



Original Research

Differences in Hemoglobin Levels Using Point-of-Care Testing in Capillary and Venous Blood Samples of Pregnant Women

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ABSTRACT

Background: Hemoglobin level examination in pregnant women is essential to prevent complications associated with anemia during pregnancy. Differences in sampling methods, particularly capillary and venous blood, may influence the accuracy of results obtained using Point-of-Care Testing (POCT). This study aimed to determine the differences in hemoglobin levels measured using POCT between capillary and venous blood samples in pregnant women at UPTD Puskesmas Kuta II.

Methods : This research employed a simple experimental design with a total sample of 30 pregnant women selected using a quota sampling technique. Hemoglobin levels were measured using a POCT device for both capillary and venous blood samples. Data were analyzed using univariate and bivariate analysis with the Paired Sample T-Test.

Results: The results showed that the mean hemoglobin level in capillary blood was 12.5 g/dL, while in venous blood it was 12.2 g/dL. Statistical analysis indicated a significant difference between the two measurements ($p\text{-value} < 0.001$). The higher hemoglobin level in capillary blood may be attributed to differences in oxygen distribution between capillary and venous circulation.

Conclusion: In conclusion, there is a significant difference in hemoglobin levels measured using POCT between capillary and venous blood samples in pregnant women.

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INTRODUCTION

Anemia in pregnancy remains a significant public health problem, particularly in developing countries, including Indonesia. The prevalence of anemia among pregnant women is still relatively high and is associated with increased risks of maternal and neonatal complications such as preterm birth, low birth weight, and maternal mortality. Hemoglobin examination is an essential laboratory test used to detect anemia during pregnancy and plays a crucial role in antenatal care. Various methods are used to measure hemoglobin levels in healthcare facilities, including laboratory-based methods and Point-of-Care Testing (POCT), which offers rapid results and practical application in primary healthcare settings (Kementerian Kesehatan Republik Indonesia, 2023; Dinas Kesehatan Provinsi Bali, 2025).

Previous studies have explored different methods of hemoglobin measurement. Research comparing the Sahli method and POCT showed significant differences in results, indicating variability between methods (Chalisa, 2021). Other studies comparing POCT with cyanmethemoglobin methods found no significant difference in capillary samples but reported differences when using venous samples (Puspitasari et al., 2020). Additionally, comparisons between POCT and hematology analyzers revealed no significant differences, suggesting that POCT is reliable for initial anemia screening (Fauzi et al., 2024; Andini, 2022). These findings highlight the increasing use of POCT in clinical practice, especially in primary healthcare settings.

Despite these findings, there is still limited research specifically comparing hemoglobin levels measured using POCT between capillary and venous blood samples in pregnant women. In clinical practice, blood sampling may involve both capillary and venous methods, which may lead to differences in results and patient discomfort due to multiple sampling procedures. Therefore, it is important to evaluate whether significant differences exist between these two sampling methods to improve efficiency and patient comfort in healthcare services.

This study addresses this gap by analyzing the differences in hemoglobin levels measured using POCT between capillary and venous blood samples in pregnant women at UPTD Puskesmas Kuta II. The novelty of this research lies in its specific focus on pregnant women and the direct comparison of capillary and venous samples using the same POCT method, which has not been extensively studied in previous research.

MATERIALS AND METHOD

The study was conducted at UPTD Puskesmas Kuta II, Bali, Indonesia, during February–March 2026, involving pregnant women undergoing hemoglobin examination. A comparative analytical approach was applied to evaluate differences in hemoglobin levels measured using Point-of-Care Testing (POCT) between capillary and venous blood samples. A total of 30 respondents were included in the study using a quota sampling technique based on predefined inclusion criteria. Hemoglobin levels were measured using a portable POCT hemoglobinometer, which analyzes whole blood samples and provides digital results with standard clinical accuracy. Capillary blood samples were obtained through finger puncture, while venous blood samples were collected via venipuncture.

Each respondent underwent both capillary and venous blood sampling, and hemoglobin levels were measured using the same POCT device to ensure consistency of results. The measurement procedures followed standard operating procedures for POCT-based hemoglobin testing. Each measurement was performed once for each type of sample, resulting in paired data for each respondent. Data obtained were processed using univariate and bivariate statistical analysis. Descriptive analysis was used to determine mean, minimum, maximum, and standard deviation values, while inferential analysis using the paired sample t-test was conducted to assess differences between capillary and venous measurements at a significance level of 0.05.

RESULTS

The results of this study present the comparative findings of hemoglobin levels measured using Point-of-Care Testing (POCT) in capillary and venous blood samples among pregnant women at UPTD Puskesmas Kuta II, including descriptive statistical outcomes and inferential analysis to determine the significance of differences between the two sampling methods.

Table 1 Characteristics of Research Subjects

No	Age Group (Years)	Number of Participants	Percentage (%)
1	<20	1	3.3
2	20–25	6	20.0
3	26–30	14	46.7
4	31–35	5	16.7
5	35–40	4	13.3
Total		30	100

Table 1 presents the characteristics of research subjects based on age groups. The majority of respondents were in the 26–30 years age group, accounting for 14 individuals (46.7%), indicating that most pregnant women in this study were within the optimal reproductive age range. This was followed by the 20–25 years age group with 6 respondents (20.0%), and the 31–35 years group with 5 respondents (16.7%). Meanwhile, 4 respondents (13.3%) were aged 35–40 years, and only 1 respondent (3.3%) was under 20 years old. Overall, the data show that most participants were concentrated in the age range of 20–35 years, which is generally considered the safest reproductive age period.

