate
Optimal cut-off (mmol/L)	<0.64
Area under the ROC curve (AUC)	0.784
95% Confidence interval	0.702–0.867
P	< .001
Sensitivity (%)	80.0
Specificity (%)	77.0
Positive predictive value (PPV) (%)	78.9
Negative predictive value (NPV) (%)	76.2

Note. AUC = area under the receiver operating characteristic (ROC) curve; CI = confidence interval; PPV = positive predictive value; NPV = negative predictive value.

IV. DISCUSSIONS

The present comparative cross-sectional study demonstrated significantly lower maternal serum magnesium concentrations among women with preterm birth compared with those who delivered at term. In addition, hypomagnesaemia (serum magnesium <0.65 mmol/L) was markedly more prevalent among women with preterm birth, affecting more than three-quarters of cases, whereas most women with term birth had normal serum magnesium concentrations. Maternal hypomagnesaemia was associated with an almost four-fold increased risk of preterm birth, and serum magnesium demonstrated good discriminatory ability for identifying women with preterm birth (AUC = 0.784). Collectively, these findings suggest that maternal magnesium deficiency may be an important nutritional factor associated with preterm birth and support its potential role as an adjunctive biomarker for identifying women at increased risk of adverse pregnancy outcomes.

The sociodemographic characteristics of women in the preterm and term groups were generally comparable, with no statistically significant differences in age, educational level, ethnicity, religion, parity, booking status, or social class. Although body mass index differed significantly between the two groups, no significant association was observed between maternal body mass index and serum magnesium status. These findings reduce the likelihood that the observed differences in maternal serum magnesium concentrations were primarily attributable to sociodemographic characteristics and strengthen the observed association between hypomagnesaemia and preterm birth.

One of the principal findings of this study was the significantly lower maternal serum magnesium concentration among women with preterm birth than among women with term birth. This observation is consistent with growing evidence implicating maternal magnesium deficiency as a potentially modifiable risk factor for spontaneous preterm birth (Zhang et al., 2021)**.** Magnesium is an essential intracellular cation that regulates calcium transport, preserves cellular membrane stability, supports placental vascular function, and modulates inflammatory pathways involved in the initiation of labour (Jahnen-Dechent & Ketteler, 2012; Zhang et al., 2021)**.**

The present findings are consistent with those reported by Okunade et al. (2014)**,** who found significantly lower maternal serum magnesium concentrations among Nigerian women presenting with spontaneous preterm labour than among women who delivered at term. Similar findings have been reported in Ghana, where maternal hypomagnesaemia was significantly associated with spontaneous preterm labour (Djagbletey et al., 2018)**.** Likewise, Shahid et al. (2018) reported significantly lower maternal serum magnesium concentrations among Bangladeshi women with spontaneous preterm labour. Collectively, these studies indicate that low maternal serum magnesium concentrations are consistently associated with preterm birth across different populations and healthcare settings (Djagbletey et al., 2018; Okunade et al., 2014; Shahid et al., 2018)**.**

The biological plausibility of this association is well established. Magnesium acts as a physiological calcium antagonist by regulating transmembrane calcium influx into myometrial smooth muscle cells (Jahnen-Dechent & Ketteler, 2012)**.** Reduced intracellular magnesium concentrations facilitate increased calcium entry, promoting actin–myosin interaction, enhanced uterine contractility, cervical ripening, and premature initiation of labour (Jahnen-Dechent & Ketteler, 2012)**.** In addition, magnesium suppresses inflammatory cytokine production, improves uteroplacental perfusion, stabilises cellular membranes, and modulates prostaglandin synthesis, thereby contributing to the maintenance of uterine quiescence during pregnancy (Zhang et al., 2021)**.**

Although most observational studies have demonstrated an inverse relationship between maternal serum magnesium concentration and preterm birth, inconsistencies remain in the literature (Zhang et al., 2021)**.** Differences in study design, gestational age at recruitment, laboratory methods, diagnostic thresholds for hypomagnesaemia, dietary magnesium intake, maternal nutritional status, and population characteristics may partly explain these discrepancies (Djagbletey et al., 2018)**.** Furthermore, serum magnesium represents less than 1% of total body magnesium stores and may not accurately reflect intracellular magnesium status, which is considered a more sensitive indicator of magnesium homeostasis (Jahnen-Dechent & Ketteler, 2012)**.** Nevertheless, serum magnesium remains the most practical and widely available biomarker for routine clinical assessment and continues to demonstrate

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

clinically meaningful associations with adverse pregnancy outcomes (Zhang et al., 2021).

Overall, the findings of the present study contribute to the growing body of evidence supporting maternal hypomagnesaemia as a potentially modifiable risk factor associated with preterm birth, particularly in low- and middle-income countries where the burden of preterm birth remains disproportionately high and opportunities for nutritional intervention may improve maternal and neonatal outcomes (World Health Organization, 2023; Zhang et al., 2021).

