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ORIGINAL ARTICLE

Finger-Stick Hemoglobin Test in Geriatric Patients

Günay Yildiz [1], Cihan Bedel [1], Fatih Selvi [1], Ökkeş Zortuk [2], Yavuz F. Yavuz [1]

[1] *Emergency Medicine, SBU Antalya Training and Education Hospital, Antalya, Türkiye*
[2] *Emergency Medicine, Bandırma Training and Education Hospital, Balıkesir; Türkiye*

SUMMARY

Background: **Finger-stick hemoglobin tests, also known as point-of-care testing (POCT) for hematology, offer a convenient and minimally invasive method for obtaining blood samples and conducting various hematological analyses. Given the paucity of studies in the literature assessing fingertip hemoglobin levels in geriatric patients and the simplicity of the method, the objective of this study was to measure fingertip blood hemoglobin levels in the geriatric population.**
Methods: **The study was conducted on geriatric patients who presented to the emergency department of a tertiary teaching and research hospital. In the study, peripheral blood samples were collected from the participants via the fingertip venipuncture method and were compared to conventional hemoglobin results.**
Results: **The study included 130 geriatric patients. The mean corpuscular hemoglobin value, as determined by the conventional method, was found to be 11.68 ± 2.66 g/dL, while the mean value obtained by fingertip measurement was 10.82 ± 3.01 g/dL. The mean value for hemoglobin was found to be -0.8615 (95% confidence interval: -1.1864 to -0.5367), while the mean value for hematocrit was -4.7969 (95% confidence interval: -5.9248 to -3.6690).**
Conclusions: **Finger-stick hemoglobin tests represent a significant advancement in point-of-care diagnostics, offering a practical alternative to traditional blood sampling methods.**
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Correspondence:
Dr. Cihan Bedel
Emergency Medicine
SBU Antalya Training and Education Hospital
Varlık, Kazım Karabekir Cd.
07100 Muratpaşa/Antalya
Türkiye
Phone: +90 5075641254
Email: cihanbedel32@gmail.com

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INTRODUCTION

The term "hemoglobin test" is used to describe a comprehensive blood test that provides critical information about the components of blood, including red blood cells, white blood cells, and platelets [1]. It is a fundamental diagnostic tool utilized to assess general health and detect a plethora of conditions, including anemia, infections, and hematological disorders. The hemoglobin test is also referred to as a complete blood count (CBC) and is a commonly used diagnostic tool in both human and veterinary medicine [2]. This will examine the significance, applications, and technological advancements associated with hemoglobin. Hemoglobin test is an essential diagnostic tool for identifying a range of conditions, including anemia, infections, inflammation, bleeding disorders, and leukemia. It provides spe-

cific and nonspecific data that, when integrated with patient history and physical examination, offers valuable diagnostic guidance. Additionally, hemoglobin tests are used to monitor the side effects of certain drugs and to assess the health status of patients undergoing treatments like chemotherapy [3,4].

The results of a hamoglobin test can be influenced by a number of factors, including the location from which the sample was obtained, the timing of the test, and the overall health status of the patient. This variability necessitates careful interpretation by healthcare professionals. Long-term exposure to ionizing radiation, as observed in radiation workers, has been demonstrated to significantly affect hemoglobin parameters, indicating the necessity for protective measures and regular monitoring [5]. Finger-stick hemoglobin tests, also known as point-of-care testing (POCT) for hematology, offer a convenient and minimally invasive method for obtaining blood samples and conducting various hematological analyses. These tests are particularly advantageous in settings where rapid results are needed or where traditional venipuncture is impractical [6]. The use of finger-stick samples has been explored across different applications, from routine blood counts to specialized diagnostic procedures [7].

A geriatric finger hemoglobin test, or complete blood count (CBC), is a critical diagnostic tool for assessing various hematological conditions, including anemia, which is prevalent in this age group. Anemia in the elderly is frequently misdiagnosed due to its insidious symptoms, which are often mistaken for the normal aging process [9]. The hemoglobin test provides essential data on hemoglobin levels, red and white blood cell counts, and other indices that facilitate the diagnosis and management of anemia and other blood disorders in the elderly [10]. Given the paucity of studies in the literature assessing fingertip hemoglobin levels in geriatric patients and the simplicity of the method, the objective of this study was to measure fingertip blood hemoglobin levels in the geriatric population.

MATERIALS AND METHODS

The study was conducted on geriatric patients who presented to the emergency department of a tertiary teaching and research hospital. The demographic data, vital signs, and fingertip hemoglobin and hematocrit values, as well as hemoglobin and hematocrit values obtained using the conventional method, were recorded for patients who consented to participate and were followed for non-trauma-related conditions. The findings were then subjected to analysis.