Table 2. Hemoglobin Levels in Capillary and Venous Blood of Pregnant Women at UPTD Puskesmas Kuta II

Hemoglobin Level	Mean (g/dL)	Standard Deviation (g/dL)	Minimum (g/dL)	Maximum (g/dL)
Capillary Blood	12.5	1.35	10.2	15.9
Venous Blood	12.2	1.38	9.8	15.8

Table 2 presents the distribution of hemoglobin levels measured in capillary and venous blood samples among pregnant women. The results show that the mean hemoglobin level in capillary blood was slightly higher (12.5 g/dL) compared to venous blood (12.2 g/dL). The standard deviation values indicate relatively similar variability between the two sample types, with 1.35 g/dL for capillary blood and 1.38 g/dL for venous blood. The minimum hemoglobin level was 10.2 g/dL in capillary blood and 9.8 g/dL in venous blood, while the maximum values were 15.9 g/dL and 15.8 g/dL, respectively. Overall, these findings suggest that capillary blood tends to yield slightly higher hemoglobin values compared to venous blood, although the distribution patterns between the two are relatively comparable.

Table 3. Data Analysis Results

Hemoglobin Level	p-value
Capillary Blood	<0.001
Venous Blood	

Table 2 presents the results of the statistical analysis comparing hemoglobin levels between capillary and venous blood samples. The analysis shows a p-value of less than 0.001, indicating that there is a statistically significant difference between hemoglobin levels measured from capillary and venous blood samples. This result suggests that the type of blood sample used can influence hemoglobin measurement outcomes, and therefore should be carefully considered in clinical practice, particularly when using Point-of-Care Testing (POCT) for pregnant women.

DISCUSSION

The present study demonstrated that hemoglobin levels measured using Point-of-Care Testing (POCT) in capillary blood were slightly higher than those in venous blood, with a statistically significant difference ($p < 0.001$). This finding confirms that the source of blood sampling plays an important role in influencing hemoglobin measurement outcomes. Similar findings have been reported in controlled studies showing that hemoglobin concentrations in capillary blood can be approximately 0.3–0.5 g/dL higher compared to venous blood, likely due to physiological differences in microcirculation and oxygen distribution (Neufeld et al., 2020; Rappaport et al., 2024). Capillary blood reflects peripheral circulation, which may undergo localized hemoconcentration, thus contributing to higher hemoglobin values.

The results of this study are consistent with previous research indicating that POCT is a reliable tool for hemoglobin measurement but may show variability depending on the sampling method (Fauzi et al., 2024; Andini, 2022). Studies by Yu and Lam (2024) also reported that capillary POCT measurements often differ from venous laboratory results, although they remain clinically useful for rapid screening (Yu & Lam, 2024). However, some studies have reported contradictory findings, where capillary hemoglobin values may be lower due to dilution by interstitial fluid when improper sampling techniques are used, particularly when excessive pressure is applied during finger puncture (Whitehead et al., 2019). This indicates that not only biological factors but also technical factors significantly affect measurement outcomes.

Furthermore, large-scale comparative studies have shown that hemoglobin values vary depending on the type of blood sample and analytical method used, potentially affecting anemia prevalence estimates (Garcia-Casal, 2023; Larson et al., 2021). A recent multicenter study also confirmed that capillary blood measurements exhibit higher variability and lower precision compared to venous samples, especially when using single-drop capillary techniques (De la Cruz-Góngora et al., 2022; Patel et al., 2026). This variability is particularly important in pregnant women, where accurate hemoglobin assessment is critical for diagnosing anemia and guiding appropriate interventions.

From a clinical perspective, the findings of this study highlight the importance of standardizing blood sampling techniques when using POCT devices. Although POCT offers advantages such as rapid results, minimal invasiveness, and ease of use in primary healthcare settings, variability in results may lead to misclassification of anemia status if the sampling method is not carefully controlled. This is in line with national guidelines emphasizing accurate and early detection of anemia in pregnant women as part of antenatal care services (Kementerian Kesehatan Republik Indonesia, 2023).

The novelty of this study lies in its specific focus on pregnant women in a primary healthcare setting and the direct comparison of capillary and venous blood samples using the same POCT device. Unlike previous studies that compared different analytical methods, this study isolates the effect of the sampling source, thereby providing more precise evidence of its impact. These findings contribute to the growing body of evidence that emphasizes the need for harmonization of hemoglobin measurement procedures, particularly in screening programs and resource-limited settings.

In summary, although POCT remains a practical and efficient tool for hemoglobin assessment, the type of blood sample significantly influences the results. Therefore, healthcare providers should consider both biological and technical factors when interpreting hemoglobin values, and standardized protocols should be implemented to improve diagnostic accuracy and patient care outcomes.

CONCLUSION

The findings of this study demonstrate that the consumption of date seed coffee significantly reduced both systolic and diastolic blood pressure among patients with hypertension. Participants who received the intervention experienced a greater reduction in blood pressure compared to those in the control group, indicating the potential effectiveness of date seed coffee as a complementary approach to hypertension management. The antihypertensive effects observed may be associated with the antioxidant, phenolic, flavonoid, and mineral content of date seeds, which contribute to improved cardiovascular function and blood pressure regulation. Therefore, date seed coffee may serve as a promising non-pharmacological adjunct to conventional antihypertensive therapy.

Despite these encouraging results, the study was limited by its relatively small sample size and short intervention duration. Further research involving larger populations, longer follow-up periods, and more rigorous control of confounding variables is recommended to confirm the effectiveness and safety of date seed coffee in the long-term management of hypertension. In conclusion, date seed coffee has the potential to be utilized as a complementary dietary intervention for reducing blood pressure among individuals with hypertension and may contribute to broader strategies aimed at preventing hypertension-related complications.

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