Another notable finding of the present study was the significant association between maternal serum magnesium status, gestational age, and neonatal birth weight, whereas no significant associations were observed with booking status, parity, body mass index, or fetal outcome. These findings suggest that maternal magnesium deficiency may primarily influence pregnancy outcomes through mechanisms that promote earlier delivery and impaired fetal growth rather than through maternal sociodemographic or obstetric characteristics. The observed association between hypomagnesaemia and low birth weight is biologically plausible because preterm birth remains one of the strongest determinants of reduced birth weight (World Health Organization [WHO], 2023). Furthermore, maternal magnesium deficiency has been associated with impaired placental vascular function, reduced nutrient transfer, oxidative stress, and fetal growth restriction, all of which may contribute to adverse neonatal outcomes (Jahnen-Dechent & Ketteler, 2012; Zhang et al., 2021).

A major finding of this study was the strong association between maternal hypomagnesaemia and preterm birth. Women with low serum magnesium concentrations were nearly four times more likely to experience preterm birth than women with normal serum magnesium concentrations (RR = 3.83, 95% CI: 2.27–6.48), while the odds of preterm birth were more than thirteen-fold higher among women with hypomagnesaemia (OR = 13.14, 95% CI: 5.50–31.39). These findings indicate that maternal magnesium deficiency is strongly associated with preterm birth and may represent an important nutritional risk factor among pregnant women.

The observed association is consistent with previous evidence demonstrating that maternal hypomagnesaemia increases susceptibility to spontaneous preterm birth. Okunade et al. (2014) reported significantly lower maternal serum magnesium concentrations among Nigerian women with spontaneous preterm labour and observed that hypomagnesaemia was associated with an increased likelihood of preterm birth. Similar findings have been reported in Ghana (Djagbletey et al., 2018) and Bangladesh (Shahid et al., 2018), where maternal hypomagnesaemia was consistently associated with spontaneous preterm labour. The stronger association observed in the present study may reflect differences in maternal nutritional status, dietary magnesium intake, socioeconomic characteristics, laboratory methods, and study populations. Nevertheless, the consistency of these findings across diverse populations supports the growing body of evidence linking maternal magnesium deficiency with preterm birth (Djagbletey et al., 2018; Okunade et al., 2014; Shahid et al., 2018; Zhang et al., 2021).

The high prevalence of hypomagnesaemia among women with preterm birth in this study further suggests that magnesium deficiency may represent an important nutritional challenge among pregnant women in northwestern Nigeria. This finding highlights the need for further research evaluating maternal dietary magnesium intake, nutritional status, and the potential role of magnesium supplementation among women at increased risk of preterm birth. However, because of the cross-sectional nature of this study, a temporal or causal relationship between maternal hypomagnesaemia and preterm birth cannot be established. Residual confounding by unmeasured factors, including dietary habits, renal function, inflammatory status, socioeconomic conditions, and other micronutrient deficiencies, may also have influenced the observed association. Consequently, prospective cohort studies and adequately powered randomized controlled trials are needed to determine whether correction of maternal hypomagnesaemia can reduce the incidence of spontaneous preterm birth (WHO, 2022; Zhang et al., 2021).

An important strength of the present study was the evaluation of the diagnostic performance of maternal serum magnesium concentration for identifying women with preterm birth. Receiver operating characteristic (ROC) curve analysis demonstrated good discriminatory ability, with an area under the curve (AUC) of 0.784 (95% CI: 0.702–0.867). An AUC within this range indicates good diagnostic discrimination and suggests that maternal serum magnesium has clinically meaningful ability to distinguish women with preterm birth from those delivering at term (Mandrekar, 2010).

The optimal serum magnesium cut-off value identified in this study (<0.64 mmol/L) yielded a sensitivity of 80.0% and specificity of 77.0%, with corresponding positive and negative predictive values of 78.9% and 76.2%, respectively. These findings suggest that maternal serum magnesium may have practical utility as an adjunctive biomarker for identifying women at increased risk of preterm birth, particularly in low-resource settings where access to advanced predictive tools may be limited.