Sample size

The study included patients aged sixty-five and older. A previous study had been conducted with twenty-nine participants [11], while another study using the capillary system analyzed seventy-nine participants [12]. In order to build upon those two studies, our study planned to include a minimum of eighty participants and was completed with 130 participants.

Finger-stick hemoglobin test

In the study, peripheral blood samples were collected from the participants via the fingertip venipuncture method. In this procedure, the patient's fingertip was cleansed with an antiseptic solution, and a small incision was made using a lancet. Following the initial drop of blood being wiped away with a clean cloth, the capillary blood sample was then measured using the Fasttest Hblyzer Plusmed brand hemoglobin analyzer. The device determined the hemoglobin level in the capillary blood samples by measuring the 10 µL volume using a photometric method. All measurements were performed using fresh blood samples.

Conventional hemoglobin results

Venous blood samples were simultaneously collected from the patients and analyzed for hemoglobin using EDTA-containing tubes in the hospital's biochemistry laboratory. During the patient's follow-up, hemoglobin and hematocrit values were measured from the venous blood sample using the conventional Sysmex XN-1000 device (Sysmex Corp., Kobe, Japan).

Statistical analysis

The data collected in the study were stored in a database and subsequently analyzed using two software programs: SPSS version 27 (IBM Co., USA) and MedCalc version 22. Following the description of the data, categorical data were presented as percentages and frequencies. For numerical data, distribution analysis was performed, and values were expressed as the mean and standard deviation. The Bland-Altman test was employed to determine the relationship between measurements, and Pearson correlation analysis was conducted to analyze the difference between the measurements and the vital signs. A p-value of less than 0.05 was considered statistically significant for the findings.

RESULTS

The study included 130 geriatric patients, with 56.9% of the participants being women. The mean age of the participants was 77.91 ± 8.86 years. The mean corpuscular hemoglobin value, as determined by the conventional method, was found to be 11.68 ± 2.66 g/dL, while the mean value obtained by fingertip measurement was 10.82 ± 3.01 g/dL. Table 1 presents the demographic data of the participants.

The results of the Bland-Altman analysis indicated the presence of a systematic discrepancy between the hemoglobin and hematocrit measurements, with the calculated mean differing significantly from zero. The mean value for hemoglobin was found to be -0.8615 (95% confidence interval: -1.1864 to -0.5367), while the

Table 1. Descriptive information.

Specification	n = 130
Gender, female (n, %)	74 (56.9%)
Age (mean ± SD)	77.91 ± 8.86
SBP (mean ± SD)	121.73 ± 13.28
DBP (mean ± SD)	78.16 ± 13.80
Temperature (mean ± SD)	80.53 ± 21.00
Pulse (mean ± SD)	36.47 ± 0.5
Hemoglobin (mean ± SD)	11.68 ± 2.66
Hematocrit (mean ± SD)	36.58 ± 8.83
Device hemoglobin (mean ± SD)	10.82 ± 3.01
Device hematocrit (mean ± SD)	31.79 ± 9.34

mean value for hematocrit was -4.7969 (95% confidence interval: -5.9248 to -3.6690). Furthermore, the p-values for both measurements were found to be less than 0.001, indicating that the difference was statistically significant. Upon examination of the limits of agreement, a significant difference was observed between the hemoglobin and hematocrit measurements. These results suggest poor agreement between the two methods, and the findings may be interpreted differently (Table 2, Figures 1 and 2).

No significant difference was observed between the participants' vital signs and the hemoglobin and hematocrit measurement differences (Table 3).

DISCUSSION

Finger-stick hemoglobin tests, also known as point-of-care testing (POCT) for hematology, offer a convenient and minimally invasive method for obtaining blood samples and conducting various hematological analyses [14]. These tests are particularly advantageous in settings where rapid results are needed or where traditional venipuncture is impractical. The use of finger-stick samples has been explored across different applications, from routine blood counts to specialized diagnostic procedures [15]. In our study, we demonstrated the effectiveness of a rapid and efficient method for hemoglobin parameters that could become important in the geriatric population.

Finger-stick tests are less invasive than traditional venipuncture, rendering them appropriate for utilization in outpatient settings, home monitoring, and for patients who experience difficulty with venous access. This method is particularly advantageous for pediatric and geriatric populations [16]. The expeditious nature of these tests is of particular importance in emergency settings and for the monitoring of conditions that necessitate frequent testing, such as diabetes or patients undergoing clozapine therapy [17]. Only minimal quantity of blood is necessary, which is beneficial for patients with conditions that limit the amount of blood that can be drawn or for those undergoing frequent testing [18]. In a study conducted by Agarwal and colleagues, the most prevalent hematological pattern of anemia among the elderly was identified as normocytic normochromic, representing 57.26% of cases. The majority of patients were in the 65 - 74 age group, with a slight male predominance (53%), and 56% of patients exhibited moderate anemia. In another study, the authors present a low-cost method for non-invasive estimation of heart rate and hemoglobin concentration [19]. A study conducted by Chatterjee et al. found that hemoglobin and hematocrit levels obtained from ear-lobe blood in children were significantly higher than normal, averaging about 15% above the expected values. This indicates that ear-lobe blood is not a reliable source for these measurements [20].

