



Research Article

Serum Calcium Concentration in Pregnant Women in Kindu, Maniema, Democratic Republic of Congo

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Abstract

Background: Calcium plays an essential role in maternal and fetal health during pregnancy. Maternal calcium status is influenced by dietary intake, nutritional status, gestational age, and physiological adaptations occurring during pregnancy. However, data on serum calcium concentrations among pregnant women in the Democratic Republic of the Congo, particularly in Maniema Province, remain limited. **Objectives:** This study aimed to determine serum calcium concentration among pregnant woman in Kindu, Maniema province, Democratic Republic of the Congo, and to assess the frequency of hypocalcémie during early pregnancy. **Methods:** A longitudinal study was conducted among 116 pregnant women with gestational ages of less than 20 weeks. Participants were recruited and followed at Lumbulumbu Hospital Center, Kindu General Referral Hospital, and Kasuku 2 Health Center between January 1 and December 31, 2024. Serum calcium concentrations were measured during pregnancy. Data were analyzed using analysis of variance (ANOVA) and the chi-square test. A p-value ≤ 0.05 was considered statistically significant. **Results:** The mean serum calcium concentration was 1.146 ± 0.132 mmol/L. Hypocalcaemia was identified in 16.4% of the pregnant women studied. **Conclusion:** This study found that hypocalcaemia was relatively frequent among pregnant women in Kindu. Early assessment of maternal calcium status may help identify women at risk of calcium deficiency and facilitate appropriate nutritional counseling and management during pregnancy. Further studies are needed to investigate the determinants of hypocalcaemia and its potential relationship with maternal and fetal outcomes in this population.

Keywords

Serum Calcium, Pregnant Women, Hypocalcaemia, Pregnancy, Concentration, Maternal Nutrition, Kindu, Democratic Republic of the Congo

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Received: 7 September 2026; Accepted: 23 September 2026; Published: 14 October 2026



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1. Introduction

Pregnancy is a period of profound metabolic changes designed to meet the increasing needs of the developing fetus. Among the essential minerals, calcium plays a fundamental role, not only in the mineralization of the fetal skeleton and the prevention of maternal bone complications, but also in critical physiological functions such as blood clotting, neuromuscular transmission, and cardiac activity [1, 2]. Calcium requirements increase significantly during pregnancy, and the maternal body implements complex adaptation mechanisms, including increased intestinal calcium absorption, reduced urinary calcium excretion, and increased mobilization from bone tissue [3, 4].

Despite these compensatory mechanisms, calcium deficiency or hypocalcemia can occur, exposing both the mother and the fetus to substantial risks. In the mother, hypocalcemia can manifest as neuromuscular symptoms (cramps, paresthesia, tetany) and, in the longer term, contribute to bone demineralization and an increased risk of postpartum osteoporosis [5]. It is also a well-established risk factor for major pregnancy complications, such as preeclampsia and premature birth [6, 7]. For the fetus, maternal calcium deficiency can compromise bone growth, lead to low birth weight, and impair dental development [8, 9].

In resource-limited regions, such as the Democratic Republic of Congo (DRC), the risk of gestational hypocalcemia is exacerbated by multifactorial vulnerabilities. A diet that is often monotonous and low in dairy products, the main source of bioavailable calcium, frequently leads to insufficient nutritional intake [10]. This situation is compounded by reproductive patterns characterized by closely spaced pregnancies and multiparity, which can progressively deplete maternal calcium reserves without complete replenishment [11, 12]. Furthermore, access to quality prenatal care services, including biological screening and appropriate supplementation, remains unequal.

However, most studies on calcium status in sub-Saharan Africa have focused on women in late pregnancy, primarily assessing the prevalence of hypocalcemia in the third trimester. Little data is available on calcium profile or concentration from the beginning of pregnancy, even though early assessment is crucial for identifying at-risk women before fetal needs peak and for implementing timely corrective interventions [13]. Knowledge of the longitudinal evolution of serum calcium levels over three trimesters in the same cohort is also scarce, limiting our understanding of the dynamics of this deficiency and its potential persistence.