Few studies from sub-Saharan Africa have evaluated the diagnostic accuracy of maternal serum magnesium using ROC curve analysis. Most previous African studies have focused primarily on comparing serum magnesium concentrations between women with preterm and term birth without establishing clinically useful diagnostic thresholds (Djagbletey et al., 2018; Okunade et al., 2014). Consequently, the ROC analysis performed in the present study provides clinically relevant information regarding the potential role of serum magnesium in antenatal risk stratification and represents an important contribution to the existing literature.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

Despite these promising findings, serum magnesium should not be considered a standalone diagnostic test for preterm birth. Preterm birth is a multifactorial syndrome resulting from complex interactions among maternal, fetal, placental, infectious, inflammatory, endocrine, genetic, and environmental factors (Goldenberg et al., 2008). Therefore, the predictive performance of serum magnesium is likely to improve when combined with established clinical predictors, including previous preterm birth, cervical length measurement, fetal fibronectin testing, maternal infection, hypertensive disorders of pregnancy, and other biochemical markers. Future multicentre prospective studies should evaluate integrated prediction models incorporating maternal serum magnesium alongside these established clinical risk factors.

The findings of the present study have important implications for antenatal care, particularly in Nigeria and other low-resource settings where the burden of preterm birth remains high (World Health Organization [WHO], 2023). Maternal hypomagnesaemia was common among women with preterm birth and was associated with a markedly increased risk of adverse pregnancy outcomes. Given that serum magnesium estimation is relatively inexpensive, readily available, and easy to perform in most tertiary healthcare facilities, assessment of maternal magnesium status may represent a practical adjunct to antenatal risk assessment, especially among women with recognised risk factors for spontaneous preterm birth.

Although current evidence does not support routine magnesium supplementation solely for the prevention of preterm birth, identifying women with hypomagnesaemia may facilitate targeted nutritional counselling, optimisation of dietary magnesium intake, and closer antenatal surveillance (WHO, 2022; Zhang et al., 2021). Such interventions may improve maternal nutritional status while additional evidence from well-designed randomized controlled trials continues to clarify the effectiveness of magnesium supplementation in reducing preterm birth.

The high prevalence of maternal hypomagnesaemia observed in this study also underscores the need for broader public health interventions aimed at improving maternal nutrition before and during pregnancy. These strategies should include nutrition education, promotion of magnesium-rich diets, strengthened antenatal nutritional assessment, and integration of micronutrient evaluation into comprehensive maternal health programmes, particularly in regions with a high burden of preterm birth (WHO, 2023).

V. STRENGTHS AND LIMITATIONS

This study has several strengths. It employed a well-defined comparative cross-sectional design with standardized laboratory methods for serum magnesium estimation and recruited equal numbers of women with preterm and term births, enhancing comparability between study groups. The sample size substantially exceeded the minimum calculated requirement, improving the precision and statistical power of the findings. Furthermore, this study extends existing evidence by evaluating not only the association between maternal hypomagnesaemia and preterm birth but also the diagnostic performance of serum magnesium using receiver operating characteristic (ROC) curve analysis, providing clinically relevant information on its potential role in antenatal risk assessment.

However, several limitations should be considered. The hospital-based, single-centre design may limit the generalisability of the findings to the wider obstetric population. In addition, the cross-sectional design precludes establishing a temporal or causal relationship between maternal hypomagnesaemia and preterm birth. Residual confounding from unmeasured factors, including maternal dietary magnesium intake, renal function, inflammatory status, socioeconomic factors, and other micronutrient deficiencies, cannot be excluded. Furthermore, serum magnesium reflects only a small proportion of total body magnesium stores and may not accurately represent intracellular magnesium status, although it remains the most practical biomarker for routine clinical assessment (Jahnen-Dechent & Ketteler, 2012). Consequently, multicentre prospective studies are required to validate these findings and determine the clinical utility of maternal serum magnesium as a biomarker for preterm birth.

VI. CONCLUSION AND RECOMMENDATIONS

This study demonstrated that maternal serum magnesium concentrations were significantly lower among women with preterm birth than among those who delivered at term. Maternal hypomagnesaemia was strongly associated with an increased risk of preterm birth and showed good diagnostic performance in distinguishing women with preterm and term births. These findings suggest that maternal serum magnesium may serve as a useful adjunctive biomarker for identifying women at increased risk of preterm birth, particularly in resource-limited settings.

Although routine screening and magnesium supplementation cannot be recommended based on this study alone, assessment of maternal magnesium status may be considered among women at increased risk of preterm birth as part of comprehensive antenatal care. Optimising maternal nutrition through dietary counselling and ensuring adequate magnesium intake may further contribute to improving pregnancy outcomes. Future multicentre prospective studies and adequately powered randomized controlled trials are required to validate these findings, determine the effectiveness of magnesium supplementation, and establish the role of maternal serum magnesium within integrated prediction models for preterm birth.

- *Conflict of Interest*

The authors declare that there are no conflicts of interest regarding the publication of this study.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jul854

REFERENCES

[1]. Araoye, M. O. (2014). *Research methodology with statistics for health and social sciences*. Nathadex Publishers.

[2]. Bhat, A., & Waheed, A. (2012). Serum magnesium levels in preterm labour and term labour: A comparative study. *Journal of Obstetrics and Gynaecology of India, 62*(3), 273–276.