The utilization of finger hemoglobin, or complete blood count (CBC), in geriatric patients represents a pivotal diagnostic instrument for evaluating overall health and diagnosing a range of conditions. For the elderly, maintaining normal CBC values is crucial for the prevention of complications associated with systemic diseases. The studies presented underscore the significance of CBC in monitoring health, diagnosing anemia, and evaluating the efficacy of interventions in the geriatric population. The subsequent sections examine the specific applications of geriatric finger hemoglobin tests. CBC is a pivotal diagnostic instrument that offers insights into the health status of elderly patients. It facilitates the identification of conditions such as anemia, which is prevalent in this age group and can lead to severe complications like cardiovascular and neurological issues [21, 22].

It is of the utmost importance to conduct regular monitoring of CBC components, including hemoglobin, hematocrit, and red cell distribution width (RDW), in order to effectively manage chronic diseases such as diabetes and cardiovascular illnesses, which are prevalent among the elderly population. Anemia is the most prevalent hematological disorder among the elderly, frequently resulting from iron deficiency, chronic disease, or nutritional deficiencies. The available evidence indicates that anemia in the elderly is the result of a complex interplay between multiple factors, with inflammation, renal impairment, and malnutrition emerging as significant contributors [25]. The prevalence of anemia in elderly diabetics is noteworthy, with significant differences in hemoglobin profiles compared to younger patients, underscoring the necessity for age-specific diagnostic criteria. In our study, the average hemoglobin value, as determined by the conventional method, was found to be 11.68 ± 2.66 g/dL, while the fingertip measurement yielded an average of 10.82 ± 3.01 g/dL.

Point-of-care testing (POCT) for hemoglobin levels, such as the HemoCue® system, has proven effective in

Table 2. Bland-Altman test for hemoglobin and hematocrit.

	Hb	Htc
Arithmetic mean	-0.8615 (-1.1864 to -0.5367)	-4.7969 (-5.9248 to -3.6690)
p-value	< 0.001	< 0.001
Lower limit	-4.5309 (-5.0875 to -3.9743)	-17.536 (-19.469 to -15.604)
Upper limit	2.8078 (2.2512 to 3.3645)	7.9428 (6.0102 to 9.8753)

Table 3. Correlation with vital sign.

Specification		AGE	SBP	DBP	Pulse	Temperatur
Hemoglobin	Pearson correlation	-0.077	0.099	-0.009	0.079	0.000
	p-value	0.386	0.261	0.922	0.371	0.999
Hematocrit	Pearson correlation	-0.018	-0.032	-0.109	0.033	0.059
	p-value	0.840	0.718	0.217	0.711	0.503