This study, conducted in the city of Kindu, DRC, falls within this context. It specifically aims to address these gaps by focusing on a subgroup of pregnant women recruited at an early stage of gestation. Its objectives are threefold: first, to determine serum calcium concentration (calcemia) in the first trimester (≤ 19 weeks of gestation) and identify the associated

demographic and obstetric factors (age, parity, place of residence). Second, to analyze the longitudinal evolution of this calcium level through three successive measurements taken during the first (≤ 19 weeks), second (20-27 weeks), and third (≥ 28 weeks) trimesters. Third, to assess the persistence and individual trajectories of hypocalcemia over this same gestational period.

By establishing a precise baseline of calcium status upon entry into the prenatal care system and monitoring its evolution, this research aims to provide evidence to guide clinical practice. The results will help determine whether it is justified to recommend systematic calcium screening at the first consultation and to target the most vulnerable subpopulations for appropriate supplementation and monitoring, with the goal of preventing maternal-fetal complications related to this major nutritional deficiency.

2. Method

Our study was conducted in the Maniema province, in the city of Kindu, at the Lumbulumbu Hospital Center (CHLL), the Kindu General Referral Hospital (HGRK), and the Kasuku 2 Health Center. The study took place between January 1 and December 31, 2024 (twelve months). It included all pregnant women who attended prenatal care (ANC) and whose pregnancies did not exceed 19 weeks. We studied serum calcium levels and the prevalence of hypocalcemia. Serum calcium was measured three times during the pregnancy (T1: ≤ 19 weeks; T2: 20-27 weeks; T3: ≥ 28 weeks) and analyzed using descriptive statistics, ANOVA, chi-square tests, and Pearson's correlation test, with the significance level set at $p \leq 0.05$. This assay was performed using the electrolyte analyzer 9180 AVL. In accordance with local standards and the French Society of Clinical Biology (SFBC), the normal value of serum calcium was defined as a serum calcium level between 1.1-1.3 mmol/l.

3. Result

Table 1 The Kindu General Referral Hospital and the CHLL receive the largest number of pregnant women in early pregnancy with similar numbers.

Table 1. Distribution of pregnant women according to the healthcare facility (N=116).

Structure	Number (n)	Percentage (%)
CHLL	52	44.83
CS/KASUKU 2	11	9.48
HGR KINDU	53	45.69

Structure	Number (n)	Percentage (%)
Total	116	100.00

Table 2 The age distribution in the subgroup of women at 19 weeks of gestation or less shows a concentration in the 20-29 age group, which alone represents 50.44% of the participants. Adolescents (15-19 years) constitute 12.2% of the sample, while women aged 30 and over represent 37.4%, including 3.5% of women aged 40 and over. This broad coverage of reproductive ages allows for the analysis of the influence of maternal age on biological parameters from the first trimester onward.

Table 2. Distribution of participants by age group (N=115).

Age group	Number (n)	Percentage (%)
15-19 years old	14	12.17
20-24 years old	30	26.09
25-29 years old	28	24.35
30-34 years old	22	19.13
35-39 years old	17	14.78
40+ years	4	3.48
Total	115	100.00

Table 3 The distribution of gestational ages in these subgroups (≤ 19 weeks) shows a marked concentration between 16 and 19 weeks, a period representing 75.0% of cases (87/116). Very early consultations (≤ 13 weeks) are less frequent (15.5%), which may reflect a delay in entering the healthcare system or the scheduling of the first prenatal visits. This distribution confirms that the majority of women are included in the middle of the first trimester and the beginning of the second trimester, a relevant window for the initial assessment of calcium status.

Table 3. Distribution of participants according to gestational age in weeks (N=116).

Weeks of amenorrhea	Number (n)	Percentage (%)
7	1	0.86
9	1	0.86
12	8	6.90
13	8	6.90

Weeks of amenorrhea	Number (n)	Percentage (%)
14	5	4.31
15	6	5.17
16	24	20.69
17	20	17.24
18	22	18.97
19	21	18.10
Total	116	100.00

Table 4 In the first trimester (≥ 19 weeks of gestation), 81.0% of pregnant women had normal serum calcium levels. Hypocalcemia affected 16.4% of women, or approximately one in six, indicating a significant prevalence from the beginning of pregnancy in this population of Kindu. Hypercalcemia was rare (2.6%), which is consistent with physiological expectations in early gestation. These data establish a baseline level of hypocalcemia before the metabolic adaptations of advanced pregnancy become fully established. The significant proportion of early hypocalcemia warrants systematic screening and assessment of nutritional intake or specific risk factors at the first prenatal visit.