[3]. Blencowe, H., Krasevec, J., de Onis, M., Black, R. E., An, X., Stevens, G. A., Borghi, E., Hayashi, C., Estevez, D., Cegolon, L., Shiekh, S., Ponce Hardy, V., Lawn, J. E., & Cousens, S. (2023). National, regional, and worldwide estimates of preterm birth in 2020, with trends from 2010: A systematic analysis. *The Lancet, 402*(10409), 1261–1271. https://doi.org/10.1016/S0140-6736(23)00878-4

[4]. Chollat, C., Sentilhes, L., Marret, S., & Goffinet, F. (2018). Fetal neuroprotection by magnesium sulfate: From translational research to clinical application. *Frontiers in Neurology, 9*, 247. https://doi.org/10.3389/fneur.2018.00247

[5]. Djagbletey, R., Adu-Bonsaffoh, K., Oppong, S. A., Seffah, J. D., & Obed, S. A. (2018). Serum magnesium levels and spontaneous preterm labour among pregnant women in Ghana. *Ghana Medical Journal, 52*(2), 87–92.

[6]. Enaruna, N. O., Ande, A. B., & Okpere, E. E. (2013). Clinical significance of serum magnesium in pregnancy. *Nigerian Journal of Clinical Practice, 16*(4), 448–453.

[7]. Goldenberg, R. L., Culhane, J. F., Iams, J. D., & Romero, R. (2008). Epidemiology and causes of preterm birth. *The Lancet, 371*(9606), 75–84. https://doi.org/10.1016/S0140-6736(08)60074-4

[8]. Haram, K., Mortensen, J. H., & Wollen, A. L. (2013). Preterm delivery: An overview. *Acta Obstetricia et Gynecologica Scandinavica, 92*(7), 687–704.

[9]. Jahnen-Dechent, W., & Ketteler, M. (2012). Magnesium basics. *Clinical Kidney Journal, 5*(Suppl. 1), i3–i14. https://doi.org/10.1093/ndtplus/sfr163

[10]. Liu, L., Oza, S., Hogan, D., Chu, Y., Perin, J., Zhu, J., Lawn, J. E., Cousens, S., Mathers, C., & Black, R. E. (2016). Global, regional, and national causes of under-5 mortality in 2000–2015: An updated systematic analysis with implications for the Sustainable Development Goals. *The Lancet, 388*(10063), 3027–3035. https://doi.org/10.1016/S0140-6736(16)31593-8

[11]. Lotfalizadeh, M., Khadem, N., & Mirzamoradi, M. (2018). Maternal serum magnesium concentration and preterm labour: A systematic review. *Journal of Obstetrics and Gynaecology Research, 44*(5), 825–832.

[12]. Mandrekar, J. N. (2010). Receiver operating characteristic curve in diagnostic test assessment. *Journal of Thoracic Oncology, 5*(9), 1315–1316. https://doi.org/10.1097/JTO.0b013e3181ec173d

[13]. Mas'ud, I. A., Ocheke, A. N., & Mutihir, J. T. (2020). Preterm birth and associated maternal risk factors in Nigeria: A review of the evidence. *Nigerian Journal of Clinical Practice, 23*(Suppl. 1), S12–S18.

[14]. Okunade, K. S., Adegbesan-Omilabu, M. A., & Oluwole, A. A. (2014). Maternal serum magnesium level at presentation in preterm labour and its association with pregnancy outcome. *Advances in Medicine, 2014*, Article 704875. https://doi.org/10.1155/2014/704875

[15]. Shahid, F., Akhtar, Z., & Begum, R. (2018). Association of maternal serum magnesium levels with spontaneous preterm labour. *Bangladesh Journal of Obstetrics and Gynaecology, 33*(2), 59–64.

[16]. Taofeek, I. (2019). *Research methodology and dissertation writing for health and allied health professionals*. Cress Global Link Limited.

[17]. Uludağ, S., Madazlı, R., Şen, C., Ocak, V., & Gezer, A. (2014). Magnesium supplementation and pregnancy outcomes: Current evidence. *Journal of Perinatal Medicine, 42*(5), 567–574.

[18]. World Health Organization. (2022). *WHO recommendations on interventions to improve preterm birth outcomes*. World Health Organization.

[19]. World Health Organization. (2023). *Born too soon: Decade of action on preterm birth*. World Health Organization.

[20]. World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053

[21]. Zhang, Y., Xun, P., Chen, C., Lu, L., Shechter, M., Rosanoff, A., & He, K. (2021). Magnesium levels in relation to rates of preterm birth: A systematic review and meta-analysis of ecological, observational, and interventional studies. *Nutrition Reviews, 79*(2), 188–199. https://doi.org/10.1093/nutrit/nuaa028.