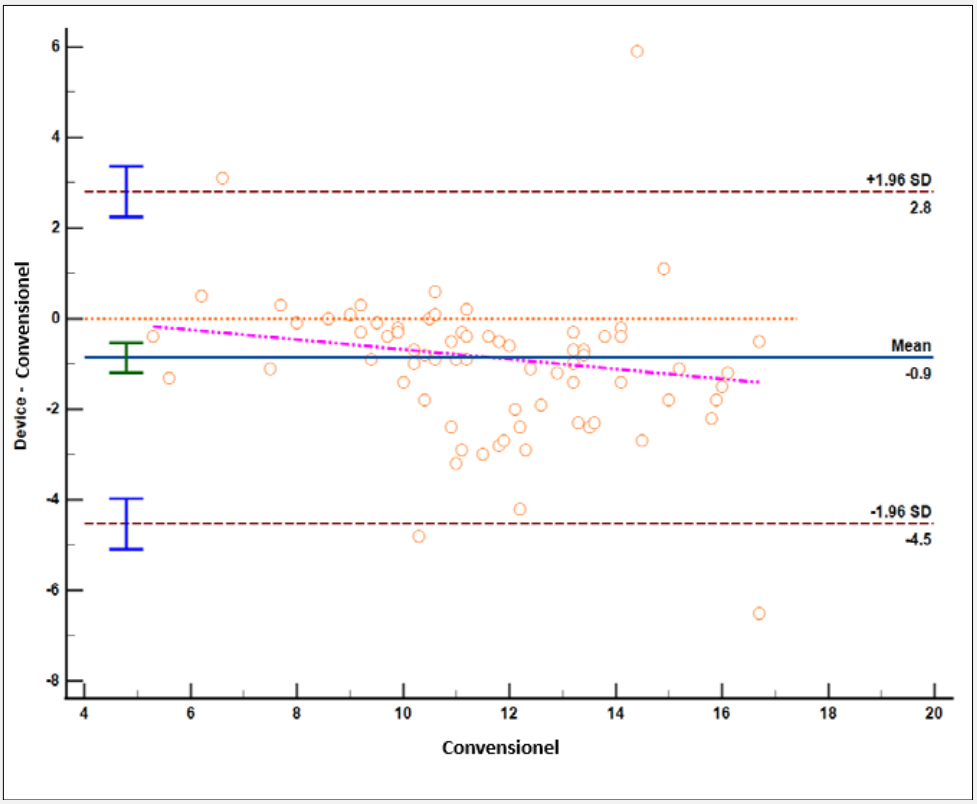

Figure 1. The Bland-Altman test for hemoglobin.

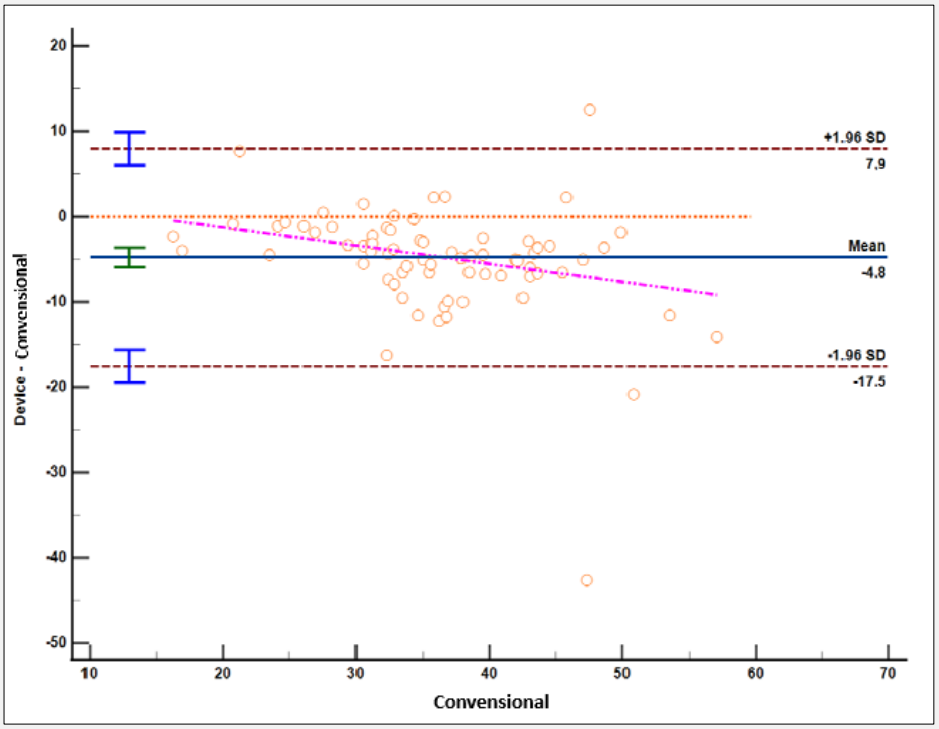

Figure 2. The Bland-Altman test for hematocrit.

geriatric intensive care settings, offering accurate and reliable results comparable to traditional methods [20]. Advanced hematology analyzers and peripheral smear examinations provide comprehensive data on hematological parameters, aiding in the diagnosis and management of various conditions in the elderly [23]. In a study conducted by Phukan, the research identifies a notable gap in the examination of finger vein biometric efficacy and reliability, particularly for the elderly population aged 60 years and above. This could potentially result in their exclusion from services that utilize this technology [27]. In our study, the mean value for hemoglobin was found to be -0.8615 (95% confidence interval: -1.1864 to -0.5367), and for hematocrit, it was -4.7969 (95% confidence interval: -5.9248 to -3.6690).

Our study is not without limitations, the most significant of which is its single-center design. Furthermore, the exclusive reliance on a single hemoglobin test may have constrained the scope of our analysis with respect to follow-up and patient-specific factors. To fully comprehend the value of our study, it would be prudent to conduct multi-center trials.

CONCLUSION

Finger-stick hemoglobin tests represent a significant advancement in point-of-care diagnostics, offering a practical alternative to traditional blood sampling methods. They are particularly useful in settings requiring rapid results and minimal invasiveness, as they facilitate the delivery of timely and minimally invasive diagnostic information.

Ethical Approval Statement:
This study was approved by the Ethics Committee of the Antalya Training and Research Hospital (ethics code: 2024-304).

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This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Data Availability Statement:
Data that support the findings of this study are available from the corresponding author upon request.

Declaration of Interest:
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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