Table 4. Distribution of serum calcium at first sample (≤ 19 weeks) (N=116).

Calciumemia category	Number (n)	Percentage (%)
Hypercalcemia (>1.3 mmol/L)	3	2.59
Hypocalcemia (<1.1 mmol/L)	19	16.38
Normal (1.1-1.3 mmol/L)	94	81.03
Total	116	100.00

Table 5 Analysis of variance reveals a statistically significant difference in serum calcium levels according to parity at the beginning of pregnancy ($P=0.023$). Women with few pregnancies have the lowest mean serum calcium level (1.075 mmol/L), significantly lower than those with first pregnancies (1.173 mmol/L) and those with many pregnancies (1.177 mmol/L). Women with many pregnancies have an intermediate value (1.151 mmol/L) but with higher variability (standard deviation=0.140). Bartlett's test indicates significant heterogeneity of variances between groups ($P<0.001$), which may influence the interpretation of the ANOVA and suggests different variability patterns depending on obstetric history.

Table 5. Serum calcium at first blood test according to parity (≤ 19 weeks gestation).

Parity	Number (n)	Mean serum calcium (mmol/L) $\pm$ Standard deviation	Minimum	Maximum
First-time mother	35	1.1729 $\pm$ 0.0838	0.80	1.30
Paucipare	24	1.0754 $\pm$ 0.1773	0.67	1.27
Multiparous	39	1.1513 $\pm$ 0.1404	0.76	1.38
Large multiparous woman	18	1.1772 $\pm$ 0.0922	0.85	1.29

Analysis of variance (ANOVA): $F = 3.29$; $p = 0.0233$

Bartlett's test (homogeneity of variances): $\chi^2 (3) = 18.88$; $p < 0.001$

4. Discussion

The serum calcium concentration in pregnant women in Kindu was 1.15 mmol/L, and the prevalence of hypocalcemia was 16.8%. Our result corroborates that found by Woldemeskel et al. in Ethiopia, which was 16.1%. Hypocalcemia affected one in six pregnant women in our study, a result similar to that found by Godluck H. et al., who reported one in five pregnant women in Tanzania in 2025.

5. Conclusion

This longitudinal study, conducted on 116 pregnant women with a gestational age ≤ 19 weeks of amenorrhea (WA) in the city of Kindu, provided a detailed assessment of calcium status at the beginning of pregnancy. The results reveal a contrasting situation, where an average improvement in biological levels indicates a persistent and concerning clinical problem within a vulnerable subgroup.

Regarding serum calcium concentration (calcemia), the study shows that the average initial level is within normal limits (1.146 ± 0.132 mmol/L). However, this general trend masks significant disparities related to obstetric history. Indeed, parity appears to be a major determinant, with women who had given birth only a few times (pauciparous) presenting a significantly lower average initial calcium level (1.075 mmol/L) than primiparous and multiparous women.

The most striking finding concerns the prevalence of hypocalcemia. By the first trimester, 16.4% of women (1 in 6) were already experiencing hypocalcemia. This persistence, despite the average adaptation observed, indicates that hypocalcemia is a chronic condition for many women, rather than a transient episode related to pregnancy. The significant association with parity is again striking: women with two or more births (pauciparous) have a tenfold increased risk, with a prevalence of hypocalcemia reaching 37.5%, more than double the cohort average.

In short, this study demonstrates that in this population,

those with few children constitute the most vulnerable population, with an extremely high prevalence of hypocalcemia and a low average serum calcium level, suggesting a critical depletion of their calcium reserves.

Abbreviations

DRC	Democratic Republic of the Congo
CHLL	Lumbulumbu Hospital Center
HGRK	Kindu General Referral Hospital
ANC	Attended Prenatal Care
SFBC	Society of Clinical Biology
WA	Week of Amenorrhea

Author Contributions

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Andy Muela Mbangama: Formal Analysis, Methodology

Rashid Rahma Tozin: Supervision

Etienne Mwamba Shindano: Supervision, Writing – review & editing

Olivier Nyakio Ngaleza: Supervision, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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